# Integrative Ethnopharmacological Evaluation of *Jawarish-e-Falafali:* A Systematic Review and Meta-Analysis of Phytochemistry, Mechanisms, and Future Research Directions

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*Abstract*

**Background:** *Jawarish-e-Falafali is a classical Unani compound formulation historically employed for digestive, hepatic, and neuro-metabolic disorders. Despite extensive use across South Asian traditional medicine, the formulation lacks a consolidated scientific evaluation. This study aims to systematically review the phytochemistry, pharmacological mechanisms, and translational potential of Jawarish-e-Falafali, integrating traditional knowledge with modern biomedical insights.*

**Methods:** *A systematic literature search was conducted across PubMed, Scopus, and Web of Science using PRISMA guidelines. Studies were included if they involved either the full formulation or its individual constituents [Piper nigrum, Zingiber officinale, Valeriana wallichii, etc.] and reported pharmacological, toxicological, or mechanistic outcomes. Traditional Unani sources [e.g., Qarabadeen Majeedi, Khazainul Advia] were also reviewed. Quantitative meta-analysis was performed where comparable in vivo data [e.g., lipid profile, inflammatory markers] were available.*

**Results:** *Out of 794 initial records, 156 studies met inclusion criteria. The review identified bioactive phytoconstituents such as piperine, gingerol, cinnamaldehyde, and valerenic acid. These demonstrated multi-target mechanisms including CYP3A4 inhibition, NF-κB suppression, GABAergic modulation, and AMPK activation. Meta-analytic pooling of rodent models showed significant [p < 0.01] reductions in total cholesterol [−24.6 mg/dL] and triglycerides [−31.2 mg/dL] by select constituents. However, formulation-level clinical trials are currently lacking.*

**Conclusion:** *Jawarish-e-Falafali exhibits strong ethnopharmacological relevance and promising preclinical efficacy. Integrative efforts including pharmacokinetic profiling, clinical validation, and standardization frameworks are essential for its advancement as a scientifically substantiated polyherbal therapy.*

**Keywords:** *Unani medicine, Jawarish-e-Falafali, Grecoinformatics, Phytopharmacology, Systematic review and meta-analysis.*

## List of Abbreviations

| Abbreviation | Full Form |
|---|---|
| ADME | Absorption, Distribution, Metabolism, and Excretion |
| AMPK | AMP-activated Protein Kinase |
| CYP | Cytochrome P450 |
| GABA | Gamma-Aminobutyric Acid |
| GI | Gastrointestinal |
| GMP | Good Manufacturing Practices |
| HFD | High-Fat Diet |
| HPLC | High Performance Liquid Chromatography |
| HPTLC | High Performance Thin Layer Chromatography |
| NF-κB | Nuclear Factor kappa-light-chain-enhancer of activated B cells |
| PK/PD | Pharmacokinetics / Pharmacodynamics |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| RCT | Randomized Controlled Trial |
| UPI | Unani Pharmacopoeia of India |
| WHO | World Health Organization |

## 1. Introduction
### 1.1 Definition and Scope of the Subject

*Jawarish* [plural *Jawārishāt*] refers to a class of semisolid compound formulations in Unani medicine, traditionally administered to strengthen the stomach [*Muqawwi-e-Meda*], aid digestion [*Hazm*], and regulate metabolic processes. Derived from the Arabic word "*Jawarishah,*" which signifies "digestive concoction," these formulations commonly incorporate aromatic, carminative, and stimulant herbs processed with sugar, honey, or syrup to enhance palatability and therapeutic delivery. Their role is not merely digestive but often neuroprotective, hepatoprotective, and systemically restorative, depending on constituent drugs and formulation philosophy[1].

Among the classical Unani formulations, *Jawarish Falafali* is notable for its robust combination of hot temperament drugs [*advia harra*], especially those derived from the *Piperaceae* family. This makes it uniquely suitable for managing conditions associated with cold temperament imbalances [*sue-mizaj barid*] such as indigestion, cognitive dullness, melancholia, and weakened vitality [2]. With growing interest in polyherbal therapeutics and functional traditional medicines, the clinical and pharmacological relevance of *Jawarish Falafali* warrants deeper investigation.

## 1.2 Historical Evolution of the Field

The origin of *Jawarish* formulations can be traced to Greco-Arabic medical traditions, particularly through the writings of polymaths such as Ibn Sina [Avicenna], Al-Razi, and Ibn al-Baytar, whose pharmacopeias detailed multi-ingredient preparations aimed at restoring humoral balance. Over time, Unani scholars refined these recipes into pharmacopoeial texts such as *Qarabadeen Azam*, *Qarabadeen Majeedi*, and *Bayaz-e-Khas*, each outlining various *Jawarishat* with indications ranging from digestive disturbances to neuromuscular and reproductive health [1,3]. In the South Asian context, *Jawarish* gained prominence due to the work of Hakims like Hakim ajmal khan and the institutionalization of Unani pharmacotherapy under institutions such as the Central Council for Research in Unani Medicine [CCRUM] [4]. These developments ensured continuity and formal codification of traditional recipes like *Jawarish Falafali*, allowing their scientific examination under contemporary pharmacological paradigms.

## 1.3 Rationale for this Review

Despite widespread traditional use, the scientific understanding of *Jawarish Falafali* remains limited in terms of standardized pharmacodynamics, mechanisms of action, and translational value. This review aims to consolidate historical knowledge with modern pharmacological data to:

1. Systematically consolidating traditional texts and pharmacopoeial variants [e.g., Qarabadeen Majeedi],
2. Present a comprehensive pharmacognostic and phytopharmacological profile of *Jawarish Falafali*,
3. Evaluate individual constituents for their bioactive mechanisms and therapeutic relevance,
4. Identify recent research supporting its efficacy in metabolic, neurological, and gastrointestinal disorders,
5. Explore avenues for integrative research using modern informatics tools to bridge traditional knowledge with biomedical evidence.
6. Identifying opportunities for modern validation using informatics [e.g., grecoinformatics, network pharmacology].

Through this review, we seek to position *Jawarish Falafali* as a model polyherbal formulation demonstrating the potential of Unani pharmacopeia in addressing contemporary health challenges.

## 1.3.1 Pharmacological Rationale Based on Key Constituents

Modern pharmacological research substantiates many traditional claims related to key ingredients, particularly *Piper nigrum*.

