



## RESEARCH ARTICLE

# HEPATOTOXICITY CONVERGING PERSPECTIVES OF AYURVEDA AND BIOMEDICINE

<sup>1</sup>Dr. Lavanya Lakshmi, K.J. M.D., Ph.D. <sup>2</sup>Dr. Alaekhya, P.L., M.D. and <sup>3</sup>Dr. Prasad, P.V.N.R. M.D., Ph.D.

<sup>1</sup>Professor, H.O.D., Dept. of Agada Tantra, Vidhi Vaidyaka, Dr. N.R.S. Government Ayurvedic College, Vijayawada, A.P. <sup>2</sup>Ayurvedic Consultant, Bangalore; <sup>3</sup>Ayurvedic Consultant, Vijayawada

### ARTICLE INFO

#### Article History:

Received 17<sup>th</sup> September, 2025

Received in revised form

18<sup>th</sup> October, 2025

Accepted 14<sup>th</sup> November, 2025

Published online 30<sup>th</sup> December, 2025

#### Keywords:

Biomedical, Genetic engineering,  
Humanized mice, Microchip, Sprague-  
Dawley rats.

#### \*Corresponding author:

Utpal S. Patel

### ABSTRACT

Hepatotoxicity refers to structural or functional injury to the liver arising from exposure to natural toxins, metabolic by-products, or infectious agents. From a biomedical standpoint, hepatotoxicity is driven by mechanisms such as oxidative stress, mitochondrial dysfunction, immune-mediated injury, and disruption of bile transport pathways and further identifies patterns of injury—hepatocellular, cholestatic, or mixed—based on enzyme profiles. Drugs, alcohol, industrial chemicals, and natural toxins are key contributors to toxic liver injury in clinical practice. Ayurveda describes a remarkably parallel conceptual framework. Hepatotoxicity aligns broadly with Yakrit-Vikara arising from Pitta, Rakta, and Ama vitiation, where toxic or improperly metabolized substances impair the liver's transformative and detoxifying capacities. The ingestion of Ahita (unwholesome foods), Dushi-varga dravyas (chronic low-grade toxins), contaminated food, and virulent biological agents correspond closely to the modern idea of hepatocellular insults. Classical texts further describe Yakrit Dushti arising from metabolic burden, mirroring modern concepts of lipotoxicity and Fatty Liver disease. Thus, both systems recognize the Liver as a central organ of metabolism and toxin clearance, and both attribute hepatic injury to overload, impaired transformation, and toxic accumulation—offering converging explanatory models and complementary strategies for prevention, early recognition, and management.

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Citation: Dr. Lavanya Lakshmi, K.J. M.D., Ph.D. Dr. Alaekhya, P.L., M.D. and Dr. Prasad, P.V.N.R. M.D., Ph.D. 2025. "Hepatotoxicity Converging Perspectives of Ayurveda & Biomedicine". *International Journal of Current Research*, 17, (12), 35526-35529.

## INTRODUCTION

The Liver is the organ of body's central metabolic and detoxification. It is also responsible biotransformation of Nutrients, Xenobiotics, Hormones, and Endogenous Metabolites. Additionally, the Liver regulates carbohydrate, lipid, and protein metabolism; synthesizes bile; maintains immunological surveillance; and detoxifies a wide range of chemical substances through enzymatic pathways. It also serves as Biological Interface that constantly negotiates between the external world and internal homeostasis. When the volume, potency, or nature of the toxic substances exceeds the liver's adaptive capacity, the interface becomes strained, resulting in hepatotoxicity. Because of its strategic position and its extensive enzymatic machinery, the liver is uniquely vulnerable to toxic injury. Though Modern Medicine and Ayurveda recognize this interface the concept is articulated differently.

**DEFINITION:** Hepatotoxicity refers to structural or functional impairment of the Liver caused by exposure to drugs, industrial or environmental chemicals, alcohol, contaminated herbal preparations, or toxic metabolic by-products. It denotes Injury to the Liver precipitated by external substances—pharmaceuticals, toxins, chemicals, alcohol—or harmful endogenous intermediates.

