International Journal of Applied Ayurved Research ISSN: 2347- 6362
Published online in: https://ijaar.in

AYURVEDIC INTERPRETATION AND INTEGRATIVE MANAGEMENT OF NON-ALCOHOLIC FATTY LIVER DISEASE (NAFLD): A COMPREHENSIVE REVIEW OF PATHOGENESIS AND THERAPEUTIC APPROACHES

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https://doi.org/10.70057/ijaar.2025.70403

ABSTRACT

Background: Non-Alcoholic Fatty Liver Disease (NAFLD), recently redefined as Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD), has become a major global health issue, affecting about 38.6% of adults in India. Closely linked to obesity, diabetes, and sedentary lifestyles, its rising prevalence in Kerala reflects changing dietary patterns. Ayurveda correlates this condition with *Yakrit Vikara* (Liver disorders) under *Santarpanajanya Vyadhi* (Disorders due to overt nutrition), primarily caused by *Agnimandya* (digestive impairment) and *Medodushti* (abnormal fat metabolism). **Aim and Objectives:** To interpret NAFLD through Ayurvedic principles, review its pathogenesis, and evaluate integrative therapeutic approaches combining Ayurveda and modern medicine. **Materials and Methods:** This review analyzed data from classical Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*) and modern scientific sources including PubMed, Scopus, and AYUSH databases (2000–2024), focusing on Ayurvedic and integrative management of NAFLD.

Results and Discussion: Ayurvedic interpretation reveals *Kapha-Pitta* vitiation causing *Srotorodha* (microchannel obstruction) and *Meda Sanchaya* (fat accumulation), leading to hepatic steatosis and inflammation. Management emphasizes *Laghu Ahara* (light diet) like *Yava* (Barley) and *Takra* (Butter milk), *Tikta Rasa* (Bitters) herbs such as *Patola* (Botanical name) and *Karavellaka* (Botanical name, and *Panchakarma* therapies mainly *Virechana*, *Vasti* for detoxification and metabolic correction. Integrating these with modern interventions like diet regulation and exercise enhances outcomes. **Conclusion:** An integrative approach grounded in Ayurvedic principles and modern science offers holistic management for NAFLD. Early intervention through personalized diet, lifestyle modification, and detoxification may prevent disease progression and promote liver health. Further research should validate these Ayurvedic interventions clinically.

Keywords: NAFLD, *Ayurveda, Agnimandya, Medodushti* (Disorders of lipid metabolism)

INTRODUCTION: NAFLD, recently known as Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD), is a condition of excess fat storage in the liver of those who have minimal or no alcohol intake. It ranges

from benign fat buildup to a more harmful type (NASH) with the potential for causing liver damage, cirrhosis, or malignancy. [1] NAFLD has emerged as a new public health challenge in India. A systematic review and meta-analysis in 2024 had estimated the pooled prevalence of NAFLD among adults in India at 38.6%. [2] The study also found higher prevalence rates in high-risk groups, such as individuals with diabetes or obesity, at 52.8%.[2] Noticing the increasing burden of NAFLD, the government of India added the condition to the National Programme for Prevention and Control of Non-Communicable Diseases in 2021.[3] The new guidelines mention that out of every 10 individuals in India, 1 to 3 might have fatty liver or its related diseases.[4] The rising incidence of NAFLD in India reflects the need for public health interventions through lifestyle modification, early diagnosis, and management of the resulting health hazards.

As per Ayurveda, Non-Alcoholic Fatty Liver Disease (NAFLD) can be considered. as a *Yakrit vikara* (disorder of Liver), but the classical texts do not write about any liver conditions of fat in a clear manner. *Yakrit* (liver) and *Pleeha* (spleen) play vital roles in *Rakta Dhatu* formation (formation of blood) and *Raktavaha Srotas* (Blood-carrying channels), while *Yakrit* is the primary site of *Ranjaka Pitta*, the metabolism of blood Ayurvedic texts, like Bhavaprakasha, Chakradutta, and Bhaishajyaratnavali, outline liver disease under *Pleeha Yakrit Adhikara* in detail, such as *Pandu* (anaemia), *Kamala* (Jaundice), and *Udar*a (Ascites).[5,6]

Role of *Agni* (digestive fire) and *Medodushti* (disorders of lipid metabolism)

