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Review Article

A Tetra-Herbal Ayurvedic Formulation in the Management of Alcoholic Liver Disease: A Pharmacological and Clinico-Ayurvedic Review

Dr. Naba Kumar Hazarika[1], Dr. Jyotirmoy Sarmah[2], Dr. Rama Kanta Sarmah[3]

[1] Asst. Prof. Department, Rasa topic and Bhaishajya kalpana, Govt. Ayurvedic College and Hospital, Guwahati, Assam
[2] HOD, Dept. Salakya tanta, Govt. Ayurvedic College and Hospital, Guwahati, Assam
[3] Retd. Principal Govt. Ayurvedic College and Hospital, Guwahati, Assam

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Corresponding Author:

Dr. Naba Kumar Hazarika
Asst. Prof. Department, Rasa topic and Bhaishajya kalpana, Govt. Ayurvedic College and Hospital, Guwahati, Assam.

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ABSTRACT

Alcoholic liver disease (ALD) is described in Ayurveda under the broader clinical umbrella of Yakrit Vikara and Kamala, arising from Pittadushti and Kaphavriddhi and progressing, in advanced stages, to Yakrit-Pliha Vriddhi and Jalodara resembling decompensated cirrhosis. This review examines the scientific and classical rationale for a tetra-herbal formulation combining Haridra (Curcuma longa Linn.), Bhumi-Amalaki (Phyllanthus urinaria Linn.), Pippali (Piper longum Linn.) and Jiraka (Cuminum cyminum Linn.) in equal (1:1:1:1) proportion for the management of ALD. Each ingredient is described in classical Ayurvedic literature as possessing Yakrit-uttejaka (hepatostimulant), Deepana-Pachana (digestive-carminative) and Kaphapittahara properties, and each has accumulated substantial experimental and clinical pharmacological evidence supporting a hepatoprotective role, including specifically in ethanol-induced hepatic injury. Drawing together classical dravyaguna description and contemporary pharmacological literature, this review builds the case for the formulation's combined use as a rational, mechanistically complementary approach to alcoholic liver disease.

Keywords*: Alcoholic liver disease; Madyaja Yakrit Vikara; Ayurveda; Curcuma longa; Phyllanthus urinaria; Piper longum; Cuminum cyminum; hepatoprotective.*

1. Introduction and Rationale of Drug Selection

Alcoholic liver disease (ALD) is understood in Ayurveda under the broader clinical umbrella of Yakrit Vikara and Kamala, arising from Pittadushti and Kaphavriddhi with progressive Yakrit-Pliha Vriddhi and, in advanced stages, Jalodara (ascites) resembling decompensated cirrhosis. The formulation examined in this review is a tetra-herbal combination of Haridra (Curcuma longa Linn.), Bhumi-Amalaki (Phyllanthus urinaria Linn.), Pippali (Piper longum Linn.) and Jiraka (Cuminum cyminum Linn.), combined in equal (1:1:1:1) proportion.

Each of these dravyas is independently described in classical Ayurvedic literature as possessing Yakrit-uttejaka (hepatostimulant), Deepana-Pachana (digestive-carminative) and Kaphapittahara properties[1,2,3,4], and each has, over the last two decades, accumulated a substantial body of experimental and clinical pharmacological evidence supporting a hepatoprotective role, including specifically in ethanol-induced hepatic injury. This review consolidates the classical Ayurvedic description of each ingredient with contemporary research evidence, so as to build the scientific rationale for their combined use in the management of alcoholic liver disease.

2. Individual Drug Review

2.1 Haridra (Curcuma longa Linn.)

Family	Zingiberaceae
Sanskrit Synonyms	Rajani, Gauri, Nisa, Ratri, Ksanada, Dosa
Part Used	Rhizome

Gana (Classical Grouping)	Lekhaniya, Shirovirechaniya (Charaka); Shleshmashamana (Sushruta)
Rasa	Katu, Tikta, Kashaya
Guna	Laghu, Rukshya
Virya	Ushna
Vipaka	Katu
Dosha Karma	Kapha-Vatahara

Classically, Haridra is regarded as a premier Yakrit-uttejaka (hepatic stimulant) dravya, and is credited with anti-inflammatory, antioxidant, anti-allergic, rejuvenative, antimicrobial, detoxifying and anti-cancer properties[1,2,3,4]. Its rhizome yields 5–8% volatile oil along with the diarylheptanoid curcumin, besides fat, protein, albumin, carbohydrate, vitamin A and minerals[3,4].

