"From Traditional Wisdom to Modern Validation: A review on Medicinal Plants for Obesity Management."

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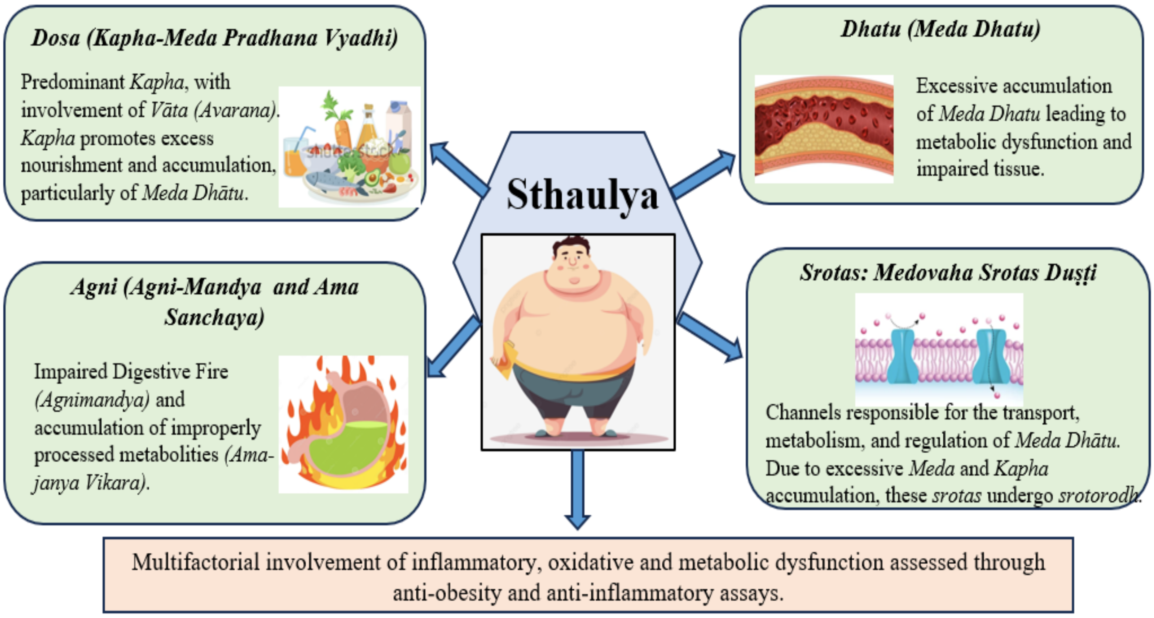
Abstract:
A significant global burden, Obesity is linked to metabolic dysfunction, insulin resistance, dyslipidemia, and persistent inflammation. According to Modern biological science, Obesity is a complex, advanced metabolic inflammatory disease including oxidative stress, altered metabolic pathways and adipose tissue malfunction. Ayurveda, an integral component of the Indian knowledge system classifies Obesity as Sthaulya, a condition associated with Agnimandya or impeded metabolism, dosha imbalance (Kapha), buildup of Ama (toxins), Meda Dhatu Vriddhi (excess), and Srotorodha. The Medohara, Lekhana, Kapha-Shamana, and Sothahara properties of medicinal plants are highlighted in ancient Ayurvedic texts as ways for mitigating obesity and associated inflammation. To assess the effectiveness of medicinal plants and bioactive constituents in modulating obesity-associated key molecular targets like AMPK, PPAR-γ, NF-κB, SREBP-1c, TNF-α, and IL-6, this review integrates Ayurvedic knowledge with contemporary biomedical techniques. Advanced techniques like LC-MS metabolomics, in-vitro cellular models, gene expression analysis, and in silico studies give evidence-based confirmation of conventional knowledge. Furthermore, multi-omics, artificial intelligence, systems pharmacology and precision Ayurveda approaches provide new avenues for the personalized treatment. A translational interface for the creation of safe and efficient therapies for the control of metabolic inflammation and obesity is provided by the integration of modern scientific techniques with the Indian knowledge system.