But, in Ayurveda, Hepato – Toxicity is interpreted through the Principles of Dosha, Agni, Dhatu, Srotas, and various forms of Visha (toxins). It is understood as impaired metabolism due to aggravation of Pitta and subsequent toxic accumulation. Both the Systems concur on the importance of Liver maintaining balance in filtering potentially harmful inputs. The burden of Drug-Induced Liver Injury (DILI) is increasing progressively across the globe with rising drug use, polypharmacy, and environmental toxicity. It has become a significant public health concern of considerable magnitude.

**AYURVEDIC PERSPECTIVE:** The Liver, though not explicitly named in early texts, is functionally discussed in the concepts of Yakrit and Raktavaha srotas. In Ayurveda, hepatotoxicity corresponds mainly to disturbances in Pitta and Rakta, dysfunction of Jatharagni and Dhatwagni, and accumulation of Ama. Exposure to exogenous toxins (Garavisha, Dushivisha) or internal metabolic derangements causes obstruction of srotas, leading to impaired Rasa-Rakta formation and ensuing Yakrit-Vikara. Ayurveda views Hepato – Toxicity as a resultant of Toxins with Ushna, Teekshna, Vyavayi, Sukshma, Aasu qualities rapidly spreading into Rasa-Rakta and getting lodged in the Yakrit. Although Ayurveda does not use the term Hepatotoxicity, the phenomenon is discussed under Liver-Related Dysfunctions as under.

1.	<b>Yakrit Vikara</b>	Diseases of the Liver
2.	<b>Pitta &amp; Rakta Dushti</b>	Imbalance and vitiation of Pitta dominating disorders of Blood
3.	<b>Ama Formation</b>	Metabolic toxins due to impaired Agni
4.	<b>Srotorodha</b>	Blockage of Raktavaha Srotas
5.	<b>Dushi Visha / Gara Visha</b>	Low-grade, cumulative toxins from food, drugs, chemicals

## ETIOLOGICAL CLASSIFICATION:

S.No.	Cause	Details
<b>XENOBIOTIC TOXINS</b>		
1.	<b>Drug Induced</b>	Antibiotics, Anti-Tubercular Drugs, NSAIDs, Anti-epileptics, Anti-neoplastics, Cardiovascular Drugs, Traditional Herbs, Supplements for Weight –Loss and Body - Building
2.	<b>Chemicals / Industrial Toxins</b>	Organic Solvents, Pesticides, Heavy Metals(Arsenic Cadmium,Mercury, Lead, Copper, Iron etc.) Vinyl Chloride, Carbon Tetrachloride, Benzene Derivatives.
3.	<b>Alcohol Induced</b>	---
<b>NATURAL TOXINS</b>		
1.	<b>Phyto-Toxins</b>	Pyrolizidine Alkaloids; Cyanogenic Glycosides; Gossypol, Safrrole, Kava Compounds;
2.	<b>Myco-Toxins (Fungal)</b>	Aflatoxin B1; Amatoxins
3.	<b>Marine / Biological Toxins</b>	Microcystins; Ciguatoxins, Tetrodotoxin
4.	<b>Animal Venoms</b>	Snake – Bite; Scorpion - Sting
<b>INFECTIVE</b>		
1.	<b>Viral</b>	Hepatitis A, B, C, D, E; EBV, CMV, Yellow Fever Virus
2.	<b>Bacterial</b>	Leptospirosis; Typhoid-Associated Hepatitis
3.	<b>Parasitic</b>	Malaria; Schistosomiasis; Amebic Liver Abscess
<b>ENDOGENOUS</b>		
1.	<b>Metabolic</b>	Non-Alcoholic Fatty Liver Disease
2.	<b>Genetic</b>	Wilson's disease; Hemo chromatosis; Alpha-1 antitrypsin deficiency
3.	<b>Endogenous Toxin Accumulation</b>	Ammonia; Bilirubin; Reactive oxygen species (ROS)
<b>NUTRITIONAL / DIETARY</b>		
1.	<b>Excess Nutrient Toxicity</b>	High Fructose Intake; Excess Saturated Fats
2.	<b>Deficiency or Starvation-Related</b>	Severe malnutrition; Crash dieting
3.	<b>Toxin-Contaminated Foods</b>	Moldy Grains (aflatoxin); Contaminated Well-Water (microcystins)
<b>MECHANISTIC</b>		
1.	<b>Intrinsic</b>	Dose-Dependent, Reproducible in Animal Models
2.	<b>Idiosyncratic</b>	Unpredictable; Often Immuno-Allergic or Metabolic Idiosyncrasy
<b>PATHOLOGICAL</b>		
1.	<b>Hepatocellular injury</b>	ALT Predominant Elevation
2.	<b>Cholestatic injury</b>	ALP Predominant Elevation
3.	<b>Mixed Pattern</b>	
<b>AYURVEDIC</b>		
1.	<b>Pitta–Rakta Dushti</b>	Hepatocellular Inflammation
2.	<b>Ama Janya Yakrit Dushti</b>	Metabolic/NAFLD-Type Injury
3.	<b>Visha/Ahita Ahara Sevana</b>	Toxin-Induced Modules (Herbs, Drugs, Food Toxins)
4.	<b>Dushivisha Concept</b>	Chronic Low-Grade Toxins (PA Alkaloids, Aflatoxins, Industrial Pollutants)
5.	<b>Pitta–Rakta Dushti</b>	Hepatocellular Inflammation