Agni, the fundamental energy in charge of digestion and metabolism in Ayurveda, is the controlling force for the body to transform food into energy and nourishment. Acharya Charaka records 13 types of *Agni* out of which *Jatharagni*—the fire that digests—is one such that is responsible for digestion of food and absorption of nutrients, a process governed by *Pachaka Pitta* and *Samana Vayu*. The balance of *Agni* is crucial to maintain health, as impairment of *Agni (Agnimandya)* leads to accumulation of *Ama*, disrupting digestion and predisposing the body to imbalances like *Ajirna* (indigestion) obesity, and diabetes.[7,8,9]

Dysfunctions such as poor nutrition, stress, and an inactive lifestyle cause Tridosha dysfunctions, lowering *Agni* and producing metabolic imbalances.[7] The Ayurvedic triad of *Ajirna* subtypes, *Ama, Vidagdha, and Vishtabdha*, falls in line with *Kapha, Pitta*, and *Vata* dysfunctions, respectively, in reflecting current knowledge of intestinal health and hormonal regulation.[10,11,12] Maintaining *Agni* through mindful nutrition, balanced routines, and stress management is at the core of overall well-being, affirming Ayurveda's timeless wisdom in digestive physiology.

Meda can be considered as body fat essential for lubrication, skin health, joint function, and body strength. Ayurveda classifies it into *Baddha Meda* (accumulated body fat in muscles and the abdomen) and *Abaddha Meda* (blood-borne lipids like cholesterol and triglycerides).[13] Having emerged due to the stepwise action of *Jatharagni* and *Medo Dhatvagni*, *Meda Dhatu* is nourished by *Sneha*-rich (food with rich fats) foodstuffs via *Medovaha Srotas*. In its state of equilibrium, it safeguards tissue integrity and nourishes *Asthi* (Bone tissue)

and *Majja* (Bone marrow).[14,15] Deficient *Medo Dhatvagni* due to faulty *Agni* leads to hyperdeposition of fat, producing *Sthaulya* (obesity), hyperlipidemia, *Prameha* (diabetes), and *Hridroga* (cardiovascular disease). Other etiological factors such as inappropriate diet, sedentary life, psychological stress, and hereditary influence further enhance fat metabolism disturbances. [16] **NAFLD An Ayurvedic Perspective**

Non-Alcoholic Fatty Liver Disease (NAFLD) is referred to in Ayurveda as a *Santarpanajanya Vyadhi*, an illness because of over-nourishment and deranged metabolism.

Nidana

The Nidana of NAFLD can be categorized into:

Aharatmaka Nidana (Dietary Causes): The causative factors arising from diet are categorized based on *Guna* (qualities), *Dravya* (substances), and *Bhojanavidhi* (eating habits). As per *Guna*, excessive intake of *Lavana* (salty), *Kshara* (alkaline), *Amla* (sour), *Katu* (pungent), *Guru* (heavy), *Snigdha* (unctuous), *Ushna* (hot), *Madhura* (sweet), and *Sheeta* (cold) foods leads to vitiation of the doshas, especially promoting the increase of *Medo Dhatu*. Similarly, consuming food that is *Ruksha* (dry), *Shushka* (dehydrated), or *Pradushta* (spoiled) adversely affects metabolism and contributes to disease manifestation. Based on *Dravya*, the excessive consumption of *Navanna* (fresh grains), *Mamsa* (meat), *Navamadhya* (fresh alcohol), *Ikshuvikara* (sugar and sugarcane derivatives), *Dadhi* (curd), *Mastu* (whey), *Sura* (liquor), and fried or heavily processed foods increases *Medas* and impairs *Agni* (digestive fire). According to *Bhojanavidhi*, irregular dietary practices such as *Ajirna* (eating before complete digestion), *Adhyashana* (frequent eating), *Vishamashana* (irregular eating), *Viruddha Ahara* (consumption of incompatible foods), and *Atimatra Bhojana* (overeating) are significant dietary causes leading to imbalance in *Doshas* and faulty *Dhatuparinama* (tissue formation).

Viharatmaka Nidana (Lifestyle Causes): Lifestyle-related causes play an equally important role in the accumulation of *Medo Dhatu*. Sedentary habits such as *Avyayama* (lack of exercise), *Avyavaya* (lack of sexual activity), *Swapna Viparyaya* (disturbed sleep pattern), and *Divasvapna* (daytime sleep) reduce metabolic activity, thereby promoting fat deposition. Excessive indulgence in *Taila Abhyanga* (oil massage) without sufficient physical activity, and general inactivity, further contribute to sluggishness of body channels (*Srotas*) and accumulation of *Kapha* and *Medas*.