Contemporary Research Update

Curcumin, the principal bioactive curcuminoid of Haridra, has been used as a hepatoprotective agent in Ayurveda and traditional Chinese medicine for centuries, and a growing body of mechanistic work has now examined its action specifically in alcoholic liver injury[5,6]. In a chronic-alcohol mouse model, curcumin supplementation attenuated ethanol-induced hepatic damage by correcting mitochondrial antioxidant enzyme activity and membrane potential, and by suppressing endoplasmic-reticulum-stress and NF-κB-driven inflammatory signalling, indicating a dual mitochondrial-protective and anti-inflammatory mechanism of action[8].

A systematic mechanistic review covering three decades of literature similarly concluded that curcumin consistently reduces ethanol-induced oxidative stress, lipid peroxidation, inflammatory cytokine release and hepatocyte apoptosis across multiple animal models[9], and a hot-water turmeric extract has been shown to suppress acute ethanol-induced liver injury in mice through inhibition of hepatic oxidative stress and inflammatory cytokine production[10].

In the clinical setting, a double-blind randomised placebo-controlled trial of a curcumin-galactomannoside complex in chronic alcoholic patients demonstrated measurable improvement in hepatic function markers, supporting translational relevance of the pre-clinical findings to human alcoholic liver disease[11]. Curcumin has also shown benefit on hepatic fibrosis and inflammatory markers in trials on fatty liver disease[12], and a recent narrative review highlights its modulation of the NF-κB, TGF-β/Smad and Nrf2 pathways as the shared mechanistic basis for its efficacy across steatotic, inflammatory and fibrotic liver conditions, while noting that nanoformulation strategies are being explored to overcome its inherently low oral bioavailability[13].

2.2 Bhumi-Amalaki (Phyllanthus urinaria Linn.)

Family	Euphorbiaceae
Part Used	Panchanga (whole plant)
Gana (Classical Grouping)	Kasahara, Shwasahara (Charaka); Pittashamana (Sushruta)
Rasa	Tikta, Kashaya, Madhura
Guna	Laghu, Rukshya
Virya	Sheeta
Vipaka	Madhura
Dosha Karma	Kapha-Pittashamaka

Bhumi-Amalaki is classically indicated as the drug of choice for Kamala (jaundice) and for Yakrit-Pliha Vriddhi with Jalodara (ascites), corresponding closely to hepatosplenomegaly with fluid accumulation seen in decompensated liver disease[1,2,3,4]. Its principal constituents include the tannins corilagin and geraniin, the flavonoids quercetin and rutin, phenolic acids such as gallic and ellagic acid, the lignan phyllanthin, and assorted terpenoids, which together underlie its reported antioxidant, hepatoprotective, antiviral and anti-inflammatory actions[3,4,7].

Contemporary Research Update

A comprehensive 2024 review of Phyllanthus urinaria in liver disease documents its established capacity to lower elevated alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in animal models of hepatic injury, and summarises evidence of efficacy across viral hepatitis, liver fibrosis/cirrhosis and hepatocellular carcinoma, attributing these effects to its rich content of lignans, flavonoids and tannins acting through antioxidant and anti-inflammatory pathways[14]. Related Phyllanthus species within the same genus have additionally shown hepatoprotective benefit in non-alcoholic fatty liver disease models, and constituent phenolics such as quercetin and ellagic acid — both present in Bhumi-Amalaki — have independently been shown to reduce oxidative and fibrotic liver injury by modulating hepatic macrophage polarisation and toll-like-receptor/NF-κB signalling, providing plausible constituent-level mechanistic support for its classical use in Kamala and Yakrit-Pliha Vriddhi[7].

2.3 Pippali (Piper longum Linn.)

Family	Piperaceae
Part Used	Fruit
Gana (Classical Grouping)	Deepaniya, Shoolaprashamana (Charaka); Deepana, Pachana (Sushruta)
Rasa	Katu
Guna	Laghu, Tikshna, Snigdha
Virya	Ushna
Vipaka	Madhura
Dosha Karma	Vata-Kaphahara

Pippali is classically valued as a Yakrit-Plihodara-hara dravya and as a Yoga-vahi (bio-enhancer) that potentiates the action of co-administered drugs[1,2,3,4]. Charaka Samhita specifically describes Pippali Rasayana and Vardhamana Pippali Kalpana among the best formulations for Yakrit (liver) disorders[23]. Its fruit contains 0.7% pungent volatile oil, 4–5% piperine alkaloid, along with piplartine, sesamin and the steroid piperlongumine (piplasterol)[3,4].