Introduction:
The alarming rise in obesity prevalence throughout the world has made it one of the most important metabolic health concerns in twenty-first century (Ahmed & Mohammed, 2025). By 2022, obesity (body mass index ≥30) afflicted over 1 billion people globally, or around one in eight adults. About 43% of people were either overweight or obese. (World Health Organization, 2025), (Gadde & Atkins, 2020). The buildup of extra body fat has a negative influence on health in this complicated, multifaceted illness. Obesity increases the risk of a number of diseases and conditions, including Type 2 Diabetes Mellitus, Depression, Metabolic Syndrome, Hypertension, and NAFLD (Non Alcoholic Fatty Liver Disease), which is associated with increased mortality. (Lin & Li, 2021).

Obesity is recognized by contemporary biology studies as a chronic inflammatory illness. In contrast to earlier inflammatory paradigms, obesity-induced inflammation is characterized by chronic activation of the innate immune system that may alter metabolic homeostasis over a lifetime. (Al-Oanzi et al., 2026). Additionally, inflammation causes maladaptive reactions like necrosis and fibrosis, which can seriously harm tissue. Furthermore, adipose tissue, the pancreas, the liver, skeletal muscle, the heart, and the brain are just a few of the organs that are affected by obesity-induced inflammation (Al-Oanzi et al., 2026). Understanding the underlying mechanisms and how they impact metabolic systems is challenging due to these features of inflammation caused by obesity (Saltiel & Olefsky, 2017). Adipose tissue secreted various adipokines, cytokines, and inflammatory mediators such as tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), leptin, resistin, and adiponectin that are well-known pro-inflammatory mediators since adipose tissue itself is regarded as an active endocrine organ. (Al-Oanzi et al., 2026). One of the biggest players in metabolic dysfunction is insulin resistance and altered deposition of excess lipids stimulate macrophages to infiltrate tissue through nuclear factor-kappa B (NF-κB) signaling (Al-Oanzi et al., 2026), (Clemente-Suárez et al., 2023).

Ayurveda referred obesity as Sthaulya or Medoroga, a metabolic condition characterized by inflammation (Sotha), interrupted metabolic processes (Agnimandya), and an excessive accumulation of Fat (Meda Dhatu) (Sindhwani et al., 2024), (More & Begani, 2021). Sthaulya is categorized as a Santarpanjanya Vyadhi in the Ayurvedic scriptures, especially in the Ashta nandita purusha of the Sutrasthana in Charaka Samhita. This disorder affects the Medovaha Srotas, causing an excess of Meda dhatu, which shows up as obesity (Mahavidyalaya, 2026). Acharya Charaka has classified Sthaulya as one of the eight Nindita Purusha (undesirable constitutions)—the undesirable constitutions observing that it is severe and detrimental to health. Ahara (dietary control), Vihara (lifestyle change), and Aushadha (herbal medicine) are the three Ayurvedic treatments for Sthaulya (Kushwaha et al., 2025).



[Figure 1: Conceptual framework of Obesity in Ayurveda as Multifactorial Disease]

According to traditional literature, diminished Agni, poor eating habits, a sedentary lifestyle, and an imbalance in Kapha dosha are the causes of Sthaulya's peculiar buildup of Meda Dhatu (adipose tissue). This excessive rise in body fat lowers energy, impairs physical performance, and increases the risk of several metabolic illnesses. In managing or avoiding entanglements of this sickness, the ideas of Ahara (Diet) and Vihara (Lifestyle) are just as significant, if not more so. Poor eating habits and inactivity lead to obesity. Obesity is a result of a modern lifestyle, bad eating habits, and excessive consumption of fried foods, fats, sugar, and processed carbs (Mahavidyalaya, 2026).