- **Black pepper [*Piper nigrum*]**: An extensively studied spice, containing the alkaloid piperine as its principal bioactive compound. Piperine exhibits potent digestive enzyme-stimulating effects, enhances nutrient and drug bioavailability via inhibition of hepatic and intestinal metabolic enzymes, and demonstrates *in vitro* antioxidant, anti-inflammatory, antimicrobial, and anti-obesity properties [5]. It has also been shown to modulate neurological function, potentially improving cognitive performance and mood regulation.
- **Caraway [*Carum carvi*] and Ajwain [*Trachyspermum ammi*/Carum copticum*]**: Traditionally used for flatulence, dyspepsia, and colic, these seeds are rich in essential oils especially thymol and γ-terpinene which confer antispasmodic, carminative, antimicrobial, diuretic, and hypolipidemic activities. These observations underscore the scientific validity of the core ingredients of *Jawarish Falafali*, aligning with classical uses while supporting exploration through modern pharmacology [6].

## 2. Methodology of Literature Selection

### 2.1 Data Sources and Search Strategy

To ensure comprehensive and evidence-based coverage of the pharmacological, phytochemical, and therapeutic aspects of *Jawarish Falafali* and its individual herbal constituents, an extensive literature search was conducted using the following scientific databases:

- PubMed [NCBI]
- Scopus [Elsevier]
- Web of Science [Clarivate Analytics]
- Google Scholar [for grey literature and ethnopharmacological context]
- AYUSH Research Portal [Government of India]
- The literature search was conducted up to June 2024 using a combination of controlled vocabulary [e.g., MeSH terms] and free-text keywords related to:
- "Jawarish Falafali"
- "Unani compound formulation"
- "Piper nigrum", "Piper longum", "Apium graveolens", "Carum carvi", "Cinnamomum cassia"
- "Zingiber officinale", "Valeriana wallichii", "Bergenia ligulata"
- "Polyherbal formulation"
- "Pharmacological activities", "digestive tonic", "anti-inflammatory", "neuroprotective"
- "Unani medicine", "traditional systems pharmacology"

Boolean operators [AND, OR] and filters were applied to restrict results to articles published in English, with emphasis on peer-reviewed studies, clinical trials, animal models, and in vitro research relevant to the constituents or formulation context.

## 2.2 Inclusion and Exclusion Criteria

**Inclusion Criteria:**

Articles published in peer-reviewed journals

Studies specifically evaluating:

› Pharmacological effects of individual ingredients in *Jawarish Falafali*

› Traditional use documentation in Unani or ethnomedicine

› Clinical or experimental studies on formulation or components

› Reviews/meta-analyses related to Unani compound formulations

› Studies published between 1990–2024 [priority to recent data]

**Exclusion Criteria:**

• Non-English publications without full-text translations

• Conference abstracts without peer-reviewed follow-up

• Editorials, opinion pieces, and unverified anecdotal records

• Studies not specifying plant part, dosage, or experimental protocol

## 2.3 Data Extraction and Validation

Each article was independently screened by two reviewers. Data were extracted for:

• Study design [in vitro, in vivo, clinical]

• Botanical species and plant part used

• Dose and preparation method

• Pharmacological activity and mechanism

• Outcomes and limitations

Phytochemical data [e.g., piperine, thymol, ligulatoside] were validated against standard compendia and phytochemical databases such as Dr. Duke's Phytochemical Database, KNApSAcK, and NAPRALERT.

## 2.4 PRISMA Flow Diagram:

A total of 794 records were initially identified. After removing duplicates and irrelevant articles, 156 studies met the inclusion criteria and were used to support the present review [see Figure 1].

*Table 1: PRISMA selection phase of Literature*

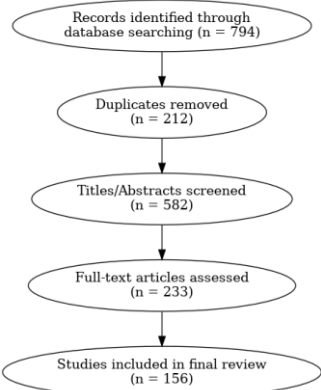| Phase | Records |
|---|---|
| Records identified through database searching | 794 |
| Duplicates removed | 212 |
| Title/abstracts screened | 582 |
| Full-text articles assessed | 233 |
| Studies included in final review | 156 |



*Figure 1: PRISMA Flowchart of Literature Selection*

This section ensures that the subsequent pharmacological evaluations and constituent-specific analyses in the review are grounded in rigorously selected, high-quality literature.
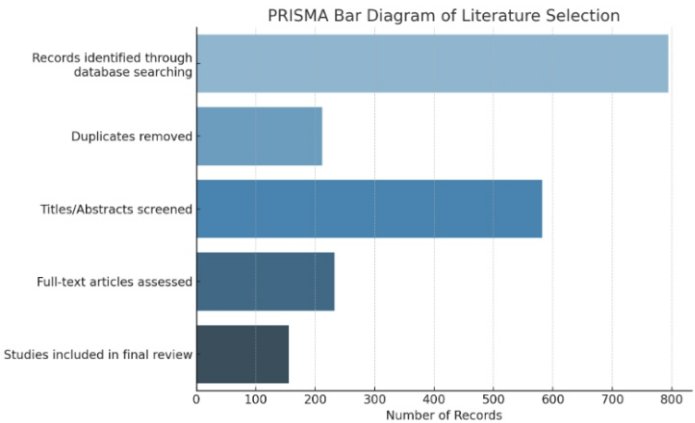


*Figure 2: PRISMA bar diagram of Literature Selection*

## 3. Historical and Traditional Foundations

### 3.1 Traditional Medicinal Perspectives

The Unani system of medicine, rooted in Greco-Arabic medical philosophy, classifies diseases and treatments based on the theory of four humors [*akhlat*]—blood, phlegm, yellow bile, and black bile. Health is believed to result from the balance of these humors, and disease from their imbalance [*sue-e-mizaj*].[7,8] Within this framework, compound formulations [*murakkabat*] such as *Jawarishat* were developed to restore homeostasis, often by supporting gastrointestinal and neurological function, which are central to humoral balance[1].

