

Review Article

Bridging Ayurveda and biochemistry: a scoping review of Agni and metabolism

Kirti B. Gaikwad*, Meera K. Bhojani

Department of Kriyasharira, All India Institute of Ayurveda, Sarita Vihar, New Delhi, India

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***Correspondence:**

Dr. Kirti B. Gaikwad,

E-mail: dr.kirti.aiia399@gmail.com

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ABSTRACT

Agni is described in Ayurveda as the fundamental principle governing digestion, metabolism, tissue transformation, and vitality. Thirteen types of Agni: Jatharagni, seven Dhatvagni, and five Bhutagni are considered essential for physiological balance. However, their mechanisms remain largely conceptual, with limited systematic correlation to contemporary metabolic science, restricting broader scientific interpretation. A scoping review was conducted following Arksey and O'Malley framework and PRISMA-ScR guidelines. A structured search was performed across PubMed, Web of Science, Google Scholar, DHARA, Ayush Research Portal, and ARD. Studies published between January 2010 and December 2024 were screened. Twenty-four eligible research studies were included for final analysis. Data extraction was performed using JBI SUMARI tool. The included studies demonstrated functional parallels between Jatharagni and digestive enzyme activity, gastric secretions, and enteric regulation. Dhatvagni showed correlation with tissue-level metabolic processes, endocrine modulation, and cellular respiration parameters including thyroid function, lipid profile, glucose metabolism, and mitochondrial activity. Bhutagni was interpreted in relation to hepatic biotransformation, cytochrome P450 pathways, detoxification processes, and immune-metabolic responses. However, objective quantification tools for Agni assessment remain insufficient. The review identifies emerging integrative interpretations between Ayurvedic Agni and modern metabolic science. While conceptual correlations are evident, further structured clinical and molecular research is required for measurable validation.

Keywords: Agni, Jatharagni, Dhatvagni, Bhutagni, Digestion, Metabolism, Detoxification

INTRODUCTION

Ayurveda describes Agni as the fundamental principle governing digestion, metabolism, and biological transformation. Although commonly translated as “fire,” Agni represents a broader life sustaining mechanism; in the Brahmasutra it signifies life itself, and Shabdakalpadruma enumerate multiple synonyms reflecting its multidimensional nature.¹ Classical texts further describe Agni as the vital force responsible for continuous physiological transformation within the body.^{2,3}

Thirteen types of Agni are described in classical literature.⁴ Among them, Jatharagni governs primary

digestion; Dhatvagni facilitates tissue-level metabolic transformation; and Bhutagni is associated with elemental modification of substances.⁵ While these descriptions are conceptually elaborate, structured scientific correlation with measurable biochemical parameters remains limited.

Modern biomedical science explains digestion and metabolism through enzymatic activity, endocrine regulation, cellular respiration, and hepatic detoxification mechanisms.⁶ Established methodological frameworks for scoping reviews are provided by the Joanna Briggs Institute (JBI) and PRISMA-ScR guidelines. However, no dedicated scoping review synthesizing correlations between Agni subtypes and contemporary metabolic pathways was identified. Therefore, this review aims to map and summarize existing research exploring

integrative perspectives between classical Agni concepts and modern biochemical processes.

This scoping review was undertaken with the following objectives:

Knowledge gap analysis

To analyze classical descriptions of Jatharagni, Dhatvagni, and Bhutagni and compare them with contemporary biochemical and physiological concepts.

To identify gaps in molecular-level understanding of Agni within current scientific literature.

Therapeutic applications

To explore correlations between Agni-modulating interventions (dietary regulation, herbal formulations, and Panchakarma) and measurable biochemical or physiological outcomes related to digestion and metabolism.

To assess existing clinical evidence supporting Agni-centered therapies in specific disorders and identify areas for future clinical trials integrating modern methodologies.

Clinical diagnostic assessment

To examine whether modern diagnostic parameters (e. g., liver function tests, lipid profile, thyroid profile, blood glucose levels, BMI) can serve as measurable indicators reflecting functional status of Agni.

To explore the feasibility of integrating traditional Ayurvedic assessment with contemporary diagnostic tools.

Research perspective

To propose methodological approaches for investigating Agni using modern experimental, clinical, and systems biology tools.