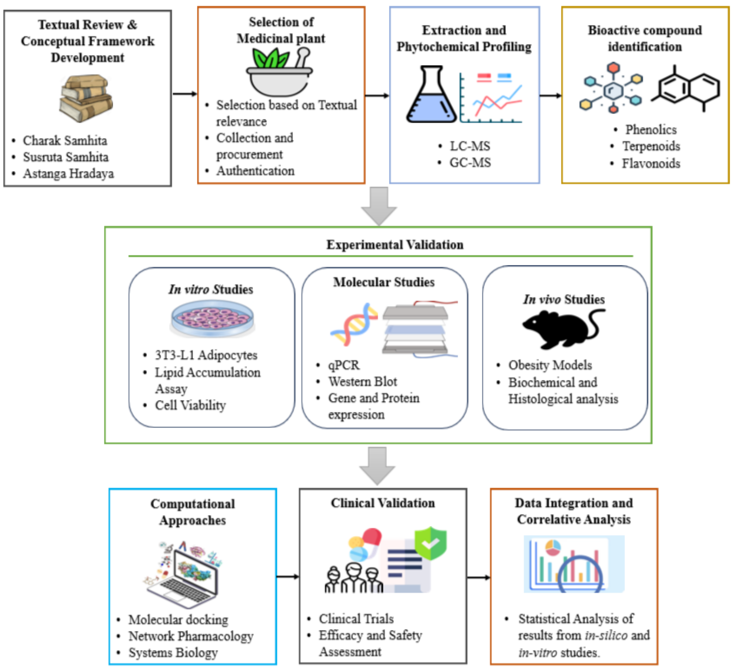
Although intensive lifestyle intervention based on diet, exercise, and behavior therapy is commonly effective in the short run, not all patients lose weight, and most who do ultimately fail to maintain weight loss over long-term follow-up despite continued intervention. (Gadde & Atkins, 2020),(Dombrowski et al., 2014). Due to well-known causes of obesity, such as genetics, epigenetics even physiological and environmental signs not every patient could react towards a certain therapeutic approach. Even more drastically, the superobese–people who are severely overweight and have been on unsuccessful fad after fad—sometimes believe that they have a biological disorder and will opt for medical or surgical procedures. (Gadde & Atkins, 2020),(Daigle et al., 2019). Bariatric surgery is now the most successful method of achieving considerable long-term weight loss for those with severe obesity (Gadde & Atkins, 2020),(Pareek et al., 2018). However, bariatric surgery is only advised for individuals with severe and difficult obesity since it is costly, usually irreversible, and bears a minor risk of catastrophic consequences. Therefore, only targeting patients with obesity who have failed enough trials of lifestyle changes without success, those incapable to maintain the initial weight reduction or other comorbidities that render them incapable of complying with lifestyle interventions. (Gadde & Atkins, 2020),(Gadde et al., 2018).

Although there are a number of anti-obesity drugs available, their long-term use is limited by logistics compared to side effects such as gastrointestinal symptoms, cardiovascular problems, sleep disturbances and psychological symptoms. For safer and more long-term obesity control, these constraints have prompted researchers to investigate plant-based treatments and conventional medical systems. Medicinal plants with Lekhana (scraping), Medohara (Anti-Obesity), Karshana (slimming) and Sothahara (Anti-inflammatory) qualities are highly valued among pharmaceutical therapies because they aid in the removal of excess fat and the correction of metabolic imbalances. Personalized selection of Medohara plants for improved clinical results is made possible by the developing area of Ayurgenomics, which provides a customized approach that is in line with the Ayurvedic idea of Prakriti-based treatment (Kushwaha et al., 2025).

Large-scale clinical applications are hampered by significant information gaps, notwithstanding the growing global interest in Ayurvedic anti-obesity treatments. These difficulties include the absence of standardized extracts, variations in phytochemical composition, a lack of understanding of dose-response relationships, the absence of pharmacokinetic and bioavailability studies for many plant extracts, and the still-undiscovered mechanisms of action for active phytoconstituents. Furthermore, evidence-based therapy positioning is limited by the absence of high-quality clinical trials, biomarker-based screens, and comparison studies with commercially available antiobesity drugs.

Advances in molecular biology, metabolomics, computational biology, and phytochemistry have made possible scientific substantiation of Ayurvedic medicinal plants. Here, modern methods like LC-MS profiling, in vitro adipocyte bioassay systems, RT-PCR transcriptomics, protein expression detection by Western blotting and molecular docking combined with network pharmacology offer valuable information on the mechanisms of action responsible for anti-obesity and anti-inflammation activities.

