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Yakritdalyodara and Fatty Liver Disease: An Updated Review of Etiopathogenesis and Ayurvedic Perspectives

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ABSTRACT

Fatty liver disease, encompassing both alcoholic and non-alcoholic forms, has emerged as a major global health concern. Modern medicine categorizes this condition primarily as Non-Alcoholic Fatty Liver Disease (NAFLD) or Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD), characterized by excessive lipid accumulation in the liver. Despite its high prevalence, modern medicine lacks a definitive pharmacological cure, relying largely on lifestyle interventions. Ayurveda, the ancient Indian system of medicine, correlates this condition with *Yakrit Roga*, specifically *Yakritodara* and *Yakritdalyodara*, involving the derangement of *Agni* (digestive fire), *Kapha*, *Pitta*, and *Meda Dhatu* (fat tissue). This review article critically analyzes the etiopathogenesis of fatty liver disease from both modern and Ayurvedic perspectives, highlighting the remarkable concordance between the modern "multiple-hit hypothesis" and the Ayurvedic concept of *Samprapti* (pathogenesis). Furthermore, it explores the therapeutic potential of Ayurvedic interventions, including *Panchakarma* therapies like *Virechana*, dietary modifications (*Ahara Parivarjana*), and hepatoprotective herbal formulations, as evidence-based strategies for managing and reversing fatty liver disease.

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INTRODUCTION

Fatty liver disease represents a spectrum of hepatic abnormalities characterized by the abnormal accumulation of lipids within hepatocytes [1]. It is broadly categorized into Alcoholic Fatty Liver Disease (AFLD) and Non-Alcoholic Fatty Liver Disease (NAFLD) [2]. In recent years, NAFLD has become a global epidemic, paralleling the rise in obesity, type 2 diabetes mellitus, and metabolic syndrome [3]. In 2020, an international expert consensus proposed the term Metabolic Dysfunction-Associated Fatty Liver Disease (MAFLD), which was later updated to Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD) to better reflect the metabolic underpinnings of the disease [4]. The global prevalence of NAFLD is estimated to be around 30%, reaching up to 75% in patients with type 2 diabetes and 90% in severely obese individuals [5].

The pathogenesis of NAFLD is complex and multifactorial. Modern medicine explains its development through the "multiple-hit hypothesis," which posits that multiple parallel insults—including insulin resistance, lipotoxicity, oxidative stress, endoplasmic reticulum (ER) stress, and gut microbiome dysbiosis—act synergistically on a genetically predisposed individual to induce liver injury and inflammation [6] [7]. If left untreated, simple steatosis can progress to Non-Alcoholic Steatohepatitis (NASH), leading to fibrosis, cirrhosis, and hepatocellular carcinoma [8]. Currently, there is no approved pharmacological treatment specifically targeting the underlying mechanisms of NAFLD; management primarily relies on lifestyle modifications, including weight loss, dietary changes, and increased physical activity [9].

Ayurveda, the traditional Indian system of medicine, offers a holistic, individualized approach to metabolic disorders based on the principles of *Tridosha* theory (*Vata*, *Pitta*, *Kapha*) and the balance of *Dhatus* (tissues) and *Malas* (waste products) [10]. In Ayurvedic classical texts, the liver (*Yakrit*) is recognized as a vital organ involved in digestion, metabolism, and the purification of blood (*Rakta Dhatu*) [11]. Conditions resembling fatty liver disease are described under the broader categories of *Yakrit Roga* (liver disorders) and *Udara Roga* (abdominal disorders), specifically *Yakritodara* and its progressed stage, *Yakritdalyodara* [12]. The Ayurvedic pathogenesis (*Samprapti*) of this condition involves *Agnimandya* (weak digestive fire), the formation of *Ama* (metabolic toxins), and the vitiation of *Kapha* and *Meda Dhatu* (fat tissue), leading to *Srotorodha* (channel obstruction) [13].

This review aims to synthesize the modern understanding of fatty liver disease with the classical Ayurvedic perspectives on *Yakritdalyodara*, exploring the etiopathogenesis, clinical manifestations, and evidence-based Ayurvedic management strategies for this growing public health challenge.

Etiopathogenesis of Fatty Liver Disease: Modern Perspective

The modern understanding of fatty liver disease has evolved significantly over the past few decades. The pathogenesis is primarily driven by a combination of genetic, environmental, and lifestyle factors that disrupt hepatic lipid homeostasis [14].

