

Insulin Secretion and *Meda Dhatu*: Neuroendocrine Integration in Ayurveda

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ABSTRACT

Background: The increasing global prevalence of metabolic disorders such as obesity, insulin resistance, metabolic syndrome, and type 2 diabetes mellitus has directed scientific attention toward the neuroendocrine regulation of metabolism. Modern biomedical sciences recognize insulin as a pivotal anabolic hormone controlling glucose homeostasis, lipid metabolism, appetite regulation, and cellular energy utilization. Ayurveda, through its sophisticated understanding of *Meda Dhatu*, Agni, Kapha Dosha, Srotas, and neuropsychological regulatory mechanisms, provides a multidimensional explanation for metabolic balance and disease progression. Although classical Ayurvedic texts do not explicitly mention insulin, the functional attributes of insulin closely resemble the physiological activities governing *Meda Dhatu* metabolism and nourishment.

Aim: This article aims to critically explore the relationship between insulin secretion and *Meda Dhatu* through the lens of neuroendocrine integration in Ayurveda and correlate Ayurvedic principles with modern endocrinology and neurophysiology.

Materials and Methods: Classical Ayurvedic literature including Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya was conceptually reviewed along with contemporary biomedical literature related

to insulin physiology, neuroendocrine regulation, adipose tissue biology, hypothalamic pathways, and metabolic homeostasis.

Discussion: Ayurveda describes *Meda Dhatu* as a dynamic tissue involved not only in fat storage but also in lubrication, energy preservation, structural stability, hormonal balance, and metabolic buffering. Insulin secretion is influenced by neuroendocrine pathways involving the hypothalamus, autonomic nervous system, gut hormones, and psychological stress. These mechanisms parallel Ayurvedic concepts such as *Manovaha Srotas*, *Majja Dhatu*, *Prana Vayu*, *Samana Vayu*, *Pachaka Pitta*, and *Kledaka Kapha*. Dysregulation of these integrative networks leads to *Medodushti*, *Agnimandya*, *Aama* formation, and ultimately metabolic disorders including *Prameha*.

Conclusion: The Ayurvedic understanding of *Meda Dhatu* offers a comprehensive framework for interpreting insulin physiology and neuroendocrine metabolism. Integrative exploration of insulin secretion through Ayurvedic principles may contribute significantly toward holistic management strategies for obesity, diabetes, and stress-induced metabolic disorders.

Keywords: Insulin, *Meda Dhatu*, Neuroendocrine Integration, Ayurveda,

Prameha, Agni, Kapha, Metabolic Syndrome, Obesity, Neurophysiology

INTRODUCTION

Metabolism represents one of the most complex physiological networks in the human body, integrating neural, endocrine, psychological, digestive, and cellular processes. Among the various hormones involved in metabolic regulation, insulin occupies a central role in maintaining glucose balance, lipid synthesis, protein metabolism, and energy storage. Secreted by the beta cells of the pancreas, insulin acts as an anabolic hormone facilitating nutrient uptake and tissue nourishment.

In Ayurveda, the concept of tissue metabolism is explained through the theory of Dhatus, where each tissue undergoes sequential nourishment under the influence of Dhatu Agni.¹ Among the seven principal Dhatus, Meda Dhatu corresponds broadly to adipose tissue and lipid metabolism. Meda Dhatu is Snigdha, Sthira, Guru, Sandra and Mrudu. Properties of Meda Dhatu are similar to Kapha Dosha, as both of them are predominantly formed of Jala and Prithvi Mahabhuta.² However, Ayurvedic understanding of Meda extends beyond mere fat accumulation and includes lubrication, insulation, stability, oleation, endocrine support, and energy conservation. The neuroendocrine regulation of insulin secretion has gained immense importance in modern medicine. The hypothalamus, autonomic nervous system, gastrointestinal hormones, circadian rhythms, and emotional states collectively influence insulin dynamics. Ayurveda had already conceptualized similar integrative physiology through the interactions of Doshas, Agni, Manas, Srotas, and Dhatus. The concept of Sharira-Manasa-Satmya reflects the inseparable connection between mind, nervous system, endocrine function, and metabolism.

Therefore, understanding insulin secretion through the Ayurvedic lens of Meda Dhatu and neuroendocrine integration may provide

a more holistic interpretation of metabolic physiology and disease.

Concept of Meda Dhatu in Ayurveda

The Mamsa which is digested completely by Medo Dhatu Swagni is called as Meda Dhatu.³ Meda Dhatu is the fourth bodily tissue formed sequentially after Rakta and Mamsa Dhatu. According to Acharya Charaka, Meda Dhatu is predominantly formed of Jala Mahabhuta.⁴ Classical Ayurvedic texts describe Meda as responsible for:

Sneha (unctuousness)

Dridhatva (stability)

Sweda Utpatti (sweat formation)

Lubrication of organs

Energy reserve

Protection against tissue degeneration

According to Charaka Samhita, balanced Meda Dhatu supports strength, vitality, and endurance, whereas vitiated Meda contributes to obesity, lethargy, excessive sweating, diabetes, and metabolic dysfunction.