The present review critically appraises Ayurvedic concepts of Medohara and Sothahara therapies in the context of modern obesity-associated inflammation, examines the prominent roles of medicinal plants and phytoconstituents, and discusses novel translational approaches that integrate insights from Indian Knowledge Systems with contemporary biomedical science.



[Figure 2: Integration of Ayurveda with scientific validation approach]

Ayurvedic Concept of Sthaulya:

India's age-old traditional medical system is called Ayurveda. The Sanskrit terms "Ayus," which means life or lifetime, and "Veda," which means knowledge or science, are the source of the phrase Ayurveda (Wallace, 2020). Translated as "the science of life," or more precisely, "the science of lifespan," Ayurveda began as an oral tradition of natural health and was written down in literature much later (P. V. Sharma & Dash, 1981), (Wallace, 2020).

According to Ayurveda's Tridosha theory, each person's physiology is governed by three basic principles or forces known as doshas. The dosha Vata is responsible for all bodily transportation, including the movement of molecules and nerve impulses. It comes from the elements of air and ether. Pitta is the dosha that controls every metabolic route in every cell, including digestion. Water and fire combine to produce it. The dosha that controls the body's cohesiveness and structure is kapha. It is a manifestation of water and soil. Prakriti is the term for the unique blend of these three doshas that each person is born with. (Wallace, 2020).

a. *Nidana* (Etiological Factors):

Sthaulya has several causes, according to Ayurvedic scriptures. These fall into two groups: Vihara (lifestyle variables) and Ahara (dietary factors) (Agnivesa, 1941). Overeating Madhura (Sweet), Snigdha Ahara (oily foods), Guru Ahara (heavy foods), Ati Bhojana (overeating), frequent meals, and consuming fatty and high-calorie foods are examples of dietary variables. Lifestyle causes include being sedentary (Avyayama), not exercising, sleeping too much, especially during the day (Divaswapna), not receiving enough exercise, and mental stress (Agnivesa, 1941). Clinical presentation indicates that Kapha Dosha predominates, with Vata Dosha playing a minor role. While Avarana of Vata contributes to irregular hunger and disordered metabolism, excess Kapha causes heaviness, lethargy, and an excessive deposit of Meda Dhatu. Excessive perspiration, dyspnea during physical activity, increased appetite and thirst, flabbiness body parts, decreased stamina, and early exhaustion are examples of traditional indications and symptoms. These characteristics closely reflect the clinical signs of metabolic syndrome and obesity that are reported in contemporary medicine (Kamble & Nimbalkar, 2026).

b. Samprapti (Pathogenesis):

The malfunction of Jatharagni brought on by poor diet and lifestyle is the first step in the development of Sthaulya. Ama is produced as a result of incomplete digestion, which impairs metabolic functions. Medo-Dhatvagni Mandya results from continuing the actions that lead to these problems. Meda Dhatu is produced excessively and abnormally as a result of this disorder. Avarana of Vata results from accumulated Meda blocking the Medovaha Srotas, which interferes with the nutrition of the succeeding Dhatus. Sthaulya becomes chronic and progressive as a result of this detrimental cycle of metabolic issues (Kamble & Nimbalkar, 2026).

Molecular consequences of Obesity:

Obesity, a multifactorial chronic disorder is caused by complex interactions of genetic factors, molecular responses, environmental aspects and behavioral risk factors. Its growing global incidence thought to influence health in terms of cardiovascular, metabolic, oncologic, hepatic, pulmonary and skeleton. Besides surplus caloric intake, genetic predisposition (Gadde &Atkins, 2020), epigenetic alterations, gut microbiome dysbiosis, endocrine disruptors, circadian misalignment and inter- and pre-genational effects are the most important drivers of human obesity risk (Gadde & Atkins, 2020). Obesity is due to a multiple factors, the major pathophysiological ones being insulin resistance, dyslipidemia, chronic low-grade inflammation and neuroendocrine dysregulation of appetite and energy balance (Gadde & Atkins, 2020). Such processes will be accompanied by comorbid diseases such as type 2 diabetes, hypertension, atherosclerosis, fatty liver disease or sleep apnea (Gadde & Atkins, 2020),(Młynarska et al., 2025).