To outline future research directions aimed at elucidating molecular mechanisms underlying Agni-related metabolic transformation.

LITERATURE REVIEW

Study design

This scoping review protocol developed according to the framework proposed by Arksey and O'Malley and it complies with JBI recommendations for elaborating scoping review used.^{7,8} This scoping review followed the PRISMA-ScR guidelines (Preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews).⁹ The search strategy includes a

combination of keywords and MeSH terms related to *Ayurveda*, *Agni*, digestion, metabolism, and cellular processes.

Review questions

The review was guided by the following review questions: (1) How are Jatharagni, Dhatvagni, and Bhutagni described in classical Ayurvedic literature? (2) What anatomical and functional attributes are assigned to each subtype? (3) Where do conceptual boundaries of Agni overlap or diverge from modern biochemical and physiological frameworks? (4) What measurable biochemical processes have been correlated with Agni in published studies? (5) What molecular mechanisms have been proposed to explain effects of Agni-modulating therapies? (6) What therapeutic interventions are designed to regulate Agni? (7) What clinical evidence supports these interventions? (8) Can modern diagnostic tools assist in assessing functional status of Agni? (9) What are the key research gaps requiring further investigation?

Search strategy

A structured three-step search strategy was employed. Initial search terms were identified and aligned with relevant MeSH terms. Using PubMed as the primary database, the search was extended to Web of Science, Google Scholar, AYUSH research portal (ARP), DHARA, AYUSHDHARA, and the AYUSH Database for Research (ARD).

Keywords included: "Ayurveda," "Agni," "Jatharagni," "Dhatvagni," "Bhutagni," "digestion," "metabolism," "cellular respiration," "enzymes," "hormones," "enteric nervous system," "detoxification," and "immune function."

Boolean operators "AND" and "OR" were applied appropriately.

The following three concept clusters were included: (1) Ayurvedic Concept of Agni (2) Digestion and Cellular Metabolism (3) Pre-clinical and clinical studies highlighting therapeutic intervention and procedures for modulating Agni.

Inclusion criteria

Articles published in peer-reviewed journals from January 2010 to December 2024 that incorporated in integrating approach and minute understanding of concept of Agni, digestion, metabolism at cellular level, detoxification and related concepts of metabolic transformation within the Ayurvedic framework were included. The rationale for this date range is to ensure that the most relevant research findings should be captured. Studies published in any language with available English translations were included.

Exclusion criteria

Studies were excluded if they discuss only Ayurveda or modern biochemical, physiological processes related to digestion, metabolism, cellular function, or detoxification; reviews (mini, narrative), editorials and grey literatures. Studies that focus exclusively on other Ayurvedic concepts (e.g., Doshas, Prakriti) without a clear connection to Agni. Studies published in other than English languages without available English translations. Studies that doesn't meet inclusion criteria, such as abstracts without sufficient detail and unavailable full texts, duplicate records. Studies that are solely discuss philosophical or theoretical aspects of Agni without any attempt to co-relate it to measurable biochemical or physiological parameters.

Screening and selection process

This scoping review implemented a structured screening and selection process in accordance with the PRISMA-ScR guidelines. A comprehensive electronic search was conducted across selected databases using predefined keywords and Boolean operators. Filters for full-text availability, language (English), and publication period (January 2010-December 2024) were applied prior to screening.

Subsequently, titles and abstracts were screened against predefined inclusion criteria, followed by full-text assessment of eligible studies.

Phase 1: Title and abstract screening

After completion of the search, all retrieved articles were collected and organized using Microsoft excel. Any duplicate citations were removed at this stage with conditional formatting. The titles and abstracts were retrieved from the database searches and subjected to screening using Microsoft excel with the predetermined inclusion criteria for the review. Document screening decisions were made (include/exclude/unsure) for each article and discrepancy were resolved through discussion and consensus.

Phase 2: Full-text review

After retrieval of all studies that passed the title and abstract screening, Eligibility assessment was done on the basis of pre-defined inclusion and exclusion criteria. Detailed Assessment of study methodology, assessment criteria, results, and discussion was done. Document passed eligibility assessment for each full-text article were included and others were excluded with the reasons for exclusion. Discrepancies were resolved through discussion and consensus.