Insulin Resistance and Lipotoxicity

Insulin resistance (IR) is considered a central pathogenic mechanism in the development of NAFLD [15]. In a state of peripheral insulin resistance, typically seen in obesity and metabolic syndrome, the suppressive effect of insulin on lipolysis in adipose tissue is blunted. This results in an increased release of free fatty acids (FFAs) into the circulation [16]. The liver takes up these excessive FFAs, leading to hepatic lipid overload. Simultaneously, hyperinsulinemia promotes *de novo* lipogenesis (DNL) in the liver, further contributing to triglyceride accumulation within hepatocytes [17].

The accumulation of lipids, particularly toxic lipid intermediates like diacylglycerol (DAG) and ceramides, induces lipotoxicity [18]. Lipotoxicity triggers mitochondrial dysfunction, resulting in incomplete fatty acid oxidation and the generation of reactive oxygen species (ROS) [19]. This oxidative stress, combined with ER stress, initiates inflammatory cascades, activating Kupffer cells and releasing pro-inflammatory cytokines such as Tumor Necrosis Factor-alpha (TNF-α) and Interleukin-6 (IL-6) [20]. This transition from simple steatosis to NASH represents the critical "second hit" in the pathogenesis of fatty liver disease [21].

The Gut-Liver Axis

Recent research has highlighted the significant role of the gut microbiome in NAFLD pathogenesis [22]. Dysbiosis, or an imbalance in the intestinal microbiota, increases intestinal permeability (often referred to as "leaky gut"). This allows the translocation of microbial-associated molecular patterns (MAMPs), such as lipopolysaccharides (LPS), into the portal circulation and the liver [23]. The interaction of LPS with Toll-like receptor 4 (TLR4) on Kupffer cells and hepatocytes exacerbates hepatic inflammation and insulin resistance, acting as another crucial "hit" in the multiple-hit hypothesis [24].

Etiopathogenesis of Yakritdalyodara: Ayurvedic Perspective

Ayurveda views disease as a manifestation of the loss of equilibrium among *Doshas* (bio-energies), *Dhatus* (tissues), and *Agnis* (metabolic enzymes) [25]. The liver (*Yakrit*) is considered the primary site of *Ranjaka Pitta* (the subtype of Pitta responsible for coloring blood and aiding digestion) and the root of *Raktavaha Srotas* (channels carrying blood) [26].

Etiological Factors (Nidana)

Classical Ayurvedic texts, such as the *Charaka Samhita* and *Sushruta Samhita*, describe the etiological factors for *Udara Roga* (which includes *Yakritodara*) that remarkably parallel modern risk factors for NAFLD [27]. These factors are primarily related to diet (*Ahara*) and lifestyle (*Vihara*):

- **Dietary Factors (*Ahara Nidana*):** Excessive consumption of *Snigdha* (oily/fatty), *Guru* (heavy/hard to digest), and *Madhura* (sweet/refined carbohydrates) foods [28]. The intake of incompatible foods (*Viruddhahara*) and fermented or processed foods is also cited as a cause [29].
- **Lifestyle Factors (*Vihara Nidana*):** *Avihara* or sedentary lifestyle (*Alasya*), daytime sleeping (*Divasvapna*), and lack of physical exercise lead to the sluggishness of metabolism [30].
- **Psychological Factors (*Manasika Nidana*):** Mental stress, grief, and negative emotions (*Manasika Sankshobha*) are known to vitiate *Vata* and *Pitta*, disrupting the digestive process [31].

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Pathogenesis (Samprapti)

The Ayurvedic pathogenesis of *Yakritdalyodara* can be understood through the sequential stages of disease development, beginning with the derangement of *Agni* (digestive and metabolic fire) [32].

1. **Agnimandya (Impaired Digestion and Metabolism):** The continuous consumption of inappropriate diet and lifestyle factors leads to *Jatharagnimandya* (weak digestive fire) and *Medodhatvagnimandya* (impaired fat tissue metabolism) [33].
2. **Ama Formation:** Due to the impaired *Agni*, the food is not properly digested, resulting in the formation of *Ama* (toxic, undigested metabolic by-products) [34]. *Ama* is a sticky, heavy substance that clogs the bodily channels (*Srotas*).

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3. **Dosha and Dhatu Dushti:** *Ama* combines with *Kapha* and *Meda Dhatu* (fat tissue), causing their vitiation. The vitiated *Kapha-Meda* travels through the *Medovaha Srotas* (channels carrying fat) and localizes in the liver (*Yakrit*) [35].
4. **Srotorodha (Channel Obstruction):** The accumulation of pathological fat (*Sleshma*) in the liver causes *Srotorodha* (obstruction of micro-channels). This leads to the enlargement of the liver (*Yakrit Vriddhi*) and hepatomegaly [36].
5. **Progression to Yakritdalyodara:** As the condition progresses, the obstruction becomes severe, leading to the destruction of the normal architecture of the liver (*Dalya* means destroyed or fragmented). *Yakritdalyodara* represents the advanced stage of fatty liver disease, characterized by severe hepatomegaly, fibrosis, and potentially cirrhosis with ascites [37].