Obesity at the molecular level is an integrated response to complex dysfunctions surrounding adipocyte biology, metabolic signaling, immunological activation and gene regulation (Gadde & Atkins, 2020). Adipocyte hypertrophy and hyperplasia are caused by excessive dietary consumption and sedentary lifestyles, especially in visceral fat depots (Gadde & Atkins, 2020). This sets off a series of cellular stress reactions that eventually result in hormone imbalance, systemic metabolic disturbance, and persistent low-grade inflammation (Gadde & Atkins, 2020), (Ahmed & Mohammed, 2025).

Growing adipose tissue becomes hypoxic and dysfunctional in obesity. Excess pro-inflammatory adipokines like interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) are secreted by hypertrophic adipocytes, whilst beneficial adipokines like adiponectin are repressed (Ahmed & Mohammed, 2025), (Galic et al., 2010). Although adiponectin levels are negatively connected with fat mass, it improves fatty acid oxidation and insulin sensitivity. On the other hand, leptin, which is typically in charge of satiety signaling, increases with fat buildup but frequently loses its effectiveness as a result of central leptin resistance, which leads to overeating and chronic hunger (Ahmed & Mohammed, 2025), (Myers et al., 2010).

Immune cells, especially M1 macrophages, penetrate the tissue as adipocytes grow, producing more cytokines and maintaining a persistent inflammatory state (Lumeng & Saltiel, 2011). Both insulin resistance and mitochondrial function are worsened by this inflammation.

In obese tissues, mitochondrial stress raises reactive oxygen species (ROS) and decreases oxidative phosphorylation, which further impairs lipid metabolism and insulin signaling (Houstis et al., 2006). Finally, particularly in skeletal muscle, there is also decreased mitochondrial biogenesis that limits the ability to utilize fatty acids efficiently. (Ritov et al., 2005).

According to new research, obesity is linked to epigenetic changes that affect gene expression patterns related to metabolism, adipogenesis, and inflammation. These modifications include microRNA regulation, histone modification, and DNA methylation (Milagro et al., 2013). Maternal food and intrauterine development are examples of early-life experiences that might epigenetically encode a person's predisposition to obesity in later life. These changes might offer new treatment targets and are reversible (Godfrey et al., 2015).

In this context, phytochemicals derived from plants, dietary bioactive substances, and lifestyle change have garnered interest due to their potential to modify epigenetic pathways (Dincer & Yuksel, 2021). From an integrative perspective, these reversible molecular changes could also be pathologically aligned with the constitutional, qualitative, and interactive relationship of Agni, Ama, and Doshas regulation, particularly by Kapha. This is probably in accordance with Ayurvedic expression of reversibility of disease potential through restoration of homeostasis by important topical herbal interventions like Medohara and Sothahara (Dijk et al., 2015).

Table 1: Important Molecular Targets in Obesity Associated inflammation

Marker	**Biological Function**
TNF-α	Promotes inflammation and insulin resistance
IL-6	Chronic inflammatory mediator
NF-κB	Regulates inflammatory signalling
MCP-1	Macrophage recruitment
PPAR-γ	Adipocyte differentiation
AMPK	Energy metabolism regulation
C/EBPα	Adipogenesis regulation
SREBP-1c	Lipogenesis

Medohara and Sothahara Medicinal Plants:

In Ayurveda, the treatment of obesity (Sthaulya) and associated metabolic-inflammatory consequences is based on the correction of Meda Dhatu vitiation, the decrease of Ama production, and the restoration of Agni balance, which together provide a systemic basis for dysregulation. Medohara (fat-reducing) and Sothahara (anti-inflammatory) plants have attracted particular attention because of their synergistic involvement in modulating lipid metabolism and attenuating chronic low-grade inflammation. In this context, medicinal plants are grouped based on their pharmacodynamic actions (Agnivesa, 1941), (Hotamisligil, 2006).