Sources that were found to be potentially relevant and fulfill the inclusion criteria undergone comprehensive review, citation details were integrated into the JBI

System for the Unified management, assessment, and review of information (SUMARI) for full-text assessment.

PRISMA flow diagram

A PRISMA-ScR flow diagram was used to visually represent the screening and selection process, including the number of articles identified, screened, excluded, and included at each stage.

Data extraction

Data extraction was done from articles selected in the scoping review using the JBI SUMARI data extraction tool. This scoping review aimed at yielding a descriptive summary of all the results. The components listed in below 1 will be considered while extracting the data- Title, authors, year of publication, country, study design, study objectives, study duration, population (Diagnostic details), sample size, age (in years), sex (M/F), AYUSH intervention, control, outcome measures insignificant safety (AE/SAE/ADR), drop outs, citation, significant values, insignificant values and additional remarks for type of Agni and its modern correlation.

A data extraction was performed with 22 selected studies. The insights gained were used to modify the draft data extraction tool as necessary. Any refinements were documented in the final scoping review. Authors of articles were contacted to resolve data discrepancies or obtain supplementary information.

COLLATING, SUMMARIZING, AND REPORTING THE RESULTS

The data extracted from the included studies was compiled into a database in a descriptive format and the results were charted to provide an organized overview of the findings from the included studies. This involved a summary of the key findings, methodological approaches, and study characteristics. A thorough analysis and discussion of the findings was conducted, specifically addressing each of the predefined questions of the scoping review. A conceptual mapping framework visualized Agni and modern science relationships. Results were reported using a PRISMA-ScR flow diagram, descriptive summaries, and thematic presentation. The discussion addressed implications, gaps, limitations, and clinical review questions whereas reporting ensures transparency and reproducibility.

OBSERVATIONS

An electronic search across selected databases identified 230 records. An additional 11 records were identified through institutional repositories and manual searches, resulting in a total of 241 records. After removal of duplicate citations (n=39), 202 records were screened based on title and abstract.

During title and abstract screening, 173 records were excluded for not meeting the predefined inclusion criteria. Twenty-nine full-text articles were assessed for eligibility. Of these, seven studies were excluded due to lack of

measurable biochemical correlation, narrative/conceptual design, or absence of direct relevance to digestive and metabolic pathways. Finally, 22 studies were included in the scoping review (Figure 1).