Manasika Nidana (Psychological Causes): Psychological factors also influence the formation and accumulation of *Medo Dhatu*. Emotional disturbances such as *Krodha* (anger), *Shoka* (grief), *Bhaya* (fear), and *Harsha Nitya* (excessive or continuous excitement) cause neuroendocrine imbalance, indirectly affecting metabolism and leading to disorders of *Medas*. As stated by *Dalhana*, the excessive accumulation of *Medo Dhatu* obstructs the normal *Gati* (movement) of *Vata Dosha*, resulting in secondary pathologies like obesity, diabetes, and hypothyroidism. These conditions are referred to as *Nidanarthakara Roga*—diseases that act as causative factors for other disorders.[17,18]

Aetiopathogenesis of NAFLD: An Ayurvedic Perspective[19]

From an Ayurvedic perspective, NAFLD is viewed as a *Yakrit Vikara* (disorder of liver). It arises mainly from *Agnimandya*

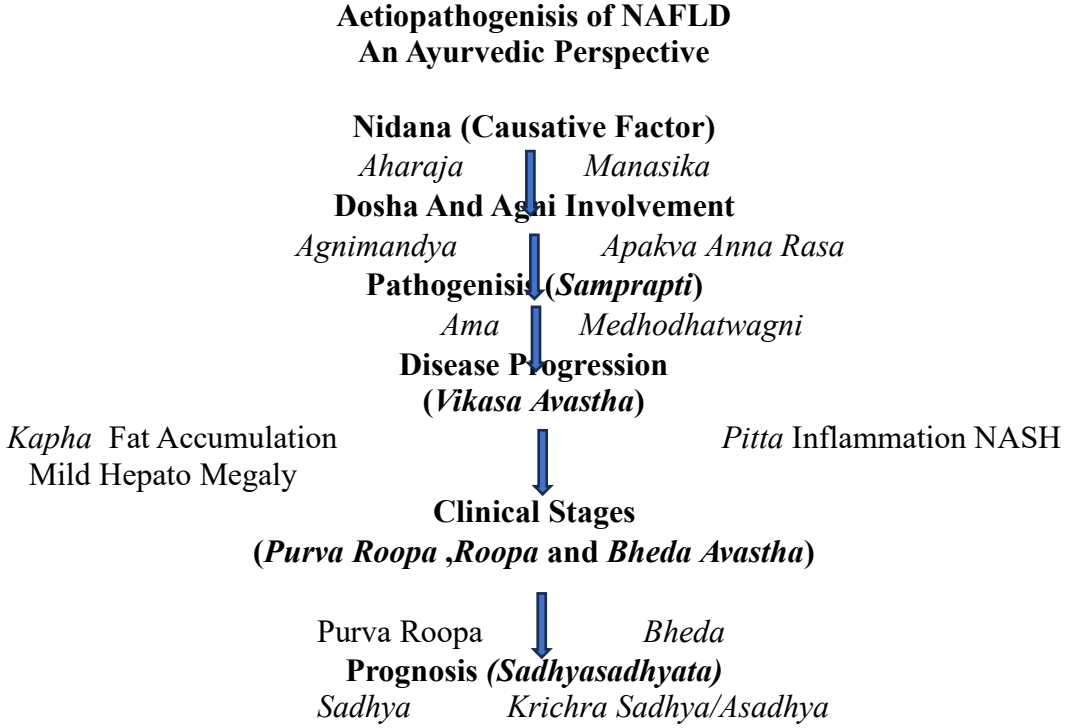
(impaired digestion and metabolism) and *Medodushti* (faulty fat metabolism). Improper dietary habits, a sedentary lifestyle, and psychosomatic factors disturb the *Doshas*—mainly *Kapha* and *Pitta.* These factors also disrupt *Agni* and the proper functioning of *Srotas* (channels).

Dosha and _Agni_ Involvement

Due to these *Nidanas*, *Agni* becomes deranged. It can become *Manda Agni* (weak), *Vishama Agni* (irregular), or *Tikshna Agni* (intense but erratic). Impaired *Agni* leads to *Ajirna* (indigestion) and the production of *Apakva Anna Rasa,* a partially digested nutrient essence that cannot properly nourish tissues.

This condition causes the formation of *Ama* (metabolic toxins). It also disturbs Kapha and weakens Medodhatvagni. As a result, fat metabolism (*Medodushti*) becomes faulty, leading to abnormal *Meda Dhatu* deposition in the *Yakrit* (liver). These are shown in the flowchart number 1

Flow chart no.1 Aetiopathogenesis of NAFLD – An Ayurvedic perspective



Disease Progression (_Vikasa Avastha_)

As the disease progresses, *Jatharagni* and *Dhatvagni Mandya* continue to produce *Ama*. In the *Sthanasamshraya* stage, the disease may resemble *Yakriddalyudara* depending on the degree of *Agnimandya* and *Ama* accumulation.