Medohara dravyas are described as the compounds that both improve nutrition metabolism and eliminate excess Meda Dhatu. Their qualities, which are mostly Ruksha (Dry), Laghu (Light), and Ushna (Hot Potency), tend to promote lipid catabolism and intensify Agni. The bioactive phytochemical components of plant extracts, including as terpenoids, flavonoids, alkaloids, curcuminoids, and saponins, which regulate lipid metabolism and adipogenesis, are primarily responsible for these effects. Guggulsterones, gingerols, and embelin are among the compounds that have been shown to activate AMPK signaling, modulate PPAR-γ expression, and inhibit lipogenic pathways, which reduces adipocyte fat accumulation and differentiation (Hardie et al., 2012), (Hewlings & Kalman, 2017).

A key strategy for controlling obesity-related chronic low-grade inflammation is the use of Sothahara dravyas, whose action primarily involves removing inflammatory edema, swelling, and congestion of tissues as well as addressing hyperlipidemia. The expansion of adipose tissue caused by obesity thereafter induces hypoxia, oxidative stress, immune cell infiltration, and increased levels of inflammatory mediators such as TNF-α, IL-6, and MCP-1. Bioactive substances found in Sothahara plants include polyphenols, flavonoids and tannins which have been demonstrated to have immunomodulatory and antioxidant properties via controlling inflammatory pathways. They manifest metabolic performance and reduce the production of pro-inflammatory cytokines by preventing the activation of NF-κB signaling pathway (Gregor & Hotamisligil, 2011)

Table 2: List of *Medohara* and *Sothahara* medicinal plants

Name of the Plant	Ayurvedic Category	Bioactive Compound	Major Pharmacological Action	Molecular Mechanism
Haridra *(Curcuma longa L.)*	*Medohara, Sothahara*	Curcumin, curcuminoids	Anti-inflammatory, anti-obesity, antioxidant, lipid regulating activity	Inhibits NF-κB signaling, decreases TNF-α and IL-6, activates AMPK, regulates adipogenesis through PPAR-γ modulation (Hewlings & Kalman, 2017).
Guggulu *(Commiphora mukul)*	*Medohara, Lekhana, Sothahara*	Guggulsterones, diterpenoids	Hypolipidemic, anti-inflammatory,	Regulates lipid metabolism through PPAR pathways,

			reduces adipose accumulation	reduces inflammatory mediators, improves cholesterol metabolism (Ulbricht et al., 2005).
Nagara/Shunthi *(Zingiber officinale)*	*Medohara, Sothahara*	Gingerols, shogaols	Thermogenic effect, improves digestion, anti-inflammatory, improves insulin sensitivity	Activates AMPK, enhances fatty acid oxidation, suppresses inflammatory cytokines (Mashhadi et al., 2013).
Amalaki *(Phyllanthus emblica)*	*Rasayana, Medohara Sothahara*	Vitamin C, gallic acid, ellagic acid, tannins	Antioxidant, hepatoprotective, lipid lowering, anti-inflammatory	Reduces oxidative stress, regulates inflammatory cytokines, improves glucose and lipid metabolism (Prananda et al., 2023).
Guduchi *(Tinospora cordifolia)*	*Sothahara, Rasayana, Medohara*	Alkaloids, diterpenoids, polysaccharides	Immunomodulatory, antioxidant, anti-inflammatory, metabolic regulation	Modulates NF-κB pathway, reduces cytokine production, improves insulin sensitivity (Chaudhary et al., 2024).
Musta *(Cyperus rotundus L.)*	*Medohara*	Flavonoids, sesquiterpenes, cyperene	Anti-inflammatory, digestive stimulant, metabolic regulator	Modulates oxidative stress pathways, reduces inflammatory mediators, regulates lipid metabolism (Xue et al., 2023).
Punarnava *(Boerhavia diffusa)*	*Sothahara, Medohara*	Boeravinones, flavonoids, alkaloids	Anti-inflammatory, anti-edematous, antioxidant	Suppresses inflammatory signaling, reduces oxidative stress, regulates cytokine expression (Mishra et al., 2014).
Ashwagandha *(Withania somnifera)*	*Rasayana, Sothahara*	Withanolides	Adaptogenic, anti-inflammatory, improves metabolic health	Reduces oxidative stress, regulates inflammatory pathways, improves insulin sensitivity (Singh et al., 2011).