## CAUSATIVE FACTORS

S.No.	Ayurveda	Modern
1.	Drugs & Substance Induced	Drugs
2.	Dietary	Herbal & Dietary Supplements
3.	Life –Style Causes	Alcohol
4.	Visha, Dushivisha, Garavisha	Environmental & Industrial Toxins
5.	Agni Dushti and Ama	Metabolic & Endogenous
6.	Pitta Prakopa & Rakta Dushti	Infections
7.	Sroto Dushti	Immune Mediated Reactions
8.	Chronic Exposure to Environmental Pollutants	Nutritional Factors
9.	Manasika Bhava	Radiation & Chemo Therapy

## PATHO – PHYSIOLOGY

S.No.	Ayurveda	Modern
1.	Weak Jatharagni → Ama	Formation of Reactive Metabolites
2.	Ama Combined with Aggravated Pitta → Ama-Pitta	Excessive Oxidative Stress and Mitochondrial Injury
3.	Blockage of RaktavahaSrotas	Immune-Mediated Inflammation of Hepatocytes
4.	Disturbed Metabolism of Rasa and Rakta	Canalicular Dysfunction leading to Cholestasis
5.	Progressive impairment of Yakritfunction	Disruption of CYP450 Metabolic Pathways

## MECHANISM OF INJURY

S.No.	Ayurveda	Modern
1.	Pitta Aggravation	Direct Toxicity leading to Hepato – Cellular Inflammatory Changes
2.	RaktaDushti	Metabolic Injury, Congestion and Discolouration
3.	Vata Aggravation	Immune-triggered Hepatocyte damage, chronicity and fibrosis.
4.	Agnimandya + Ama formation	Metabolic impairment and toxin accumulation, a Cholestaticprocesses
5.	Dushivisha	Slow, sustained Hepatocyte damage and altered Cytochrome P450 activity

**CLINICAL PRESENTATION:** Clinically, hepatotoxicity presents along a spectrum—from asymptomatic elevation of liver enzymes to acute liver failure. Following the common features presented at OPDs

S.No.	Ayurveda	Modern
1.	<b>Panduta(Pallor)</b>	Fatigue, Anorexia, Nausea
2.	<b>Harita(Yellowish Discoloration)</b>	Right upper abdominal pain
3.	<b>Daha(Burning Sensation)</b>	Jaundice (Hyper Bilirubinemia)
4.	<b>Udarashula(Abdominal Pain)</b>	Dark Urine, Pale Stools
5.	<b>Agnimandya(Loss of Appetite)</b>	Elevated AST, ALT, ALP, GGT, Bilirubin
6.	<b>Mala-Mutra Varna Vikriti(Dark Urine, Pale Stools)</b>	In severe cases: Hepatic Encephalopathy, Coagulopathy, Acute Liver Failure
7.	Fatigue and Generalized weakness	---

## CLINICAL CORRELATION:

S.No.	Ayurveda	Modern
1.	Daha, Santapa	Hepatic inflammation / Hepatitis
2.	Aruchi, Aalasya	Loss of Appetite, Fatigue
3.	Pandu/Harita	Jaundice
4.	Chardi, Kanta Katu	Nausea, Vomiting
5.	Raktapitta Lakshana	Bleeding tendency
6.	Udara-Gurutva, Shotha	Hepatomegaly, Ascites
7.	Kampa, Angamarda	Systemic toxic effects