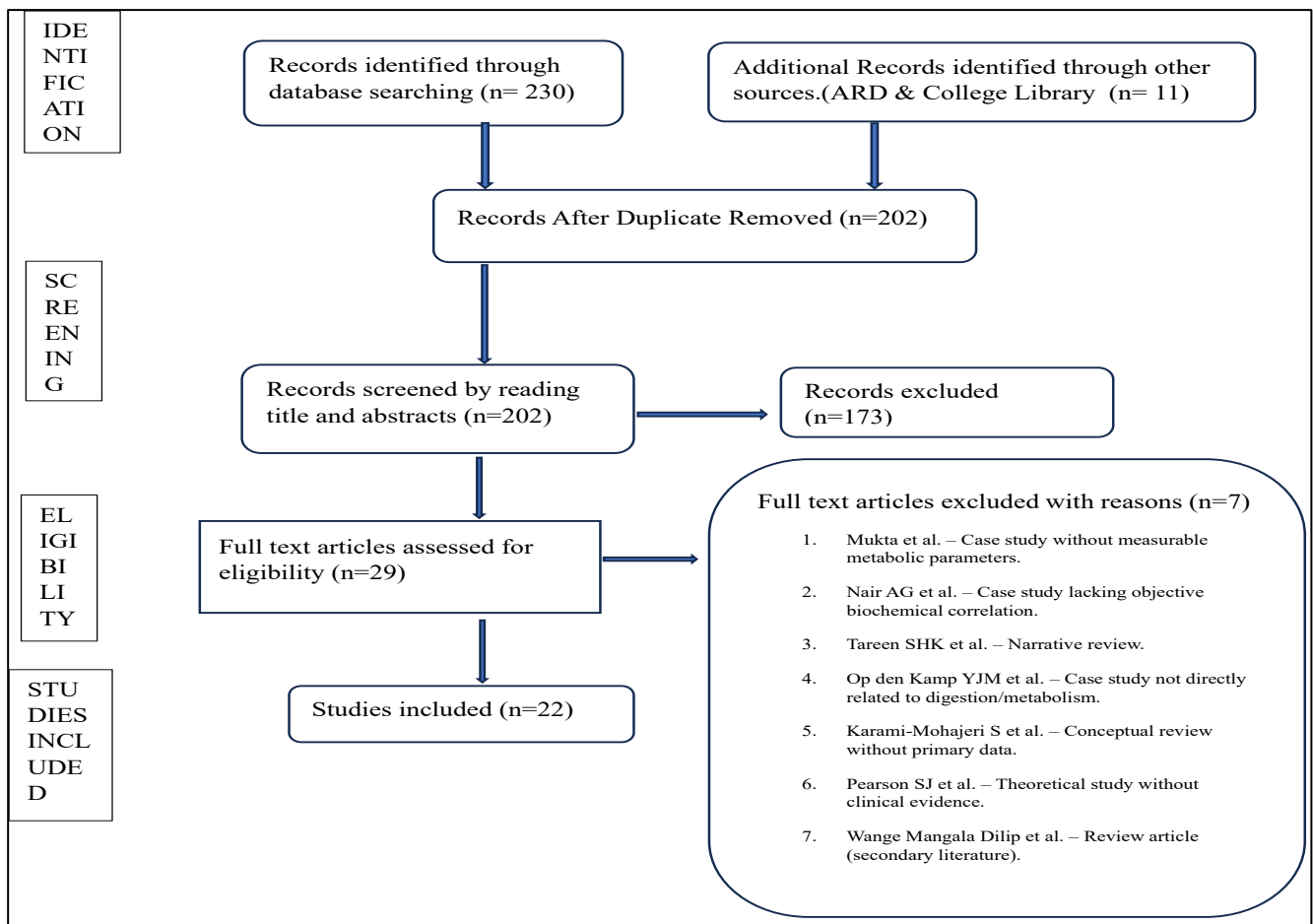


Figure 1: Scoping review process adapted from the PRISMA statement.

*The diagram summarizes the identification, screening, eligibility, and inclusion phases of the scoping review.

Characteristics of included studies

Among the 22 studies included in the scoping review, one was an open-label clinical trial and one was a randomized controlled trial. Five studies were clinical interventional studies, while the remaining fifteen were case-based clinical reports. The included studies were subsequently categorized based on their functional alignment with classical Agni subtypes, namely Jatharagni, Dhatvagni, and Bhutagni, to facilitate thematic synthesis and interpretative analysis (Table 2).

Quality appraisal of included studies

Quality appraisal of the included studies was performed using the JBI critical appraisal checklists appropriate to the study design. Randomized controlled trials, quasi-experimental studies, observational studies, and conceptual/laboratory-based studies were assessed separately. Appraisal findings are presented in Tables 3-6.

Outcomes assessed

Outcomes assessed are summarised in Table 7.

STUDIES RELATED TO JATHARAGNI

Seven studies primarily addressed digestive disorders such as Grahani, Agnimandya, and Ajirna. Interventions included herbal formulations, dietary modifications, and Panchakarma procedures. Outcome measures predominantly consisted of symptomatic improvement, appetite regulation, bowel pattern normalization, and limited biochemical parameters. These findings suggest functional correspondence with digestive transformation processes attributed to Jatharagni.

STUDIES RELATED TO DHATVAGNI

Nine studies focused on metabolic and endocrine-related conditions, including Sthaulya, Artavakshaya,

inflammatory disorders, and broader metabolic dysfunction. Reported outcome measures included body weight, BMI, lipid profile and selected hormonal parameters. These findings indicate tissue-level metabolic modulation, functionally aligned with classical descriptions of Dhatvagni.

STUDIES RELATED TO BHUTAGNI

Six studies, including 1 multi-omics clinical trial, evaluated biochemical and cellular metabolic processes

such as erythrocyte bioenergetics and systemic metabolic regulation. Measured parameters included ATP production and metabolic pathway markers.