Sequential Dosha involvement and corresponding manifestations:

***Kapha* predominance:** Fat accumulation and mild hepatomegaly (comparable to simple steatosis).

***Pitta* predominance:** Inflammation and hepatocellular injury (akin to NASH).

***Vata* predominance:** Fibrosis, cirrhosis, and possible malignant transformation (HCC).

***Srotas* involved:** *Annavaha, Udakavaha, Rasavaha, Raktavaha, Mamsavaha, Medovaha,* and *Purishavaha*—all of which play a critical role in hepatic metabolism and systemic homeostasis.

Clinical Stages (_Purvarupa, Rupa_ and _Bheda_)

***Poorvarupa* (Prodromal stage):** Subclinical symptoms like *Ajeerna* (indigestion), lethargy, heaviness, loss of appetite—signifying early metabolic derangement.

***Rupa* (Manifest stage):** Prominent features like *Haridra Netra* (yellowish discoloration), hepatomegaly, and metabolic signs mimicking *Prameha* with *Medasvikara* (lipid accumulation).

***Bheda* (Complication stage):** If untreated, complications such as *Jalodara* (ascites), fibrosis, cirrhosis, or hepatocellular carcinoma (*Yakrit Arbuda*) may develop.

Prognosis (*Sadhyasadhyata*)

In the early stages, the condition is *Sadhya* (manageable or reversible). Early intervention, such as *Ahara-Vihara Parivartana* (diet and lifestyle changes), and *Shodhana–Shamana* therapies can help. However, if structural liver damage happens, the prognosis becomes *Krichra Sadhya* or *Asadhya* (difficult to cure). At that point, intensive and prolonged management is needed.

This Ayurvedic pathogenesis mirrors modern mechanisms—insulin resistance, oxidative stress, and lipid peroxidation leading to hepatic fat accumulation, inflammation, and fibrosis. Thus, *Agnimandya* corresponds to metabolic dysfunction, while *Ama* corresponds to toxic lipid intermediates and oxidative metabolites responsible for disease progression.[19]

Management of NAFLD: An Integrative Approach

Management of Non-Alcoholic Fatty Liver Disease (NAFLD) is a holistic approach based on diet modification, life-style adjustment, therapeutic interventions, and rejuvenation therapies for metabolic balance reversal and disease progression prevention.

Dietary Regimen (Ahara) plays a key role in the regulation of liver function and lipid metabolism. Laghu and digestible foods such as *Yava* (barley), *Mudga* (greengram), and *Takra* (butter milk) increase digestion and reduce the load of metabolism. For the control of *Kapha* and *Pitta Dosha*, Guru (heavy), Snigdha (oily), and *Madhura* (sweet) foods should be avoided, which increase fat deposition and delay metabolism. Rather, the addition of Tikta Rasa (pungent taste) dominant foods such as *Karavellaka* [*Momordica charantia* L.] and *Patola* [*Trichosanthes cucumerina* L.]serves to promote liver detoxification and lipid metabolism. Lifestyle Modifications (*Vihara*) also play a vital role in the reversal of NAFLD.[20] Regular exercise, particularly of a moderate nature, enhances Meda (lipid) metabolism, and it avoids excess fat deposition within the liver.[21,22] *Divaswapna* (daytime sleeping) must be evaded, as it stimulates *Kapha* and leads to metabolic dullness. Additionally, incorporating stress reduction techniques like *Pranayama* and meditation can significantly improve digestion, metabolism, and liver function as a whole.

Therapeutic Interventions comprise both *Shodhana* (purificatory procedures) and *Shamana* (paliative therapy) to restore normal liver function. *Virechana* (purgation therapy) using herbs like *Trivrit* [*Operculina turpethum* (L.) Silva Manso] excellently eliminates excess *Pitta-Kapha*, while Basti using *Tikta Dravyas* (drugs with pungent taste) supports *Srotoshodhana* (clearing channels). In *Shamana Chikitsa* (palliative therapy), hepatoprotective formulations like *Arogya Vardhini Vati*, *Guduchi Kashaya*, *Katuki Churna* (*Picrorhiza kurrooa* Royle), and *Triphala* support detoxification in the liver, aid digestion, and regulate lipid metabolism. Solitary drugs like *Guduchi*