The principal sites of Meda Dhatu include: Abdomen, Buttocks, Breasts, Omentum, Bone marrow-associated fat tissues

Modern anatomy correlates these with adipose tissue depots and metabolically active visceral fat. Importantly, Ayurveda never viewed Meda as passive storage tissue. Instead, it was considered metabolically active and deeply interconnected with digestive fire, fluid metabolism, and hormonal equilibrium.

Physiology of Insulin Secretion

Insulin is secreted by pancreatic beta cells located within the Islets of Langerhans. Its secretion primarily depends upon blood glucose concentration but is also influenced by amino acids, fatty acids, gastrointestinal hormones, neural stimulation, and emotional stress. Insulin is a polypeptide hormone mainly secreted by β cells in the islets of Langerhans of the pancreas. The hormone potentially coordinates with glucagon to modulate blood glucose levels; insulin acts via an anabolic pathway, while glucagon performs catabolic functions.⁵

The process of insulin secretion involves:

1. Glucose entry into beta cells via GLUT-2 transporters
2. ATP generation through glycolysis
3. Closure of ATP-sensitive potassium channels
4. Membrane depolarization
5. Calcium influx
6. Exocytosis of insulin granules

The normal reaction of β -cells is to release their granule content into the bloodstream in response to an increase in the concentration of various nutrients, mainly blood glucose but also other soluble macronutrients.⁶

Insulin facilitates:

Cellular glucose uptake, Glycogen synthesis, Lipogenesis, Protein synthesis, Inhibition of lipolysis

From an Ayurvedic perspective, these anabolic and nourishing functions resemble:

Brimhana Karma

Kapha Karma

Meda Poshana

Dhatu Poshana

Thus, insulin may be functionally interpreted as a biochemical mediator involved in Meda Dhatu regulation.

Neuroendocrine Regulation of Insulin Secretion

Modern neuroendocrinology recognizes that insulin secretion is not merely pancreatic

but centrally regulated through extensive brain-body communication networks. Neuroendocrine centers within the hypothalamus and brainstem monitor metabolic signals such as glucose, insulin, and leptin to regulate autonomic outflow, endocrine function, and behavior.⁷

Role of the Hypothalamus

The hypothalamus regulates:

Appetite, Satiety, Energy expenditure, Circadian rhythm, Hormonal coordination

Hypothalamic neurons respond to:

Glucose levels, Leptin, Ghrelin, Insulin, Stress hormones

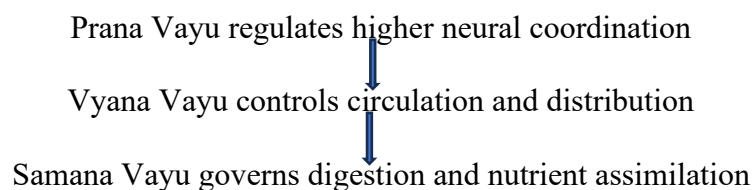
Ayurveda correlates these integrative control systems with: Majja Dhatu, Prana Vayu, Sadhaka Pitta, Tarpaka Kapha

These entities govern cognition, autonomic balance, emotional processing, and neurohormonal regulation.

Autonomic Nervous System and Insulin

The modern view of insulin is as a ligand that activates a specific cellular receptor, designated the insulin receptor (IR). The IR belongs to a superfamily of receptor tyrosine kinase whose activation modulates multiple post-receptor signaling pathways.⁸ Parasympathetic stimulation enhances insulin secretion, whereas sympathetic overactivity inhibits insulin release and promotes hyperglycemia.

Ayurvedic Correlation



Balanced Vata supports proper endocrine communication. Disturbed Vata, especially under stress, disrupts insulin regulation and digestive harmony.

Gut-Brain-Endocrine Axis

Modern physiology highlights the role of incretin hormones such as:

GLP-1, GIP

These hormones enhance insulin secretion after meals.

Ayurveda similarly emphasizes: Pachaka Pitta, Kledaka Kapha, Samana Vayu as regulators of digestive signaling and nutrient transformation. Healthy digestion (Samagni) ensures proper tissue nourishment, whereas impaired digestion (Mandagni) leads to:

Aama formation, Metabolic obstruction, Insulin resistance, Meda Dushti

Meda Dhatu and Adipose Tissue:

Modern Correlation

Ayurvedic *Meda Dhatu* fundamentals and modern adipose tissue biology may overlap. *Meda Dhatu* energy storage, insulation, lubrication, and metabolic control capabilities resemble white (WAT), brown (BAT), and beige adipose tissue.⁹ Modern science recognizes adipose tissue as an endocrine organ secreting:

Leptin, Adiponectin, Resistin, Cytokines

These molecules regulate: Appetite, Insulin sensitivity, Inflammation, Energy metabolism

This concept remarkably resembles Ayurvedic understanding of *Meda Dhatu* as a dynamic metabolic tissue influencing systemic physiology.