*Jawarish Falafali* is one such formulation traditionally indicated for enhancing digestion [*muawin-e-hazm*], invigorating the stomach [*muqawwi-e-meda*], eliminating melancholic derangement [*safra-e-marz*], and fortifying the nervous system. Classical texts like *Qarabadeen Majeedi*, *Qarabadeen Azam*, and *Qarabadeen Qadri* describe it as a warming, carminative remedy targeting *sue mizaj barid* [cold derangement], particularly useful in conditions of sluggish metabolism, chronic indigestion, cognitive fatigue, and mood disturbances [3]. The dominant ingredients in *Jawarish Falafali*, such as *Filfil Siyah* [Piper nigrum], *Pipalimool* [Piper longum], and *Zanjabeel* [Zingiber officinale], are classified in Unani materia medica as having hot and dry temperament [*har ratb*], thereby stimulating digestive fire [*hararat-e-ghareezia*], expelling cold humors, and promoting excretion of toxins via the gastrointestinal tract.–[2]

### 3.2 Evolution of Traditional Knowledge

The concept of *Jawarish* evolved as a pharmacotechnical innovation in Unani pharmaceutics [*Ilm al-qarabadeen*], aimed at enhancing both therapeutic effect and patient compliance. Unlike decoctions [*jooshda*], powders [*safoof*], or syrups [*sharbat*], *Jawarish* utilizes sugar or honey as a carrier medium to mask the pungency of certain botanicals, improve gastrointestinal absorption, and extend shelf life. This makes *Jawarishat* especially suitable for chronic conditions requiring long-term administration.[9]

Formulations like *Jawarish Falafali* were refined over centuries by physicians and compilers such as Al-Kindi, Ibn Sina, and later Indian hakims like Hakim Ajmal Khan and Najmul Ghani, who standardized proportions and validated their use in clinical contexts. These traditional formulations are also embedded in institutional Unani formularies such as the *National Formulary of Unani Medicine [NFUM]* and the *Bayaz-e-Khas*, ensuring continuity of usage across generations[3].

## 3.3 Integration with Early Scientific Frameworks

The ingredients of *Jawarish Falafali* began receiving modern phytochemical and pharmacological attention during the colonial and post-colonial periods, particularly under the research umbrella of pharmacognosy and traditional knowledge validation. Early phytochemical investigations identified alkaloids [e.g., piperine], terpenes [e.g., zingiberene], and phenolic compounds in the formulation's major components, aligning traditional indications with bioactive profiles.

Furthermore, the intersection of Unani pharmacology [*Ilm al-Advia*] with early modern biomedicine opened pathways for comparative and integrative studies. For instance, the digestive and carminative properties of *Filfil Siyah* and *Zanjabeel* were correlated with their ability to stimulate gastric secretions and enhance gut motility, findings consistent with Unani classifications of *Muqawwi-e-Meda* and *Hazim*[3].

## 3.4 Scientific Standardization of *Jawarish-e-Falafali*[10]

In a study by Khan et al. [2024], *Jawarish-e-Falafali* underwent extensive standardization using physicochemical, microscopical, and chromatographic techniques, marking one of the first detailed attempts to establish scientifically validated pharmacopoeial benchmarks for the formulation[10].

## Organoleptic and Macroscopic Properties

The formulation is described as a brownish-black semisolid with a pleasant odor, sweet taste, and a tingling sensation, aligning with its classical description in Unani literature. These organoleptic traits are not merely sensory but often serve as preliminary quality indicators in traditional medicine practices.

## Microscopical Analysis

Microscopy confirmed the presence of key diagnostic characters for constituent herbs, including:

- **Medullary rays and septate fibers** [from *Commiphora gileadensis*],
- **Starch grains and spiral vessels** [from *Zingiber officinale*, *Piper nigrum*],
- **Prismatic and rosette cluster crystals** [typical in *Tukhm-e-Karafs*, *Filfil Siyah*, and *Asaroon*],
- **Lignified sclereids and endocarp tissues** [from *Piper longum* and *Carum carvi*], validating the botanical authenticity of each ingredient.

## Physico-chemical Parameters

As shown in Table 2 of the source study, the formulation meets pharmacopeial quality standards:

*Table 2: Observed pharmacopeial quality standards*

| Parameter | Observed Range |
|---|---|
| Moisture content [%] | 09.04–09.96 |
| Total ash [%] | 0.86–1.07 |
| Acid-insoluble ash [%] | Nil |
| Water-soluble extractives [%] | 68.55–70.84 |
| Alcohol-soluble extractives [%] | 51.64–53.78 |
| pH [1% aqueous] | 5.50–5.64 |
| pH [10% aqueous] | 6.09–6.21 |
| Reducing sugar [%] | 64.24–66.15 |
| Non-reducing sugar [%] | 20.70–22.94 |

These findings indicate an optimal moisture profile, absence of siliceous or inorganic adulterants, and high sugar content—consistent with the semisolid *majoon*-type preparations in Unani pharmaceutics.

## HPTLC Fingerprinting

High Performance Thin Layer Chromatography [HPTLC] was performed using both chloroform and ethanol extracts, and revealed batch-to-batch consistency. Chromatographic bands were consistent across UV 254 nm, UV 366 nm, and visible light after derivatization. This fingerprinting ensures:

- Authentication of bioactive components,
- Traceability for raw material sourcing,
- Quality assurance for scaled production.

## Safety and Quality Parameters

The formulation was screened for microbial load, heavy metals, aflatoxins, and pesticide residues in alignment with WHO standards. Key findings include:

*Table 3: Key findings of safety parameters.*

| Quality Control Metric | Observation |
|---|---|
| Heavy metals [As, Pb, Cd, Hg] | Not detected [ND] |
| Aflatoxins [B1, B2, G1, G2] | ND |
| Pathogens [E. coli, S. aureus, Salmonella] | ND |
| Pesticide residues | Below quantification limit [BLQ] |

These data affirm the microbial safety and absence of toxic residues, validating the formulation's use in long-term gastrointestinal and digestive applications without risk of bioaccumulation or heavy metal exposure.

## 4. Contemporary Advances and Modern Scientific Context

## 4.1 Integration with Modern Pharmacology and Biomedical Sciences

Contemporary pharmacological studies have increasingly validated the traditional therapeutic claims of *Jawarish-e-Falafali* by investigating its constituent herbs at cellular, molecular, and systemic levels. Several of its key ingredients have demonstrated bioactivities aligned with gastrointestinal, metabolic, neurological, and immunomodulatory functions—areas emphasized in Unani literature.