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Ayurvedic Concept	Modern Correlation
Agnimandya / *Medodhatvagnimandya*	Insulin resistance, impaired hepatic lipid metabolism, mitochondrial dysfunction
Ama	Lipotoxic metabolites (ceramides, DAG), advanced glycation end-products (AGEs)
Srotorodha in *Medovaha Srotas*	Hepatic steatosis, triglyceride accumulation in hepatocytes
Kapha-Pitta vitiation	Hepatic inflammation, oxidative stress, Kupffer cell activation
Yakrit Vriddhi to *Yakritdalyodara*	Hepatomegaly progressing to steatohepatitis (NASH) and liver fibrosis/cirrhosis

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Clinical Manifestations

Modern Clinical Presentation

In its early stages, NAFLD is often asymptomatic and discovered incidentally during routine blood tests showing elevated liver enzymes (ALT and AST) or imaging revealing hepatic steatosis [38]. As the disease progresses, patients may experience generalized fatigue, malaise, and mild discomfort or dull pain in the right upper quadrant of the abdomen due to liver enlargement [39]. In advanced stages (NASH and cirrhosis), clinical signs of liver failure may manifest, including jaundice, ascites, splenomegaly, and hepatic encephalopathy [40].

Ayurvedic Clinical Presentation (*Lakshana*)

Classical texts describe the clinical features of *Yakritodara* and *Udara Roga* that align with the symptoms of fatty liver disease:

- **Digestive Symptoms:** *Arochaka* (loss of appetite), *Avipaka* (indigestion), *Hrillasa* (nausea), and *Trikta Mukha* (bitter taste in the mouth) [41].
- **Systemic Symptoms:** *Gaurava* (heaviness of the body), *Alasya* (lethargy/ fatigue), and *Klama* (exhaustion) [42].
- **Abdominal Symptoms:** *Udaraparinama* (abdominal distension), *Yakrit Vriddhi* (palpable enlargement of the liver), and *Udarshoola* (abdominal pain) [43].
- **Signs of Vitiated Pitta and Rakta:** *Arunavarna Udara* (reddish discoloration of the abdomen), visible superficial veins, and changes in skin complexion (*Pandutva* or pallor) [44].

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Ayurvedic Management of Fatty Liver Disease

Ayurveda offers a comprehensive, multi-modal approach to managing fatty liver disease, focusing on correcting the underlying metabolic imbalance, detoxifying the system, and rejuvenating liver function [45]. The treatment principles are divided into *Shodhana* (bio-purification) and *Shamana* (palliative care), supported by strict *Ahara* (diet) and *Vihara* (lifestyle) modifications [46].

1. AHARA PARIVARJANA (DIETARY MODIFICATIONS)

Dietary regulation is the cornerstone of managing fatty liver disease in Ayurveda. The primary goal is to pacify *Kapha* and *Meda Dhatu* while kindling *Agni* [47].

- **Foods to Avoid (*Apathya*):** Excessive intake of heavy, oily, fried, and processed foods. Refined carbohydrates, excessive sweets, dairy products (especially cheese and yogurt at night), and fermented foods should be strictly avoided. Alcohol consumption must be completely abstained [48].
- **Foods to Include (*Pathya*):** A diet rich in light, easily digestible, and warm foods. The inclusion of bitter (*Tikta*) and astringent (*Kashaya*) tastes is emphasized, as they help reduce fat accumulation and improve liver function. Whole grains (like barley and old rice), green leafy vegetables, legumes, and lean proteins are recommended [49]. Herbal spices like turmeric, black pepper, cumin, and coriander are encouraged to stimulate digestion and reduce inflammation [50].

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2. VIHARA PARIVARJANA (LIFESTYLE MODIFICATIONS)

A sedentary lifestyle is a major contributor to *Yakritodara*. Therefore, adopting an active lifestyle is crucial [51].