Balanced *Meda*:

Supports stamina, Maintains lubrication, Preserves hormonal balance, Protects tissues, Vitiating *Meda*

Abnormal *Meda* causes: Obesity, Dyslipidemia, Diabetes, Fatigue, Excessive sleep, Sweating abnormalities

This corresponds closely with metabolic syndrome and insulin resistance.

Agni and Insulin Metabolism

Agni is not limited to the physical process of digestion. From the breakdown of food that has been consumed to the alteration of *Dhatu*s (subtle body tissues) and *Bhutas* elements, it is conceived as a multilayered metabolic force operating at various levels.¹⁰ The concept of Agni forms the foundation of Ayurvedic physiology. Proper metabolism depends upon: *Jatharagni*, *Bhutagni*, *Dhatu Agni*

Impaired Agni causes incomplete metabolism and toxic accumulation.

Mandagni and Hyperinsulinemia,

Excessive intake of: Heavy foods, Sweet foods, Sedentary lifestyle, Day sleep, Psychological stress causes *Kapha* aggravation and *Mandagni*. This leads to:

Excess nutrient accumulation, Abnormal fat deposition, Reduced tissue sensitivity, Insulin resistance

Modern medicine similarly identifies obesity and chronic caloric excess as central

causes of hyperinsulinemia and metabolic dysfunction.

Psychological Stress and Neuroendocrine Dysfunction

Stress constitutes a state of threatened homeostasis triggered by intrinsic or extrinsic adverse forces (stressors) and is counteracted by an intricate repertoire of physiologic and behavioral responses aiming to maintain/reestablish the optimal body equilibrium (eustasis). The adaptive stress response depends upon a highly interconnected neuroendocrine, cellular, and molecular infrastructure, *i.e.* the stress system.¹¹ Stress significantly influences insulin secretion through: Cortisol elevation, Sympathetic activation, Inflammatory cytokines

Chronic stress induces: Insulin resistance, Visceral obesity, Appetite dysregulation, Sleep disturbances

Ayurveda recognized the profound effect of mental factors on metabolism.

Role of Manas

Negative emotional states such as: Fear, Anxiety, Anger, Grief aggravate *Vata* and *Pitta*, impair *Agni*, and disturb tissue nourishment. The concept of *Manovaha Srotodushti* includes:

Emotional imbalance, Neurohormonal dysregulation, Digestive disturbances, Metabolic disease. Thus, Ayurvedic psychophysiology closely parallels modern neuroendocrine science.

Prameha: Ayurvedic Perspective of Metabolic Syndrome

Prameha represents one of the most detailed metabolic disorders described in Ayurveda. It encompasses: Obesity, Polyuria, Hyperglycemia, Lipid abnormalities, Tissue degeneration

Classical etiological factors include: Excessive sweet intake, Sedentary habits, Lack of exercise, Excessive sleep, psychological indulgence

These factors cause: *Kapha Dushti*, *Meda Vridhhi*, *Agnimandya*, *Kleda Vridhhi*

Modern parallels include: Type 2 diabetes mellitus, Obesity, Metabolic syndrome, Insulin resistance

Neuroendocrine Integration Through Ayurvedic Principles

Ayurveda does not isolate endocrine organs as separate structures. Instead, physiological

regulation occurs through integrated functional networks.

Modern Concept	Ayurvedic Correlation
Hypothalamus	Sadhaka Pitta + Prana Vayu
Autonomic nervous system	Vata regulation
Hormonal signaling	Dhatu Agni
Adipose endocrine function	Meda Dhatu
Insulin metabolism	Kapha-mediated anabolic activity
Stress axis	Manovaha Srotas=
Digestive-endocrine axis	Agni system

This systems-based approach demonstrates Ayurveda’s advanced understanding of integrative physiology.