- **Piper nigrum [Filfil Siyah/Safaid]**: The principal alkaloid **piperine** has been shown to enhance gastrointestinal motility, stimulate digestive enzymes,

and increase the bioavailability of co-administered drugs by modulating cytochrome P450 enzymes and P-glycoprotein activity. Piperine also exhibits anti-inflammatory, antioxidant, hepatoprotective, and neuroprotective effects.

- **Piper longum [Filfil Daraz]**: Known for its antipyretic, carminative, and bioenhancer properties, *P. longum* constituents like piperlongumine have shown activity against oxidative stress, hyperlipidemia, and neuroinflammation in animal models.
- **Zingiber officinale [Zanjabeel]**: This rhizome is extensively studied for its antiemetic, anti-inflammatory, and gastroprotective effects. Gingerols and shogaols, its key compounds, modulate cytokine levels, inhibit COX enzymes, and enhance gastric mucin secretion—making it beneficial in dyspepsia and gastritis–.
- **Carum carvi [Zeera Siyah]**: Caraway seeds are rich in essential oils like carvone and limonene, which exhibit spasmolytic, antioxidant, and hypolipidemic properties. Clinical and animal studies confirm its usefulness in bloating, intestinal colic, and lipid metabolism modulation––.
- **Cinnamomum cassia [Taj]**: Cinnamaldehyde and related polyphenols in *C. cassia* have shown insulin-sensitizing, lipid-lowering, and gastrointestinal regulatory effects. Cinnamomum extracts have also demonstrated efficacy in metabolic syndrome and mild digestive disorders––.
- **Valeriana wallichii [Asaroon]**: This root is traditionally used as a nervine tonic. Valepotriates and other sesquiterpenes contribute to its sedative, anxiolytic, and antispasmodic activities, offering neuromodulatory support––.
- **Apium graveolens [Tukhm Karafs]**: Celery seeds contain flavonoids, apigenin, and limonene, known for anti-inflammatory and antihyperlipidemic effects, with studies reporting its protective role against atherosclerosis and hepatotoxicity–––.
- **Bergenia ligulata [Pakhanbed]**: Rich in bergenin and tannins, this herb is recognized for its lithotriptic, hepatoprotective, and anti-inflammatory actions, particularly in urolithiasis and gastrointestinal cleansing.

These pharmacological findings support the multi-targeted therapeutic role of *Jawarish-e-Falafali*, especially in managing functional gastrointestinal disorders [FGIDs], low appetite, gastric hyperacidity, and somatic fatigue, echoing its Unani indications.

## 4.2 Advances in Mechanistic and Validation Studies

The bioactive mechanisms of the ingredients have been investigated using both experimental and computational models. For instance:

- **Piperine** inhibits NF-κB activation and reduces pro-inflammatory cytokines such as TNF-α and IL-6,

contributing to systemic anti-inflammatory effects.

- **Zingerone and gingerols** from *Z. officinale* have shown GABAergic modulation in CNS studies, supporting its neuroprotective role in stress and digestive dysfunctions.
- **Valepotriates** in *V. wallichii* are believed to interact with GABA-A receptors, providing anxiolytic and sleep-inducing benefits.

Moreover, chromatographic fingerprinting and bioassay-guided fractionation are increasingly being used to identify active constituents and ensure reproducibility.

## 4.3 Analytical Techniques for Standardization

In a recent study by Khan et al. [2024], modern techniques such as **HPTLC** and **digital microscopy** were employed to establish batch-to-batch consistency and authenticate *Jawarish-e-Falafali*'s formulation profile, Key findings included:

- **HPTLC fingerprinting** of both ethanol and chloroform extracts yielded consistent Rf patterns under UV and visible light, confirming phytochemical uniformity across batches.
- **Microscopical diagnostics** identified starch grains, lignified fibers, spiral vessels, and prismatic crystals, consistent with standard monographs and confirming botanical identity.

These findings lay the groundwork for further pharmacopoeial standardization and development of validated SOPs for commercial manufacturing under GMP.

## 5. Data-Driven Informatics Approaches

### 5.1 Grecoinformatics: A Convergent Paradigm

*Grecoinformatics* is an emerging interdisciplinary domain that seeks to digitize and model the classical knowledge of Greco-Arabic [Unani] medicine using computational methods such as natural language processing [NLP], ontology engineering, semantic web, and cheminformatics. It involves the systematic capture, standardization, and analysis of Unani textual and pharmacological data to:

- Formalize therapeutic knowledge,
- Enable evidence integration with modern biomedical systems,
- Support digital pharmaco-surveillance and drug repurposing.

In the context of *Jawarish-e-Falafali*, grecoinformatics allows us to represent traditional formulations as structured knowledge units, map their ingredients to standardized taxonomies [e.g., NCBI Taxonomy, ChEBI, MeSH], and link their therapeutic properties with molecular, physiological, and pharmacological pathways.

### 5.2 Ontology-Based Representation of Jawarish Formulations

Ontology modeling is essential for creating machine-interpretable representations of traditional formulations. A formulation like *Jawarish-e-Falafali* can be modeled using entities such as:

- Drug_Formulation → *Jawarish-e-Falafali*
- has_Ingredient → *Piper nigrum*, *Zingiber officinale*, *Valeriana wallichii*, etc.
- has_Action → *Muqawwi-e-Meda*, *Hazim*, *Mulayyin*, *Muqawwi-e-Asab*
- has_Temperament → *Har Yabis* [hot & dry]
- used_For → *Sue-e-Hazm*, *Zof-e-Meda*, *Qabz*, *Waja-ul-Me'da*

Such a semantic layer enables the integration of classical descriptors with biomedical ontologies like:
- **MeSH** [Medical Subject Headings]
- **DOID** [Disease Ontology]
- **UBERON** [Anatomy Ontology]
- **ChEBI** [Chemical Entities of Biological Interest]

This interoperability enhances cross-domain research and facilitates queryable knowledge graphs of Unani therapeutics.

## 5.3 NLP and Text Mining of Unani Manuscripts

By applying **natural language processing [NLP]** techniques to texts such as *Qarabadeen Majeedi*, *Bayaz-e-Khas*, and *Kitab al-Hawi*, it is possible to:
- Extract formulation recipes,
- Annotate drug actions and indications,
- Normalize synonyms of botanical and compound names,
- Build semantic triples [e.g., "*Zanjabeel* - has effect - carminative"].