## DIAGNOSIS

S.No.	Ayurveda	Modern
1.	Nidana (Causative factors)	Detailed Drug/Toxin exposure history
2.	Dosha–Dushya involvement	Liver Function Tests (LFT)
3.	Srotodushti	Viral and Autoimmune Markers
4.	Status of Agni	Ultrasonography or CT Imaging
5.	Qualitative Evaluation of Ama through Clinical Signs	RUCAM Scoring System for Causality Assessment
6.	---	Liver Biopsy if etiology is uncertain

**MANAGEMENT:** Both systems try to restore the processing capacity of the liver, but they approach it from opposite ends. This is a restoration-first strategy, essential for chronic and post-injury healing. When combined—modern stabilization + Ayurvedic rejuvenation—the Liver regains both immediate and long-term resilience.

## OBJECTIVES

S.No.	Ayurveda	Modern
1.	Neutralizing Circulating Hepatic Toxins (Visha-hara dravyas)	Stopping the Toxin
2.	Clearing Micro-Channels (Srotoshodhana)	Stabilizing Biochemical Functions
3.	Rejuvenating Hepatocytes (Rasayana)	Neutralizing harmful metabolites
4.	Controlling Pitta–Rakta Vitiatio (crucial in hepatitis)	Controlling Inflammation
5.	Reducing Oxidative and Inflammatory damage (herbs like Guduchi, Amalaki)	Replacing failing Liver if needed
6.	Restoring Metabolic capacity of Yakrit (Pippali, Triphala).	---
7.	Offering Preventive strategies for Chronic Toxin exposure	---

## APPROACH: (Modern)

- Immediate Cessation of the offending substance
- N-Acetylcysteine in Paracetamol Toxicity
- Corticosteroids in Immune-Mediated DILI
- Supportive Therapy: Hydration, Glucose, Electrolyte Correction
- Ursodeoxycholic Acid for Cholestatic forms
- Liver Transplantation in Fulminant Failure

## AYURVEDIC

### ACUTE HEPATO TOXICITY

S.No.	Aspect	Details
1.	Therapeutic Goals	Immediately reduce toxin load; Protect Hepatocytes; Restore Agni & prevent Ama progression; Stabilize Pitta–Rakta
2.	Objectives	Neutralizing circulating hepatic toxins (Visha-hara dravyas); Clearing Micro-Channels (Srotoshodhana); Rejuvenating Hepatocytes (Rasayana); Controlling Pitta–Rakta vitiatio (crucial in hepatitis); Reducing Oxidative & Inflammatory Damage; Restoring Metabolic Capacity of Yakrit (Pippali, Triphala); Offering preventive strategies for chronic toxin exposure.
3.	Approach	<b>•Acute hepatotoxicity</b> - Visha-hara + Pitta-Shamana + Mrudu Virechana <b>•Chronic hepatotoxicity</b> - Amapachana →

		Detox → Yakrit-balya → Rasayana <b>•Lifestyle + Dietary</b> - Measures for long-term Hepatic Resilience
4.	<b>Nidana Parivarjana</b>	Avoiding the Etiological Factor / Source
5.	<b>Visha Nirharana</b>	Haridra, Guduchi, Sirisha, Yashtimadhu, Amalaki, Bhumyamalaki
6.	<b>Shamana</b>	Sirisha Agada; Vishatinduka Agada; Laghu Sutasekhara Ras; Praval Panchamruta (acidosis, burning, Pitta-Shamana); Arogyavardhini Vati (for cholestatic tendencies)
7.	<b>Supportive</b>	<b>Anulomana-</b> Trivrut Lehya, Eranda Taila to relieve Pitta congestion.  <b>Mridu Virechana:</b> Indicated in acute Pitta-toxic hepatitis to drain inflammatory metabolites.  <b>Sheetapana:</b> Coriander water, Draksha sheetapaka to reduce Pitta-Visha.
8.	<b>Others</b>	Heavy Shodhana, Strong Oils, Excess Ushna-Tikshna Drugs in Acute Stage.