- **Physical Activity (*Vyayama*):** Regular, moderate physical exercise is recommended to burn excess *Meda Dhatu* and improve insulin sensitivity. *Udwartana* (powder massage) with dry herbal powders is a specific Ayurvedic therapy recommended for reducing body fat and improving circulation [52].
- **Yoga and Pranayama:** Specific yoga postures (*Asanas*) like *Paschimottanasana*, *Ardha Matsyendrasana*, and *Dhanurasana* are beneficial for compressing and stretching the abdominal organs, thereby stimulating liver function. Breathing exercises (*Pranayama*) such as *Kapalabhati* and *Bhastrika* help increase metabolic rate and oxygenate the blood [53].

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3. SHAMANA CHIKITSA (PALLIATIVE HERBAL THERAPY)

Ayurveda utilizes numerous hepatoprotective and lipid-lowering herbs to manage fatty liver disease. Modern scientific studies have validated the efficacy of several of these traditional formulations [54].

- **Single Herbs:**
  - ***Phyllanthus niruri* (Bhumyamalaki):** Widely recognized for its hepatoprotective properties. Clinical trials have shown that *Bhumyamalaki* extract can significantly improve liver enzymes and reduce liver fat accumulation in NAFLD patients [55].
  - ***Curcuma longa* (Haridra/Turmeric):** The active compound curcumin exhibits strong anti-inflammatory and antioxidant properties. Clinical meta-analyses have demonstrated that curcumin supplementation significantly reduces liver enzymes (ALT, AST) and improves lipid profiles in NAFLD patients [56].
  - ***Picrorhiza kurroa* (Katuki):** Known for its ability to stimulate bile secretion and protect hepatocytes from toxic damage.
  - ***Boerhavia diffusa* (Punarnava):** Exhibits anti-inflammatory and hepatoprotective effects, helping to reduce liver enlargement and inflammation [57-58].
- **Polyherbal Formulations:**
  - ***Triphala*:** A combination of *Amalaki*, *Bibhitaki*, and *Haritaki*, *Triphala* is highly effective in detoxifying the system, improving digestion, and reducing oxidative stress in the liver [59-62].
  - ***Liv.52*:** A well-known proprietary Ayurvedic formulation containing a blend of herbs like *Capers bush* (Himsra) and *Cichory* (Kasani). Clinical studies have reported that *Liv.52* improves liver function tests, reduces hepatic steatosis, and aids in the regeneration of liver cells [63-66].
  - ***Arogyavardhini Vati*:** A classical formulation containing *Punarnava*, *Guduchi*, and purified heavy metals (in *Bhasma* form), traditionally used for liver disorders and metabolic imbalances. It is highly effective in reducing liver enzymes and correcting lipid profiles [67-71].

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4. SHODHANA CHIKITSA (PANCHAKARMA THERAPIES)

Panchakarma, the Ayurvedic detoxification protocol, plays a vital role in treating advanced or resistant cases of fatty liver disease by physically eliminating the vitiated *Doshas* and *Ama* from the body [72-76].

- **Virechana (Therapeutic Purgation):** This is the most specific and effective *Panchakarma* therapy for liver disorders, as it targets the pacification of *Pitta* and the elimination of toxins through the lower gastrointestinal tract [77-80]. Studies have shown that *Virechana* therapy significantly reduces ALT, AST, and lipid levels, decreases hepatomegaly, and improves the overall metabolic status of NAFLD patients [81-84].
- **Lekhana Basti (Scraping Medicated Enema):** *Basti* therapy involves the administration of medicated decoctions and oils through the rectum. *Lekhana Basti*, which utilizes bitter and pungent herbs, helps in scraping out the excess fat (*Meda*) from the tissues and channels, thereby addressing the root cause of metabolic syndrome [85-90].

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CONCLUSION

Fatty liver disease, represented by NAFLD or MASLD in modern medicine and *Yakritdalyodara* in Ayurveda, is a complex metabolic disorder driven by lifestyle

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factors, insulin resistance, and chronic inflammation. While modern medicine emphasizes lifestyle changes and lacks specific pharmacological agents, Ayurveda provides a comprehensive, evidence-based framework for its management. The Ayurvedic concept of *Agnimandya* leading to *Ama* formation and *Srotorodha* perfectly mirrors the modern understanding of lipotoxicity and channel dysfunction. Ayurvedic interventions, including *Ahara Parivarjana* (dietary regulation), *Vihara Parivarjana* (lifestyle modifications), hepatoprotective herbs like *Bhumyamalaki* and *Turmeric*, and detoxification therapies like *Virechana*, offer a safe, effective, and holistic approach to reversing hepatic steatosis and restoring metabolic health. Integrating these Ayurvedic principles into contemporary hepatological practice holds immense potential for the prevention and treatment of fatty liver disease

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