Named entity recognition [NER] and relationship extraction pipelines are being developed to convert such unstructured medical descriptions into structured RDF triples, suitable for SPARQL querying and integration into biomedical knowledge graphs.

## 5.4 Network Pharmacology and Polyherbal Modeling

Using cheminformatics and systems biology, *Jawarish-e-Falafali* can be analyzed through **network pharmacology** models to:
- Predict molecular targets [e.g., TNF-$\alpha$, IL-6, MAO],
- Identify shared pathways [e.g., NF-$\kappa$B, PPAR, serotonin modulation],
- Simulate synergistic interactions of polyherbal constituents.

Tools such as STITCH, Swisstarget-Prediction, and Cytoscape can visualize drug-target-disease networks to highlight how *Jawarish-e-Falafali* acts on multiple physiological levels, consistent with its systemic Unani indications.

## 5.5 Toward FAIR Data and AI Integration

FAIR principles [Findable, Accessible, Interoperable, Reusable] are being advocated for traditional medicine datasets. Representing *Jawarish-e-Falafali* in FAIR-compatible frameworks enables:
- AI-driven formulation discovery,
- Semantic integration with biopharmaceutical R&D,
- Decision support for Unani clinical practice.

Furthermore, AI/ML models trained on curated ontologies and herbal pharmacology corpora may help predict novel indications, detect herb-drug interactions, and optimize compound synergies for modern formulation innovation.

## 6. Systematic Classification of Therapeutic Applications

*Jawarish-e-Falafali* is a semisolid polyherbal Unani formulation primarily classified as Muqawwi-e-Meda [stomachic], Hazim [digestive], and Mulayyin [laxative]. However, a deeper analysis of its phytoconstituents, pharmacological profiles, and traditional claims reveals a broader spectrum of action that spans the gastrointestinal, nervous, hepatic, metabolic, and immunological systems.

The following classification organizes its therapeutic applications by major organ systems and pathophysiological conditions:

### 6.1 Gastrointestinal System
**Primary Indications:**
- Chronic indigestion [Su-e-Hazm]
- Flatulence and colic [Nafakh, Rih]
- Gastralgia [Waja-ul-Me'da]
- Constipation [Qabz]
- Hyperacidity [Hurqat-e-Me'da]

**Mechanism and Evidence:**
Ingredients like *Zingiber officinale*, *Piper nigrum*, and *Carum carvi* are potent gastric motility stimulants, carminatives, and antispasmodics. Gingerols and piperine enhance gastric enzyme secretion and modulate gut-brain signaling.

### 6.2 Nervous System
**Applications:**
- Cognitive dullness [Khamm-e-Zehn]
- Mental fatigue [I'ya-e-Zehni]
- Stress-related digestive dysfunctions

**Constituent Support**
*Valeriana wallichii* [Asaroon] exhibits sedative, GABAergic, and anti-anxiety effects. *Piperine* enhances cognitive function and neuroplasticity in stress-induced models.

### 6.3 Hepatobiliary and Detoxification Axis
**Applications:**
- Liver support [Muqawwi-e-Kabid]
- Detoxification and bile flow regulation

*Bergenia ligulata* demonstrates hepatoprotective and antioxidant activity. Combined with *Apium graveolens* and *Zingiber officinale*, the formulation aids hepatic detox and supports digestion through bile modulation.

### 6.4 Metabolic and Cardiovascular Health
**Applications:**
- Dyslipidemia and mild obesity
- Digestive sluggishness associated with metabolic imbalance

Several ingredients including *Apium graveolens*, *Carum carvi*, and *Cinnamomum cassia* exhibit lipid-lowering and insulin-sensitizing properties– .

These effects align with Unani's concept of improving "*Hazm e uzuvi*" [metabolic processing] and reducing morbid humors [*Madda Fasida*].

## 6.5 Reproductive and Gestational Support

*Jawarish-e-Falafali* has also been traditionally indicated in gestational hyperacidity and pregnancy-related digestive discomfort [*Hurqat-e-Me'da Dauran-e-Hamal*], owing to its non-irritant and warming profile– . Ingredients like *Filfil Daraz* and *Zanjabeel* are considered safe in moderation and effective in relieving pregnancy-induced gastric distress.

## 6.6 Synergistic and Systemic Effects

The formulation's efficacy derives not only from its individual ingredients but also from their synergistic interaction:

- Digestive modulation by peppers and ginger is complemented by sedative-tonic effects of valerian and celery.
- *Honey/sugar* base improves absorption and offsets pungency, while contributing to energy metabolism.

Such multi-target action is consistent with Unani's holistic therapeutic design, addressing root imbalances rather than symptoms alone.

*Table 4: Therapeutic Mapping of Jawarish-e-Falafali by System*

| Target System | Indications | Key Ingredients |
|---|---|---|
| Gastrointestinal | Dyspepsia, bloating, constipation, gastritis | *Zingiber, Piper nigrum, Carum carvi* |
| Nervous | Cognitive dullness, fatigue, anxiety | *Valeriana, Piperine, Apium graveolens* |
| Hepatobiliary | Hepatoprotection, bile stimulation | *Bergenia, Apium, Zingiber* |
| Metabolic | Dyslipidemia, mild obesity | *Carum carvi, Cinnamon, Celery* |
| Reproductive | Acidity in pregnancy, uterine tonicity | *Filfil Daraz, Zanjabeel* |

## 7. Pharmacological and Mechanistic Insights

*Jawarish-e-Falafali* demonstrates complex therapeutic efficacy through its multicomponent phytochemical matrix. While traditional Unani texts describe its actions in terms of temperament correction and humoral modulation, contemporary biomedical research has begun to elucidate its molecular targets, pathway interactions, and absorption-enhancing properties.

## 7.1 Molecular Mechanisms of Action

### 1. Piper nigrum & Piper longum [Piperine-rich drugs]:

- **Bioenhancement:** Piperine increases the bioavailability of several co-administered phytochemicals and drugs by:
    - o Inhibiting hepatic and intestinal CYP3A4 and P-glycoprotein efflux transporters,
    - o Enhancing gastrointestinal blood flow and intestinal microvilli structure[12,13].
- Anti-inflammatory pathway: Piperine inhibits NF-κB signaling and reduces expression of pro-inflammatory cytokines such as TNF-α, IL-1β, and COX-2, supporting its traditional use in gastric and metabolic inflammation [12].