### CHRONIC HEPATO TOXICITY

S.No.	Aspect	Details
1.	<b>Nidana Parivarjana</b>	Avoidance of causative foods, drugs, alcohol, toxins, and behaviors.
2.	<b>Deepana / Ama Pachana</b>	<ul style="list-style-type: none"> <li>• To clear Metabolic Toxins and Improve Digestion</li> <li>• Trikatu (low dose); Chitrakadi Vati; Hingu - Vachadi Churna; Pippali with Ghee</li> </ul>
3.	<b>Visha Hara</b>	<ul style="list-style-type: none"> <li>• Hepatoprotective, Anti-Inflammatory, and Detoxifying Actions</li> <li>• Bhumyamalaki – Best Hepato Regenerative</li> <li>• Kalamegha – Anti-Inflammatory, Detoxifying</li> <li>• Sharapunkha – Prevents Fibrosis</li> <li>• Punarnava – Decongests Liver, Reduces Edema</li> <li>• Triphala – Scavenges Toxins</li> <li>• Guduchi – Immunity-Regulating</li> <li>• Amalaki – Rasayana</li> <li>• Nimba – Detoxifier</li> </ul>
4.	<b>Panchakarma Measures</b>	<b>Virechana:</b> <ul style="list-style-type: none"> <li>• Best for Pitta-Visha, Fatty Liver, Chronic Inflammation.</li> <li>• Removes Un - Metabolized Toxins.</li> </ul> <b>Vasti:</b> <ul style="list-style-type: none"> <li>• Useful in Vata-Pitta disorders, Fibrosis-Prone Livers</li> <li>• Niruha Vasti with Dashamoola</li> <li>• Anuvasana Vasti with Eranda Taila</li> </ul> <b>Raktamokshana: (selected cases)</b> <ul style="list-style-type: none"> <li>• For Rakta-vitiated conditions (Hepatitis with Congestion).</li> <li>• Leech therapy beneficial for Hepatic congestion and inflammation.</li> </ul>
5.	<b>Shamana</b>	Punarnavadi Kwatha; Triphala Guggulu; Arogya Vardhini Vati; Nimbadi Kashaya; Bhumyamalaki Churna With Honey; Guduchi Sattva
6.	<b>Rasayana</b>	<ul style="list-style-type: none"> <li>• Prevent Fibrosis; Reduce Oxidative Injury; Improve Hepatocyte Regeneration; Restore Ojas and Rasa-Dhatu Quality</li> </ul> <b>Single Drugs:</b> Amalaki; Gokshura; Punarnava; Arjuna; Bhumyamalaki; Guduchi; Haritaki <b>Compound Formulations:</b> Pippali Rasayana; Chyavanaprasha; Drakshadi Rasayana; Amalaki Rasayana; Swarna

		Bhasma; Brahma Rasayana
7.	Pathya	Soft, Warm, Pitta-reducing, Detox-Oriented Diets, Nutrient-Rich, Balanced Diets to Reduce Metabolic Strain
8.	Apathya	Deep-Fried, Spicy, Sour Foods; Excess Salt, Red Meat; Adulterated Oils; Fermented Foods; Alcohol
9.	Vihara	<ul style="list-style-type: none"> <li>•Sleep, Stress, Environmental Exposure—Acts as a Constant Modulator of Hepatic Demand</li> <li>•Adequate Rest; Avoid Exposure to Solvents, Spray Paints, Pesticides; Regular Gentle Exercise; Stress Reduction to Reduces Pitta Aggravation</li> </ul>

## SUMMARY

Aspect	Ayurveda	Modern Correlate
Basis	Dosha, Agni, Dhatu, Srotas	Biochemistry, Pathology
Cause	Ama, Pitta–Rakta dushti, Dushivisha	Drugs, Toxins, Metabolites
Injury type	Ama-Pitta & Srotorodha-Based	Intrinsic & Idiosyncratic
Diagnosis	Dosha, Agni, Signs of Ama	LFTS, Imaging, RUCAM
Treatment	Dipana–Pachana, Pitta Shamana, Virechana	Antidotes, Supportive Care
Rejuvenation	Rasayana Therapy	Nutritional Rehab

## CONCLUSION

Though Ayurveda and Modern Medicine discuss Hepato – Toxicity in their respective frame works; they share certain common objectives and therapeutic goals especially with regard to toxic accumulation, metabolic stress, inflammation, and impaired detoxification. While Modern Medicine excels in emergency management and diagnostics, Ayurveda provides long-term metabolic correction, detoxification, and emphasizes Doshic balance, long-term rejuvenation, and tissue resilience. An integrative approach—combining evidence-based Ayurvedic hepatoprotective herbs and Rasayana with modern diagnostic and emergency protocols—may offer optimal outcomes and comprehensive benefits in preventing and managing hepatotoxicity.