Vidanga *(Embelia ribes)*	*Medohara*	Embelin, phenolic compounds	Anti-adipogenic, lipid metabolism regulation	Inhibits adipocyte differentiation, reduces lipid accumulation, antioxidant action (V. Sharma et al., 2022).
Neem *(Azadirachta indica)*	*Sothahara, Kapha* balancing	Nimbidin, flavonoids, limonoids	Antioxidant, anti-inflammatory, metabolic regulation	Reduces inflammatory cytokines, oxidative stress and improves metabolic homeostasis (Alzohairy, 2016).

Modern Scientific Validation Approaches for Anti-Obesity and Anti-inflammatory Therapeutics:

A systematic method for clinically verifying the therapeutic effectiveness of traditional treatments for Sotha (inflammation) and Sthaulya (obesity) is the integration of modern science with Ayurveda. Modern Scientific Validation approaches are successful in identifying therapeutic bioactive compounds, clarifying the molecular processes behind these effects, evaluating safety, and guiding the logical and empirically supported applications of Medohara and Sothahara therapies.

a. Phytochemical Profiling and LC-MS Metabolomics of Medicinal Plants:

Potential bioactive substances in Ayurvedic medicinal plants, such as polyphenols, flavonoids, alkaloids, terpenoids, and other secondary metabolites, can be found using LC-MS and metabolomics. These methods are helpful for identifying therapeutic active compounds linked to pharmacological effects, standardization of plant extracts, and ensuring their quality. Ayurvedic concepts like *Guna*, *Rasa*, *Virya*, and *Vipaka* may be integrated with specific quantitative phytochemical indicators using metabolomic profiling in conjunction with traditional knowledge (Abubakar, Abdullahi R; Haque, 2020).

b. In-Vitro Assay:

Anti-obesity efficacy has typically been assessed with cell-based models including 3T3-L1 pre-adipocytes also measuring adipogenesis, lipid accumulation and metabolic pathway modulation. The plant extract also decreased the fat digestion and metabolism, as indicated by an inhibition of α-amylase, pancreatic lipase and α-glucosidase (Pereira et al., 2018), (Mangal et al., 2017), (Zarei et al., 2025). Obesity has a positive correlation with chronic inflammation, and challenges that elevate circulating levels of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) activation transcription factors (NF- κB and MAPK), also contribute to the onset manly in type 2 of diabetes. Inflammatory cell models are used to assess the Sothahara potential of medicinal plants by controlling inflammatory mediators (Hotamisligil, 2006), (Bashir et al., 2023).

c. Cytotoxicity Assay:

For the development of plant-derived medicines, safety evaluation is essential. The MTT/MTS assay is most used cytotoxicity test for determining cell viability and identifying acceptable doses prior to biological assessment of plant extracts (Mosmann, 1983).

d. Gene and Protein Expression Analysis:

Alterations in gene expression associated with obesity that are involved in inflammation, lipid metabolism, and adipogenic differentiation can be found by transcriptional profiling employing molecular-based methods including RT-PCR, qPCR, and transcriptomics. Mechanistic molecular targets that control energy metabolism and adipocyte development include PPAR-γ, SREBP-1c, C/EBPα and AMPK (Livak & Schmittgen, 2001), (Aziz et al., 2023). Western blotting confirms the signaling pathways that control inflammation and obesity at the protein level (Mahmood & Yang, 2012).

e. In silico studies:

Potential interactions between several phytochemicals and biological targets linked to obesity, such as PPAR-γ, AMPK, NF-κB, and pancreatic lipase, are predicted using in silico molecular docking and computational techniques. These methods enhance drug development processes and help identify potential bioactive biochemicals (Djeziri et al., 2025).

f. Multi-omics approach:

To investigate the complex biological changes associated with obesity, multi-omics integrates many omics data types, including transcriptomics, genomics, proteomics, epigenomics and metabolomics. These techniques allow to pinpoint the molecular mechanisms behind insulin resistance, inflammation, adipogenesis, and metabolic control. The impacts of these plants in Medohara and Sothahara may be thoroughly understood by the combination of omics and phytochemical profiling (Johnson et al., 2016), (Hasin et al., 2017).