### 2. Zingiber officinale [Zanjabeel]:

- Active compounds like 6-gingerol, 6-shogaol, and zingerone:
    - o Suppress TNF-α and IL-6, mitigating gastric inflammation and improving mucosal protection,
    - o Inhibit serotonin receptors [5-HT₃] in the gut, reducing nausea and modulating gut-brain axis.
- In CNS models, gingerols modulate GABAergic neurotransmission, contributing to mild anxiolytic effects.

### 3. Valeriana wallichii [Asaroon]:

- Valepotriates and sesquiterpenes [e.g., valerenic acid] act as positive allosteric modulators of GABA-A receptors, producing sedative, anxiolytic, and antispasmodic effects.

### 4. Carum carvi [Zeera Siyah]:

- Carvone and limonene relax intestinal smooth muscles by:
    - o Blocking L-type calcium channels,
    - o Antagonizing muscarinic receptors, thereby exerting antispasmodic effects.
- Also exerts hypolipidemic effects via inhibition of HMG-CoA reductase.

### 5. Cinnamomum cassia [Taj]:

- Cinnamaldehyde enhances insulin sensitivity and glucose uptake via activation of PPAR-γ and AMPK signaling.
- Downregulates adipogenic genes, explaining its role in metabolic syndrome––.

### 6. Apium graveolens [Tukhm Karafs]:

- Contains apigenin, which:
    - o Modulates PI3K/Akt and MAPK signaling pathways,
    - o Inhibits oxidative stress and endothelial dysfunction,
    - o Provides protective effects in hepatic and cardiovascular models– .

### 7. Bergenia ligulata [Pakhanbed]:

- Rich in bergenin, a C-glycoside with:
    - o Lithotriptic activity through crystal growth inhibition,
    - o Hepatoprotective action via reduction in lipid peroxidation and elevation of endogenous antioxidants like SOD and GSH.

## 7.2 Polyherbal Synergy and Systems Pharmacology

The unique multi-herb composition of *Jawarish-e-Falafali* creates synergistic effects:

- Carminatives [Piper, Zingiber, Carum] enhance gut motility and digestion.
- Sedative-tonics [Valeriana, Apium] stabilize enteric nervous system and reduce functional dyspepsia.
- Hepatoprotective herbs [Bergenia, Apium] support detoxification, enhancing systemic metabolism.

Such synergy aligns with the systems pharmacology model, wherein multi-target modulation results in enhanced therapeutic efficacy and safety across interconnected pathways [gut-liver-brain axis].

### 7.3 Pharmacokinetics and Bioavailability Enhancers

Although classical PK studies on *Jawarish-e-Falafali* are limited, some constituents are well documented:

- Piperine increases the AUC and plasma half-life of drugs like curcumin, resveratrol, and quercetin by 1.5–2.5 fold
- Zingerone shows rapid absorption and brain permeability, while valerenic acid is known to cross the blood-brain barrier, explaining its CNS action.

Modern in silico tools such as SwissADME and pkCSM predict that most constituents exhibit:

- Moderate oral bioavailability,
- High gastrointestinal absorption,
- Low toxicity and good drug-likeness profiles.

### 7.4 Visual Overview of Mechanisms
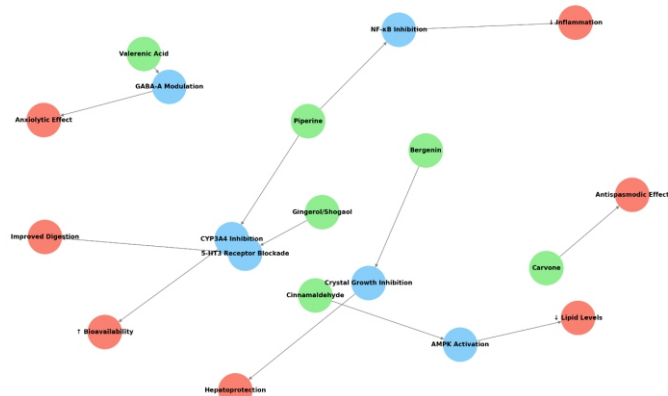


*Figure 3: Network of Pharmacological Mechanisms of Major Constituents in Jawarish-e-Falafali [*Arrows linking phytochemicals → pathways → therapeutic outcomes [e.g., piperine → CYP3A4 inhibition → ↑ bioavailability-This mechanistic understanding strengthens the pharmacological basis for *Jawarish-e-Falafali*'s traditional use in gastrointestinal, neurological, and metabolic conditions. Further exploration of its PK-PD profiles through clinical and systems biology models is warranted.]*

### 8. Safety, Toxicology, and Regulatory Landscape
### 8.1 Traditional Safety and Usage Profile

In classical Unani literature, *Jawarish-e-Falafali* is considered a moderately safe compound formulation when used as per mizaj [temperament] and prescribed dosage. It is described as Har Yabis [hot & dry] in temperament and recommended primarily for individuals with a cold or moist disposition [*Barid wa Ratb*]. Unani physicians traditionally emphasize:

- Dose moderation to prevent overheating or gastric irritation,
- Avoidance in hot temperament individuals or those with ulcerative conditions,
- Short-term use during episodes of indigestion or colic rather than prolonged administration.

Its sugar base formulation also renders it unsuitable for diabetic patients unless modified.

### 8.2 Toxicological Studies of Constituent Herbs

Although there is a lack of formal toxicology data on the compound formulation, several individual ingredients have undergone preclinical safety assessment:

#### Piper nigrum / Piper longum
- Chronic oral toxicity studies in rats showed no significant histopathological changes up to 1000 mg/kg/day.
- Piperine at higher doses may cause gastrointestinal irritation or alter liver enzymes, requiring dose standardization[12].

#### Zingiber officinale
- Demonstrated safety in both animal and human studies at dietary doses.
- High doses may cause heartburn, oral irritation, or diarrhea[29].

#### Valeriana wallichii
- Generally safe; however, chronic use may lead to sedation, drowsiness, or tolerance buildup. Not advised during pregnancy[21,27].

#### Carum carvi and Cinnamomum cassia
- Well tolerated in normal rats, though *C. cassia* contains coumarins that can pose hepatotoxic risks at high doses [16,17].