These findings demonstrate indirect parallels with elemental and cellular transformation processes described under Bhutagni. Across included studies, clinical improvement was reported following Agni-modulating interventions. However, standardized assessment tools for Agni not identified, and biochemical correlations inconsistently reported across studies.

Table 1: Electronic search strategy and stepwise application of filters used for study selection.

Step	Search strategy	Yielded articles
1	(((Ayurveda) AND (Agni)) AND (Jatharagni)) AND (Dhatvagni)) AND (Bhutagni)) AND (Digestion OR Metabolism OR Cellular metabolism OR Enzymes OR Hormones OR Cellular respiration)	241
2	Filters: text availability-full text	202
3	Filters: Language-English	198
4	Filters: published between January 2010 and December 2024	173
5	Title/abstract screening and eligibility assessment (Clinical studies meeting inclusion criteria)	22

Table 2: General characteristics of included studies.

Author(s)	Short title of study	Study design	Thematic link to Agni
D'Alessandro et al ³¹	Functional and multi-omics signatures of mitapivat efficacy in SCD	Open-label phase I/II trial	Cellular metabolism-Bhutagni parallel
Shruthi ¹¹	Ayurvedic approach in Grahani (IBS)	Case study	Jatharagni dysfunction
Jadhav ¹²	Mahasankh vati and dadimashtak in ajirna	Case study	Digestive metabolism
Joshi et al ¹⁰	Lifestyle modification and shatapushpadya churna in agnimandya	RCT	Digestive enzyme regulation
Nair et al ¹³	Vataja grahani with takra basti	Case study	Gastrointestinal transformation
Rajani et al ¹⁵	Effect of therapy on lakshanas of grahani	Clinical study	Functional digestion
Pattonder et al ¹⁶	Sarpagandha and maricha yoga in hypertension	Clinical study	Metabolic regulation
Harishma Asok et al ¹⁷	Goghrita in metabolic disorders	Clinical study	Lipid metabolism-Dhatvagni
Yadav et al ¹⁴	Virechana therapy and gut microbiota	Clinical study	Digestive-metabolic interface
Bansode ¹⁸	Dadimadi ghrita matrabasti in oligomenorrhea	Clinical study	Endocrine metabolism
Mohite ¹⁹	Dadimadi ghrita in artavakshaya	Case study	Hormonal regulation
Chavan ²⁰	Phalasarpi in artavakshaya	Case study	Endocrine metabolism
Londhe ²¹	Sthaulya with lekhana basti	Case study	Obesity metabolism-Dhatvagni
Waghmare ²²	Sthaulya management	Case study	Lipid metabolism
Walke ²³	Amavata management	Case study	Inflammatory metabolism
Patil ²⁴	Vicharchika management	Case study	Tissue metabolic response
Patil ²⁵	Sandhigata vata management	Case study	Degenerative metabolism
Kamble ²⁶	Anidra management	Case study	Neuro-metabolic regulation
Mahajan ²⁷	Shvitra management	Case study	Tissue-level metabolic alteration
Raut ²⁸	Katigraha with kati basti	Case study	Musculoskeletal metabolism
Raut ²⁹	Katigata vata management	Case study	Tissue metabolism
Walake ³⁰	Gridhrasi management	Case study	Metabolic tissue dysfunction

Table 3: JBI critical appraisal-randomized controlled trials.

Checklist item	Joshi et al ¹⁰	D'Alessandro et al ³¹
Was true randomization used?	Yes	Yes
Was allocation to treatment groups concealed?	No	Yes
Were treatment groups similar at baseline?	Yes	Yes
Were participants blind to treatment assignment?	No	Yes
Were treatment provider's blind?	No	Yes
Were outcome assessor's blind?	No	Yes
Were groups treated identically other than intervention?	Yes	Yes
Was follow-up complete and balanced?	Yes	Yes
Were participants analyzed as randomized?	Yes	Yes
Were outcomes measured consistently and reliably?	Yes	Yes
Was appropriate statistical analysis used?	Yes	Yes
Was the trial design appropriate?	Yes	Yes

Table 4: JBI critical appraisal-quasi-experimental studies.