Contemporary Research Update

Piperine, the chief alkaloid of Pippali, has demonstrated significant hepatoprotective activity against tert-butyl hydroperoxide- and carbon tetrachloride-induced hepatotoxicity, and a milk-processed extract of Piper longum produced hepatoprotection comparable to silymarin in normalising serum transaminases and bilirubin[15]. Piperine has separately been shown to attenuate acetaminophen-induced hepatotoxicity through membrane-stabilising and antioxidant activity[17], and to reduce thioacetamide-induced hepatic fibrosis in mice via modulation of the miR-17 and TGF-β/Smad signalling axis, indicating an anti-fibrotic action relevant to progressive alcoholic liver disease[18].

Of particular relevance to this formulation, a network-pharmacology and in-vivo study on Trikatu Churna — a classical formulation containing Piper longum together with Piper nigrum and Zingiber officinale — demonstrated dose-dependent hepatoprotective effects specifically against ethanol-induced alcoholic liver disease in an animal model, lending direct pre-clinical support to the inclusion of Pippali in a formulation intended for ALD[16].

2.4 Jiraka (Cuminum cyminum Linn.)

Family	Apiaceae (Umbelliferae)
Part Used	Seeds
Gana (Classical Grouping)	Shoolaprashamana (Charaka)
Rasa	Katu, Tikta
Guna	Laghu, Rukshya
Virya	Ushna
Vipaka	Katu
Dosha Karma	Kapha-Vatashamaka, Pittavardhaka

Jiraka is classically indicated for Agnimandya (indigestion), Adhmana (flatulence), abdominal pain and Daha (burning sensation), functioning primarily as a Deepana-Pachana (digestive-carminative) dravya[1,2,3,4]. Its seeds yield 2–4% volatile oil rich in cuminaldehyde, together with protein, carbohydrate, calcium, phosphorus, vitamin C and iron[3,4].

Contemporary Research Update

Experimental work has shown that Cuminum cyminum supplementation reduces hepatic lipid accumulation and normalises elevated AST, alkaline phosphatase and gamma-glutamyl transferase levels induced by combined alcohol and thermally-oxidised-oil feeding in rats, indicating a protective action against alcohol-associated hepatotoxicity and lipid peroxidation[19]. A related study confirmed that cumin restores glutathione, vitamin C, vitamin E and antioxidant enzyme (superoxide dismutase, catalase, glutathione peroxidase) activity that is otherwise depleted by ethanol and oxidised-oil exposure[20]. Cumin seed powder has further been shown to prevent oxidative stress, hyperlipidaemia and fatty liver changes in high-fat-diet-fed rats[22], and a comparative hepatoprotective study found Cuminum cyminum extract to be at least as effective as Phyllanthus emblica in normalising liver enzymes in a hepatotoxicity model, supporting its rationale as the Deepana-Pachana and antioxidant component of the formulation[21].

3. Synthesis: Combined Rationale for Use in Alcoholic Liver Disease

Taken together, the four ingredient dravyas act on complementary aspects of the pathophysiology of alcoholic liver disease. Haridra and Bhumi-Amalaki contribute antioxidant, anti-inflammatory and hepatocyte-protective actions relevant to ethanol-induced oxidative stress, NF-κB-mediated inflammation and evolving fibrosis[7,8,9,10,11,12,13,14]; Pippali, besides direct hepatoprotective and anti-fibrotic activity, functions as a Yoga-vahi that may enhance the bioavailability of the co-administered ingredients[15,16,17,18,23]; and Jiraka provides Deepana-Pachana support and additional antioxidant action against alcohol- and lipid-peroxidation-induced hepatic injury[19,20,21,22].

This convergence between the classical Ayurvedic description of each dravya as Yakrit-uttejaka, Kaphapittahara and Deepana-Pachana, and the modern pharmacological evidence of anti-oxidative, anti-inflammatory and anti-fibrotic activity in ethanol-induced hepatic injury models, provides the scientific and classical basis for evaluating this tetra-herbal combination in the management of alcoholic liver disease.

Conclusion

The tetra-herbal combination of Haridra, Bhumi-Amalaki, Pippali and Jiraka brings together classically validated hepatoprotective, digestive-carminative and Kaphapittahara actions with a converging body of modern pharmacological evidence demonstrating anti-oxidative, anti-inflammatory and anti-fibrotic effects specifically relevant to ethanol-induced liver injury. The complementary mechanisms of each ingredient — spanning mitochondrial protection, NF-κB and TGF-β/Smad pathway modulation, antioxidant enzyme restoration and bioavailability enhancement — together support the rational basis for this formulation's use in the clinical management of alcoholic liver disease (Madyaja Yakrit Vikara), and justify its further evaluation in controlled clinical trials.

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