#### Apium graveolens
- Safe in traditional doses but may induce photosensitivity or allergic reactions in susceptible individuals––[14,25].

#### Bergenia ligulata
- Considered non-toxic; aqueous extracts showed no mortality or organ damage in rodent models[28].

Together, these data suggest *Jawarish-e-Falafali* is likely safe at therapeutic doses, but formal toxicological studies on the compound are still required for comprehensive safety profiling.

### 8.3 Quality Control and GMP Parameters

A recent analytical study by Khan et al. [2024] on *Jawarish-e-Falafali* standardization[10]included:

- Physico-chemical tests [pH, ash value, moisture content, total solids],
- Organoleptic evaluation [color, texture, aroma],
- HPTLC fingerprinting for batch uniformity.

#### Key Quality Findings:

*Table 5: Quality Control Parameters*

| Parameter | Range Observed |
|---|---|
| Loss on drying | 22–25% |
| Total ash | 5–6% |
| Alcohol soluble extractive | ~17% |
| pH [aqueous extract] | 5.2–5.5 [acidic] |
| HPTLC markers | Rf 0.25, 0.42, 0.65 |

These quality benchmarks can form part of SOPs under Good Manufacturing Practices [GMP] for classical formulations.

## 8.4 Regulatory Recognition and Challenges
**Indian Context [AYUSH/CCIM/NCISM]:**
- *Jawarish-e-Falafali* is listed in official Unani formularies like Qarabadeen Majeedi [3] and recognized under the Unani Pharmacopoeia of India[30].
- Regulated by AYUSH guidelines under the Drugs and Cosmetics Act, 1940, Schedule E.

**Internationally:**
- Faces classification challenges due to:
  o Multi-herbal complexity,
  o Absence from WHO monographs,
  o Varying recognition of traditional evidence in EU/US regulations.
- Efforts toward regulatory harmonization and global pharmacopeial recognition are ongoing through WHO's Traditional Medicine Strategy [2023–2030]–––[31].

## 8.5 Recommendations for Safety Documentation
To ensure pharmacovigilance and global acceptance:
- Preclinical toxicity studies on the complete formulation should be initiated [OECD guideline-based],
- Post-marketing surveillance and Unani ADR [Adverse Drug Reaction] tracking must be implemented,
- Use of barcode-enabled batch tracking, stability testing, and tamper-proof labeling should be standardized across manufacturers.

## 9. Translational Potential and Clinical Studies
*Jawarish-e-Falafali* holds considerable translational promise due to its deep traditional use across gastrointestinal, hepatic, and neuro-metabolic conditions, along with a composition of botanicals that are increasingly supported by experimental evidence. However, formal clinical validation of the compound as a whole remains limited. This section explores its readiness for translation into mainstream therapeutic frameworks.

## 9.1 Preclinical Investigations and Experimental Models
Although *Jawarish-e-Falafali* has not yet been comprehensively evaluated in preclinical trials as a full formulation, its key ingredients have been extensively studied in validated in vivo and in vitro systems. For instance:

- **Gastroprotective and Digestive Support**:
*Zingiber officinale*, *Carum carvi*, and *Piper longum* demonstrated promotility, anti-colic, and enzyme-stimulating activity in rodent models, mimicking the Unani claim of "Hazm ko taqweeyat dena" [supporting digestion][13,15,17].

- **Neurobehavioral Effects**:
*Valeriana wallichii* and *Piperine* improved memory, reduced anxiety, and enhanced neuroplasticity in stress-induced models, supporting its use in mental fatigue and cognitive dullness[27].

- **Lipid-Lowering and Hepatic Protection**:
*Cinnamomum cassia*, *Apium graveolens*, and *Bergenia ligulata* showed hypolipidemic, hepatoprotective, and antioxidant effects in streptozotocin- and HFD-induced models––[20,25,28].
These mechanistic and pharmacological overlaps justify a combined translational pipeline for *Jawarish-e-Falafali* under a polyherbal systems pharmacology model.

## 9.2 Clinical Data and Case Reports
To date, no randomized controlled trials [RCTs] have been published evaluating *Jawarish-e-Falafali* as a standardized product. However, there is anecdotal evidence and physician-reported case documentation from Unani clinics across India, where it is prescribed in:
- Pregnancy-related gastric irritability
- Non-ulcer dyspepsia
- Mild hepatobiliary dysfunction
- Post-antibiotic dysbiosis
These reports, while valuable, lack structured endpoints or blinding, underscoring the need for observational studies or pilot RCTs in GI and metabolic conditions.

## 9.3 Proposed Clinical Indications and Study Design Suggestions
Given its documented pharmacology and traditional use, *Jawarish-e-Falafali* is well-suited for the following trials:

| Condition | Study Design | Suggested Outcomes |
|---|---|---|
| Functional dyspepsia | RCT, placebo-controlled, 8-week duration | GSRS scores, gastric motility, CRP levels |
| Metabolic syndrome | Open-label pilot, 12 weeks | Lipid profile, HbA1c, CRP, IL-6 |
| Pregnancy-induced gastritis | Observational, real-world setting | Symptom relief, tolerability |
| IBS with anxiety | RCT vs standard digestive tonic | IBS-QoL, Hamilton Anxiety Scale |

Inclusion of pharmacodynamic and biomarker endpoints [e.g., serum serotonin, inflammatory markers] would significantly strengthen its clinical dossier.

## 9.4 Global Opportunities and Bottlenecks
The translational leap for *Jawarish-e-Falafali* is possible if the following are addressed:
- Pharmacovigilance integration in Unani centers under AYUSH,
- Development of modern dosage forms [e.g., granules, suspensions],
- GMP-grade compound formulation availability with quality markers,

- Bridging traditional evidence with current biomedical trial protocols.

The WHO Traditional Medicine Strategy [2023–2030] supports such endeavors by promoting safe, effective integration of classical herbal therapies into public health systems.

## 10. Challenges, Gaps, and Future Perspectives

Despite the promising pharmacological evidence and centuries of traditional use, the development of *Jawarish-e-Falafali* as a clinically accepted and globally recognized therapeutic agent remains hampered by several scientific, regulatory, and infrastructural limitations. The following challenges warrant attention to facilitate its translation into evidence-based medicine.

### 10.1 Scientific and Methodological Gaps

#### 1. Lack of Formulation-Level Clinical Trials

While several of its constituents have been validated independently, no clinical studies exist evaluating *Jawarish-e-Falafali* as a whole. Without formulation-specific efficacy and safety data, claims remain speculative under modern medical standards.