JBI checklist item	Pattonder et al ¹⁶	Harishma Asok et al ¹⁷	Rajani et al ¹⁵	Yadav et al ¹⁴	Bansode ¹⁸
Is it clear what is the cause and what is the effect?	Yes	Yes	Yes	Yes	Yes
Were participants similar at baseline?	No information	Yes	Yes	Yes	Yes
Were there multiple measurements of outcomes pre and post the intervention?	Yes	Yes	Yes	Yes	Yes
Was there a control group?	No	No	No	No	No
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes
Was follow-up complete and outcome data available for all participants?	Yes	Yes	Yes	Yes	Yes
Were outcomes measured using valid and reliable tools?	Yes	Yes	Yes	Yes	Yes
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes

Table 5: Critical appraisal table-conceptual and laboratory-based study.

Study	Type	Summary	Ayurveda-modern integration	Relevance to Agni	Use of scientific evidence	Clinical translation potential	Appraisal
D'Alessandro et al ³¹	Laboratory/Multiomics	Demonstrated modulation of glycolysis, ATP production, and the RBC metabolic stability	High	Indirect (Bhutagni)	Strong experimental evidence	High	High scientific quality
Yadav et al ¹⁴	Clinical-Microbiota	Impact of Virechana on gut microbiota	Moderate-High	Direct (Jatharagni)	Moderate (clinical with lab basis)	High	Good translational value
Harishma Asok et al ¹⁷	Clinical-metabolic	Role of Goghrita in the lipid metabolism	Moderate	Direct (Dhatvagni)	Moderate	High	Moderate scientific strength
Rajani et al ¹⁵	Clinical-conceptual	Therapeutic correction linked with metabolic outcomes	Moderate	Direct	Limited laboratory correlation	Moderate	Moderate
NCBI CYP450 pathway	Laboratory	Hepatic detoxification and metabolic enzyme systems	Indirect	Indirect (Bhutagni)	Strong biochemical basis	Moderate	High mechanistic depth

Table 6: Critical appraisal table-observational and case studies.

Name of authors	Inclusion criteria	Setting described	Exposure reliable	Standard criteria used	Confounders identified	Confounders managed	Outcomes reliable	Q8: statistics appropriate
Shruthi ¹¹	Yes	Yes	Yes	Yes	No	No	Yes	NA
Jadhav ¹²	Yes	Yes	Yes	Yes	No	No	Yes	NA
Nair ¹³	Yes	Yes	Yes	Yes	No	No	Yes	NA
Mohite ¹⁹	Yes	Yes	Yes	Yes	No	No	Yes	NA
Chavan ²⁰	Yes	Yes	Yes	Yes	No	No	Yes	NA
Londhe ²¹	Yes	Yes	Yes	Yes	No	No	Yes	NA
Waghmare ²²	Yes	Yes	Yes	Yes	No	No	Yes	NA
Walke ²³	Yes	Yes	Yes	Yes	No	No	Yes	NA
Patil ²⁴	Yes	Yes	Yes	Yes	No	No	Yes	NA
Patil ²⁵	Yes	Yes	Yes	Yes	No	No	Yes	NA
Kamble ²⁶	Yes	Yes	Yes	Yes	No	No	Yes	NA
Mahajan ²⁷	Yes	Yes	Yes	Yes	No	No	Yes	NA
Raut ²⁸	Yes	Yes	Yes	Yes	No	No	Yes	NA
Raut ²⁹	Yes	Yes	Yes	Yes	No	No	Yes	NA
Walake ³⁰	Yes	Yes	Yes	Yes	No	No	Yes	NA

Table 7: Outcomes assessed in selected studies.

Study author	Design	Sample size	Intervention	Outcomes assessed	Tool/ method	Follow-up	Agni correlated (rationale)	Modern mapping	Result summary
D'Alessandro et al ³¹	Open-label phase I/II	15	Mitapivat	ATP levels, 2,3-DPG, RBC sickling	Multi-omics, sickling assay	6-24 months	Bhutagni-cellular bioenergetics	↑ATP=cellular metabolic fire	Sustained metabolic improvement
Joshi SS et al ¹⁰	RCT	60	Lifestyle + Shatapushpadya	Appetite, digestion score	Symptom scale	4 weeks	Jatharagni	Improved digestive regulation	Significant Agnimandya relief
Pattonder et al ¹⁶	Clinical	30	Herbal therapy	BP, metabolic symptoms	Clinical exam	4 weeks	Dhatvagni	Endocrine-metabolic modulation	Clinical stabilization
Harishma Asok et al ¹⁷	Clinical	30	Goghrita	Lipid profile	Lab investigations	6 weeks	Medo-Dhatvagni	↓LDL, improved lipid metabolism	Metabolic correction
Rajani et al ¹⁵	Clinical	30	Ayurvedic therapy	Symptom improvement	Clinical scoring	4 weeks	Jatharagni	Digestive symptom relief	Clinical improvement observed

Continued.