Preventive and Therapeutic Ayurvedic Approaches

Ahara (Diet), Recommended: Light and warm food, Low glycemic grains, Bitter and pungent tastes, Fiber-rich vegetables

Avoid: Excessive sweets, Heavy oily foods, Overeating, Daytime sleeping after meals
Vihara (Lifestyle) Essential measures include: Daily exercise, Yoga, Proper sleep, Stress management

Circadian discipline (Dinacharya)

Exercise improves: Agni, Insulin sensitivity, Fat metabolism, Neuroendocrine balance

Yoga and Meditation

Meditation and yogic practices reduce: Cortisol, Sympathetic overactivity, Inflammation

They enhance: Parasympathetic activity, Insulin sensitivity, Emotional regulation

This supports the Ayurvedic concept of balancing: Prana, Manas, Agni, Dhatus

Ayurvedic Herbs

Several Ayurvedic herbs support metabolic and neuroendocrine balance:

Guduchi, Haridra, Amalaki, Meshashringi, Shilajit, Triphala

These herbs demonstrate: Anti-inflammatory effects, Antioxidant activity, Glucose regulation, Lipid balancing effects

Integrative Significance in Contemporary Medicine

Modern medicine increasingly recognizes: Psychometabolic disorders, Gut-brain axis,

Stress endocrinology, Adipose endocrine activity

Ayurveda had already conceptualized these relationships holistically through: Dosha, Dhatu, Agni, Srotas, Manas

Integrating Ayurvedic concepts with modern neuroendocrinology may improve:

Preventive healthcare, Lifestyle medicine, Obesity management, Diabetes care, Mind-body therapies

CONCLUSION

Insulin secretion represents far more than a pancreatic endocrine process; it is part of a highly coordinated neuroendocrine network integrating digestion, metabolism, emotional state, circadian rhythm, and tissue nourishment. Ayurveda explains these multidimensional interactions through the concepts of Meda Dhatu, Agni, Kapha, Manovaha Srotas, and Vata-Pitta regulation. The close functional parallels between insulin physiology and Meda Dhatu metabolism reveal the profound scientific insight embedded within Ayurvedic physiology. Disturbance in digestive fire, mental equilibrium, and tissue metabolism ultimately culminates in disorders resembling modern metabolic syndrome and diabetes.

A neuroendocrine interpretation of Ayurveda provides a valuable integrative framework for understanding obesity, insulin resistance, and psychosomatic metabolic disorders. Future interdisciplinary research combining Ayurvedic concepts

with endocrinology, neuroscience, and metabolic medicine may open new dimensions in holistic healthcare and preventive medicine.

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REFERENCES

1. Dr. Heena Sheikh, Dr. Dipika kinkar, & Dr. Nitin Urmaliya. (2026). Physiological Understanding of Dhatu Poshan Nyaya in Ayurveda. *International Journal of Contemporary Research in Multidisciplinary*, 5(2), 307–309.
2. Subhash Ranade. A text book of Sharira Kriya Vijnan, Vol-2, 3rd edition, Chaukamba sanskrit pratishtan, Delhi. Pg 191.
3. Mishra BS. Bhavaprakasha, Poorvardha, Vol-01, 7th edition, Chowkamba Sanskrit series office, Varanasi.
4. R Vidyanath. Charaka Samhita, Vol-2, 1st edition, Chaukhambha prakashak, Varanasi, Sha-7/16.
5. Rahman MS, Hossain KS, Das S, Kundu S, Adegoke EO, Rahman MA, Hannan MA, Uddin MJ, Pang MG. Role of Insulin in Health and Disease: An Update. *Int J Mol Sci*. 2021 Jun 15;22(12):6403. doi: 10.3390/ijms22126403. PMID: 34203830; PMCID: PMC8232639.
6. <https://derangedphysiology.com/main/cicm-primary-exam/endocrine-system/Chapter-111/physiology-insulin>
7. Gallardo N, Artigas-Jerónimo S, Mazuecos L and Andrés A (2025) Neuroendocrine control of glucose homeostasis: integrative mechanisms from the hypothalamus to the brainstem. *Front. Endocrinol*. 16:1731725. doi: 10.3389/fendo.2025.1731725
8. Weiss M, Steiner DF, Philipson LH. Insulin Biosynthesis, Secretion, Structure, and Structure-Activity Relationships. [Updated 2014 Feb 1]. In: Feingold KR, Adler RA, Ahmed SF, et al., editors. *Endotext* [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK279029/>
9. Dr. Krishna Yadav, Dr. Mamta Yadav, Dr. Priyanka Deegwal, Dr. Saurabh Dongare, Prof. (Dr.) Dinesh Chandra Sharma, & Dr. Pooja Pareek. (2025). The Physiological Correlate Of Meda Dhatu: An Integrative Review Of Ayurvedic Principles And Modern Adipose Tissue Biology. *Revista Electronica De Veterinaria*, 25(1), 4226-4232.
10. <https://jaims.in/jaims/article/view/5027/9139>
11. Tsigos C, Kyrou I, Kassi E, et al. Stress: Endocrine Physiology and Pathophysiology. [Updated 2020 Oct 17]. In: Feingold KR, Adler RA, Ahmed SF, et al., editors. *Endotext* [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK278995/>

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