Limitation And Challenges:

The systematic review also indicated some obstacles and restrictions for new trials although the availability of Ayurvedic Medohara and Sothahara medicinal plants to patients with obesity and its correlated comorbidities are increasing. The lack of regulated procedures for plant collecting, extraction, and formulation is one of the main problems with peripheral research. This results in variations in the phytochemical content and therapeutic effects. Although some in vitro, in vivo, or in silico investigations have shown beneficial anti-inflammatory and anti-obesity benefits, there are presently no large-scale randomized controlled clinical trials. The identification of certain active ingredients that underlie the effects of Ayurvedic formulations and the clarification of molecular processes are made more difficult by the formulations many components and targets.

Furthermore, identifying quantifiable biological indicators that correlate to traditional Ayurvedic notions such as Agni, Ama, Medohara, and Sothahara remains a significant scientific difficulty. Problems with phytochemical absorption, long-term exposure safety assessment, herb-drug interactions, and regulatory uniformity hinder broader clinical use. Furthermore, the possibility to analyze the mechanism by which Ayurvedic therapies reduce inflammation caused by obesity is limited by the absence of comprehensive multi-omics datasets and validated biomarkers.

Future Perspective:

Integrating Indian Knowledge Systems (IKS) with modern biomedical sciences provides great opportunities to promote obesity research aimed at therapeutic development. In order to understand the intricate processes of Medohara action and Sothahara action, research integrating Ayurveda with cutting-edge technologies like as genomics, transcriptomics, proteomics, metabolomics, epigenomics, artificial intelligence, and systems biology is urgently needed. Extensive multi-Omics studies may collectively represent the state in which several fields are combined to find new biomarkers, treatment targets, and molecular pathways in inflammatory environments caused by obesity. To improve the repeatability and worldwide acceptance of Ayurvedic medicinal plants, phytochemical profiling and standardization procedures should be standardized. vast-scale multicentric clinical trials should demonstrate their long-term effectiveness and safety in vast populations.

Additionally, the advancement of Ayurgenomics would act as a link between contemporary precision medicine and ancient Ayurvedic notions based on Prakriti. By using personalized medicine techniques, particular herbal treatments can be chosen according to a person's genetic profile, metabolic traits, gut microbiota composition, epigenetic signatures, and Ayurvedic constitution (Prakriti), increasing their effectiveness while reducing side effects. The creation of new phytopharmaceuticals and functional foods from Ayurvedic medicinal plants may be aided by these integrative and customized techniques, which can serve as the foundation for evidence-based, person-centered obesity care.

Conclusion:

Obesity is a multifactorial metabolic disorder associated with a state of chronic low-grade inflammation, oxidative stress and impaired energy metabolism. Medoroga or Sthaulya are terms used to describe this illness in Ayurveda, which is caused by changes in Agni, Ama buildup, Kapha vitiation, and excessive Meda Dhatu deposition. The traditional use of Sothahara and Medohara medicinal plants creates a comprehensive treatment strategy that targets inflammation and excess fat. According to experimental research, bioactive components of various parts including Haridra, Guggulu, Shunthi (ginger), Guduchi, Punarnava, and Vidanga alter important molecular pathways controlling oxidative stress, inflammatory signaling, adipogenesis, and lipid metabolism.

Phytochemical profiling, LC-MS metabolomics, cell-based assays, gene and protein expression analysis, molecular docking studies, and multi-omic technologies are some of the current strategies that significantly improve the logical understanding of the mechanistic basis of activity behinds conventional approaches. However, there are still problems with bioavailability, clinical validation, standardization, and mechanistic translation. In the future, Ayurvedic obesity treatment might become a scientifically robust, evidence-based and personalized health system through the combination of Indian knowledge systems with contemporary molecular and precision medical techniques. The discovery of safe, multi-targeted, and long-lasting treatment strategies for inflammation linked to obesity and related metabolic diseases may be aided by this integration.

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