Study author	Design	Sample size	Intervention	Outcomes assessed	Tool/ method	Follow-up	Agni correlated (rationale)	Modern mapping	Result summary
Yadav et al	Clinical	25	Virechana	Gut microbiota change	Microbiota analysis	15 days	Jatharagni	Digestive-microbiome modulation	Favorable microbial shift
Shruthi¹¹	Case	1	Grahani therapy	Stool frequency, appetite	Bowel diary	2 weeks	Jatharagni	Normalized bowel pattern	IBS symptom reduction
Jadhav¹²	Case	1	Mahasankh Vati	Appetite, bloating	Symptom scale	15 days	Jatharagni	Enhanced digestion	Complete relief
Nair¹³	Case	1	Takra Basti	Stool consistency	Clinical observation	2 weeks	Jatharagni	Restored gut function	Marked improvement
Bansode¹⁸	Clinical	30	Dadimadi Ghrita	Menstrual cycle, ET	USG, logs	2 cycles	Rasa-Rakta Dhatvagni	Improved endometrial growth	Cycle regularization
Chavan²⁰	Case	1	Phalasarpi	Menstrual parameters	Clinical record	2 weeks	Artava Dhatvagni	Hormonal balance	Symptom relief
Londhe²¹	Case	1	Lekhana Basti	Weight, BMI	Weight log	4 weeks	Medo-Dhatvagni	↓Adiposity	Gradual weight reduction
Walke²³	Case	1	Simhanada Guggulu	Joint pain	VAS	30 days	Asthi Dhatvagni	Reduced inflammation	Mobility improved
Walake	Case	1	Dashmoola + Basti	Pain, stiffness	VAS, ROM	15 days	Asthi/Majja Dhatvagni	Tissue metabolism	Pain reduction
Narnavare	Case	1	Ksheera Basti	Sciatica pain	VAS	8 days	Majja Dhatvagni	Neural function support	Symptom relief
Akhade	Case	1	Baladi Basti	Swelling, ROM	Joint exam	8 days	Asthi Dhatvagni	Joint tissue metabolism	Functional recovery
Nikam	Case	1	Panchatikta Basti	Joint mobility	Gait observation	8 days	Dhatvagni	Structural correction	Stabilization achieved
Kamble²⁶	Case	1	Ayurvedic therapy	Musculoskeletal pain	Clinical exam	2 weeks	Asthi Dhatvagni	Tissue metabolism	Clinical improvement
Mahajan²⁷	Case	1	Basti therapy	Pain score	VAS	2 weeks	Dhatvagni	Dhatu-level correction	Relief achieved
Raut²⁸	Case	1	Ayurvedic therapy	ROM	Joint scoring	2 weeks	Asthi Dhatvagni	Improved mobility	Functional benefit
Raut²⁹	Case	1	Basti + Kwatha	Back pain	VAS	8 days	Dhatvagni	Musculoskeletal metabolism	Rapid pain relief
Walake³⁰ (second clinical mapping if distinct case)	Case	1	Panchatikta Basti	Degenerative symptoms	Clinical observation	2 weeks	Dhatvagni	Degenerative tissue correction	Symptom reduction

DISCUSSION

The present scoping review synthesized evidence from 22 included studies to explore the functional correspondence between the classical concept of Agni and measurable physiological and biochemical processes. The included literature demonstrates thematic clustering around digestive regulation, tissue-level metabolism, and cellular bioenergetics.