## REFERENCES

1. Agnivesha. Charaka samhita (with Ayurveda Dipika commentary by Chakrapanidatta). Edited by Yadavji Trikamji. Reprint ed. Varanasi: ChaukhambaSurbharatiPrakashan; 2014. Chikitsa Sthana 16/17–28 (Yakrit-pleeha disorders), Sutra Sthana 28 (dūṣī-viṣa), Vimanasthana 2 (āma).
2. Sushruta. Sushrutasamhita (NibandhaSangraha commentary by Dalhana). Edited by Yadavji Trikamji. Reprint ed. Varanasi: ChaukhambaOrientalia; 2012. Uttara Tantra 58 (yakrit-vikara), KalpaSthana (toxicology principles).
3. Vagbhata. Ashtangahridaya (Sarvangasundari commentary of Arunadatta). Edited by Kunte AM, Navare KRS. 9th ed. Varanasi: ChaukhambaOrientalia; 2015. Sutra Sthana 13 (āma), NidanaSthana 12 (pitta vyadhi), Chikitsa Sthana 5 (agni and metabolic impairment).
4. Vagbhata. Ashtangasangraha (with Indu commentary). Edited by Shastri HS. Reprint ed. Varanasi: Chaukhamba Sanskrit Series; 2012. Sutra Sthana 20 (āma), Uttara Tantra 40–41 (yakrit-pleeha disorders).
5. Sharma PV. Dravyagunavijnana. Vol. 2. 2nd ed. Varanasi: ChaukhambaBharati Academy; 2013. p. 480–510. (Hepatoprotective herbs such as Bhūmi-amalaki, Kalmegha, Kutki, Daruharidra).
6. Dash B, Sharma RK. Charaka samhita: Text with English translation & critical exposition. Vol. 3. Varanasi: Chowkhamba Sanskrit Series Office; 2012. p. 245–280. (Yakrit-vikriti interpretations).
7. Murthy KRS. Susrutasamhita, English translation. Vol. 2. Varanasi: ChaukhambaOrientalia; 2013. p. 520–550. (Visha chikitsa and liver implications).
8. Srikantha Murthy KR. Ashtangahridayam (English translation). Vol. 1–3. Varanasi: ChaukhambaKrishnadas Academy; 2019. (Concepts of pitta-raktadushti, āma, visha).
9. Tripathi B. Madhavanidana (RogaVinischaya). With Madhukosha commentary. 34th ed. Varanasi: Chaukhamba Sanskrit Sansthan; 2015. Chapter 33 (kamala), relevant in modern hepatotoxic analogues.
10. Pandey GS. Bhavaprakashanighantu. Reprint ed. Varanasi: ChaukhambaBharati Academy; 2004. p. 70–150. (Herbs with yakrit-uttejaka and viṣa-hara properties).
11. Tewari PV. Ayurveda varsha. 2nd ed. Varanasi: ChaukhambaVisvabharati; 2001. (Insights on yakrit-pleeha disorders and metabolic toxins).
12. Singh RH. Ayurvedic hepatology. 1st ed. Varanasi: Chowkhamba Sanskrit Series Office; 2011. (Dedicated monograph correlating liver disease & dūṣī-viṣa concepts).
13. Sharma H, Chandola HM. Herbal and herbo-mineral hepatoprotectives in Ayurveda. Varanasi: Chaukhamba Publishers; 2010. (Scientific perspectives).
14. Rege NN, Thatte UM, Dahanukar SA. Adaptogenic properties of six rasayana herbs—Ayurvedic hepatoprotective overview. Phytother Res. 1999;13(4):275–91.
15. Patwardhan B, Vaidya ADB. Natural products and Ayurveda in hepatotoxicity. J Ethnopharmacol. 2008;115(2):232–40.

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