[*Tinospora cordifolia* (Willd.) Hook.f. & Thomson], *Bhumyamalaki* [*Phyllanthus amarus* Schumach. & Thonn.], *Kiratatikta* [*Andrographis paniculata* (Burm.f.) Wall). ex Nees], *Bhringaraja* [*Eclipta prostrata* (L.) L.] and *Nimba* [Azadirachta A.Juss.] possess anti-inflammatory, hepatoprotective, and lipid-lowering properties and hence are beneficial in NAFLD management.[23,24,25] *Rasayana Therapy*, as it targets rejuvenation and cell regeneration, also improves liver function. *Amalaki Rasayana,* rich in antioxidants, induces detoxification and regeneration in the liver, while *Pippali Rasayana* maximizes hepatic metabolism and bioavailability of nutrients.[26,27]

Discussion

The Ayurvedic understanding of Non-Alcoholic Fatty Liver Disease (NAFLD), or *Metabolic Dysfunction–Associated Steatotic Liver Disease (MASLD)*, offers a comprehensive framework that parallels modern concepts of metabolic dysfunction, insulin resistance, and oxidative stress. Ayurveda attributes the origin of this disease primarily to *Agnimandya* (impaired digestion and metabolism) and *Medodushti* (disordered lipid metabolism), which together lead to the accumulation of *Ama* (metabolic toxins) and excessive deposition of *Meda Dhatu* (fat tissue) within the *Yakrit* (liver). The vitiation of *Kapha* and *Pitta Doshas* due to improper diet, sedentary lifestyle, and psychological stress initiates the pathological cascade resulting in *Sthaulya* (obesity), *Prameha* (diabetes), and *Hridroga* (cardiovascular disease). This Ayurvedic pathophysiology mirrors the modern understanding of NAFLD as a metabolic disorder driven by lipid dysregulation, hepatic inflammation, and oxidative damage. Thus, concepts like *Agnimandya* and *Ama* provide an insightful traditional interpretation of biochemical phenomena such as reduced mitochondrial oxidation, accumulation of toxic lipid intermediates, and inflammatory cytokine release in liver pathology.

The management of NAFLD through Ayurveda emphasizes an integrative approach that includes *Ahara* (diet), *Vihara* (lifestyle), and *Chikitsa* (therapeutic intervention). Light, easily digestible foods such as *Yava* (barley), *Mudga* (green gram), and *Takra* (buttermilk) are recommended to enhance *Agni* and reduce *Meda* accumulation, while unwholesome and heavy foods that vitiate *Kapha* and *Pitta* are discouraged. Lifestyle correction through regular physical activity, avoidance of *Divaswapna* (daytime sleep), and stress-reduction practices like *Pranayama* and meditation restore metabolic harmony. Therapeutically, *Shodhana* procedures like *Virechana* and *Basti* help in the elimination of vitiated Doshas, while *Shamana Chikitsa* using hepatoprotective herbs such as *Guduchi* (*Tinospora cordifolia*), *Bhumyamalaki* (*Phyllanthus amarus*), and *Katuki* (*Picrorhiza kurrooa*) enhances hepatic detoxification and lipid regulation. The inclusion of *Rasayana* therapies like *Amalaki* and *Pippali Rasayana* further aids tissue rejuvenation and metabolic restoration. Hence, Ayurveda provides not only a theoretical understanding but also a practical, multi-dimensional therapeutic strategy to manage and prevent NAFLD through metabolic correction, digestive enhancement, and lifestyle optimization.

CONCLUSION

NAFLD, characterized by excess lipid deposition in hepatic cells, correlates with *Viṣamavṛddhi* of *Meda* (Irregular or abnormal increase of fat) due to *Medo-Dhātvagni* impairment. In its early stages,

it aligns with *Agnivikṛti* (impairment of digestive fire) and *Medoroga* while advanced forms resemble *Yakṛtvidradhi*, *Yakṛtgulma*, or *Yakṛddalyudara*. Ayurveda emphasizes restoring *Agni* and rebalancing *Meda Dhatu* through appropriate diet, lifestyle, and therapeutic measures, offering a holistic and sustainable approach to managing NAFLD and maintaining liver–metabolic health.

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Cite this Article as: [Ayurvedic Interpretation and Integrative Management of Non-Alcoholic Fatty Liver Disease (NAFLD): A Comprehensive Review of Pathogenesis and Therapeutic Approaches] *www.ijaar.in: IJAAR VOL VII ISSUE IV SEP-OCT 2025Page No: -163-171*