Digestive regulation and functional correlates of Jatharagni

Joshi et al demonstrated significant improvement in Agnimandya following lifestyle modification and herbal intervention, indicating restoration of primary digestive transformation.¹⁰ Similarly, Shruthi MN and Jadhav PS reported symptomatic correction in Grahani and Ajirna, with improvements in appetite as well as bowel regulation.^{11,12}

Nair et al observed marked clinical improvement in Vataja Grahani following Takra Basti, suggesting functional normalization of gut activity.¹³ Yadav et al further reported modulation of gut microbiota following Virechana, indicating a potential digestive–metabolic interface.¹⁴ Rajani et al demonstrated symptomatic relief linked to improved digestive function.¹⁵

Collectively, these studies suggest that clinical correction of indigestion correlates with physiological processes attributed to Jatharagni.

However, most relied on symptom-based scoring rather than enzymatic assays or gastric secretory markers.

Tissue-level metabolic modulation and the conceptual scope of Dhatvagni

Pattonder et al reported metabolic stabilization in hypertension following Ayurvedic therapy, suggesting systemic tissue-level modulation.¹⁶ Harishma Asok et al observed improvements in lipid profile following Goghrita administration, indirectly reflecting Medo-Dhatvagni correction.¹⁷

Bansode and Chavan reported improvements in menstrual regularity and endometrial parameters, suggesting modulation of Rasa-Rakta-Artava Dhatvagni.^{18,19}

Musculoskeletal case studies by Walke, Patil, Patil, Raut and Walake demonstrated improvements in inflammatory and degenerative joint conditions, indirectly supporting restoration of tissue metabolism.²⁰⁻²⁴

These findings indicate tissue-level metabolic influence aligned with classical descriptions of Dhatvagni. However, objective hormonal profiling and mechanistic validation were inconsistently reported.

Cellular bioenergetics and biochemical transformation: expanding the framework of Bhutagni

D'Alessandro et al demonstrated increased ATP production, reduced 2,3-DPG levels, and improved erythrocyte stability in a multi-omics trial.²⁵ Although not framed in Ayurvedic terminology, these cellular bioenergetic improvements conceptually parallel transformation processes described under Bhutagni.

Biochemical pathways such as cytochrome P450-mediated metabolism further provide a molecular framework for elemental transformation and detoxification processes traditionally attributed to Bhutagni.

However, direct empirical correlation between classical elemental metabolism and modern molecular pathways remains theoretical.

Methodological trends and quality appraisal across included studies

Among the 22 studies, only one randomized controlled trial and one open-label experimental study demonstrated structured methodology. The majority were case-based reports with limited confounder control. Standardized assessment tools for quantifying Agni were not identified.

Biochemical markers were inconsistently incorporated, and mechanistic explanations were largely inferential rather than experimentally validated.

Conceptual gaps and directions for translational research

Future research should prioritize the development of validated and reproducible assessment tools for Agni, enabling objective clinical stratification beyond symptom-based evaluation. Integration of endocrine profiling, enzymatic assays, metabolomic analysis, and inflammatory biomarkers would strengthen biochemical correlation with classical functional descriptions. Additionally, well-designed controlled in vivo and in vitro experimental studies are required to elucidate mechanistic pathways underlying Agni-modulating interventions. Incorporation of systems biology approaches and computational modeling may further help in mapping tissue-level metabolic transformations described under Dhatvagni and Bhutagni. Such multidisciplinary integration is essential to advance the measurable translation of classical Agni principles within contemporary biomedical research frameworks.

Limitations

This review is limited by the absence of validated tools for quantifying Agni, which restricts direct correlation with biochemical markers. The majority of included studies were case-based with limited control of

confounders and inconsistent laboratory integration. As a scoping review, methodological synthesis was descriptive rather than quantitative. Additionally, exclusion of grey literature and restricted database access may have limited comprehensive evidence capture.

CONCLUSION

This scoping review mapped available evidence exploring correlations between the classical concept of *Agni* and contemporary metabolic science. The included studies demonstrate thematic alignment of *Jatharagni* with digestive regulation, *Dhatvagni* with tissue-level metabolic modulation, and *Bhutagni* with cellular bioenergetics. However, objective biochemical validation remains limited. The findings highlight the need for standardized *Agni* assessment tools and rigorously designed clinical and experimental studies integrating molecular, endocrine, and systems biology approaches. Such efforts are essential for advancing measurable translation of classical *Agni* principles into modern biomedical research.

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