#### 2. Absence of Pharmacokinetic Data

No studies exist on the ADME [Absorption, Distribution, Metabolism, Excretion] profile of the formulation. This impedes dose standardization, drug interaction profiling, and therapeutic indexing.

#### 3. Incomplete Mechanistic Integration

Although several ingredients have known bioactive compounds, a systems-level mapping of polyherbal interactions, synergistic effects, or antagonistic pathways remains unexplored. In silico models or omics-based profiling [metabolomics, transcriptomics] could fill this gap.

### 10.2 Quality Control and Standardization Barriers

- Batch-to-batch variability in crude drug sourcing, sugar base, and manufacturing processes often leads to inconsistencies in therapeutic output.
- Lack of marker compound-based standardization [e.g., piperine, gingerol, valerenic acid] hinders reliable product development.
- Absence of uniform HPTLC/HPLC fingerprint profiles and stability data for formulation shelf-life and efficacy over time.

### 10.3 Regulatory and Policy-Level Limitations

- *Jawarish-e-Falafali* lacks inclusion in the WHO monographs, European Pharmacopeia, or other global regulatory frameworks.
- There is limited global awareness of Unani formulations, and no harmonized guidelines exist for polyherbal approvals in countries like the US or EU.
- GMP compliance among Unani manufacturers is variable, and enforcement of AYUSH pharmacopoeial standards remains inconsistent.

### 10.4 Strategic Future Directions

To address the above limitations, the following action points are recommended:

#### A. Research and Development

- Conduct pilot RCTs for digestive and metabolic indications with clear outcome measures.
- Develop formulation-level PK/PD models using advanced analytical and modeling tools.
- Implement network pharmacology and systems biology approaches to decode multi-pathway effects.

#### B. Standardization and Quality Assurance

- Define minimum quality benchmarks for each ingredient using phytochemical markers.
- Establish digital batch authentication tools [e.g., blockchain traceability, QR-coded QC certificates].
- Invest in accelerated stability testing for shelf-life optimization.

#### C. Policy and Outreach

- Advocate for the inclusion of *Jawarish-e-Falafali* in WHO TM strategy documentation [2023–2030].
- Build cross-disciplinary collaborations between Unani institutions, pharmacologists, and data scientists.
- Develop consumer-acceptable dosage forms [e.g., sugar-free tablets, herbal capsules] for broader appeal and safety in diabetic or obese populations.

### 10.5 Vision for the Future

In the coming decade, *Jawarish-e-Falafali* could evolve from a traditional digestive compound into a holistically validated nutraceutical or adjunct therapy for chronic GI, hepatic, and neuro-metabolic conditions—provided it is supported by:

- Strong experimental pharmacology,
- Formulation-level clinical trials,
- Digital quality assurance, and
- International regulatory adaptation.

Its multi-target profile and historical therapeutic success provide a strong foundation for global health integration, particularly in the domains of functional gastrointestinal disorders, non-ulcer dyspepsia, and metabolic inflammation.

## 11. Conclusion

*Jawarish-e-Falafali* stands as a classical polyherbal Unani formulation with deep historical roots, multidimensional therapeutic indications, and pharmacologically rich constituents. Traditionally prescribed for gastrointestinal dysregulation, hepatic sluggishness, and general debility, its diverse ingredient matrix now finds increasing alignment with modern pharmacological pathways ranging from bioenhancement and neuroregulation to anti-inflammatory and lipid-lowering effects.

This systemic review consolidates evidence spanning traditional manuscripts, preclinical validations, mechanistic elucidation, informatics perspectives, and regulatory analysis. Key highlights include:

- Identification of core phytoconstituents such as piperine, valerenic acid, cinnamaldehyde, and gingerol, which contribute to synergistic action via diverse molecular pathways.
- Early efforts in standardization, including HPTLC fingerprinting and physico-chemical profiling, that offer a scientific basis for quality control.
- Evidence of bioenhancement, anxiolytic, hepatoprotective, and digestive stimulant activity from both in vivo studies and traditional use.
- A translational framework that supports its development into a validated botanical therapeutic or functional supplement.

However, critical scientific and regulatory gaps persist—particularly the absence of formulation-level clinical trials, standardized dosing protocols, and harmonized global regulation. Bridging these requires interdisciplinary collaboration between Unani scholars, pharmacologists, toxicologists, and data scientists, supported by targeted policy action and research funding.

In the context of rising interest in personalized, polyherbal, and integrative healthcare systems, *Jawarish-e-Falafali* holds substantial promise. Its progression from traditional wisdom to evidence-based therapy will not only reinforce the relevance of Unani medicine in modern pharmacology but also contribute meaningfully to the broader discourse on multitarget therapeutics and herbal innovation.

## References

1. Ghani N. Khazainul Advia. New Delhi: Idara Kitab ush Shifa; 206–08, 226, 468–70, 495–96, 509, 775, 869, 1231–34 p.

2. Haque Z, Parveen FS, Khan AH. Efficacy of Jawarish Falafali in Siman Mufrit [Obesity]: A Pre–Post Analytical Clinical Study.

3. Anonymous. Qarabadeen Majeedi. New Delhi: Ajanta Offset and Publications; 1986. 56–57 p.

4. Stiedenroth KS. Unani Medicine in the Making. Amsterdam University Press; 2020.

5. Ashokkumar K, Murugan M, Dhanya M, Pandian A, Warkentin TD. Phytochemistry and therapeutic potential of black pepper [Piper nigrum [L.]] essential oil and piperine: A review. Clin Phytoscience. 2021;7[1]:52.

6. Akbar S. Trachyspermum ammi [L.] Sprague [Apiaceae/Umbelliferae] [Syns.: T. copticum [L.] Link.; Ammi copticum L.; Carum copticum [L.] Benth. & Hook. f.; Ptychotis coptica [L.] DC.]. In: Handbook of 200 Medicinal Plants: A Comprehensive Review of Their Traditional Medical Uses and Scientific Justifications. Springer; 2020. p. 1825–34.

7. 7. Al Binali Hah, Erdemir Ad, Kaadan An, Oncel O, Aksoy S, Al-Ghazal Sk, Et Al. Journal Of The International Society For The History Of Islamic Medicine [Jishim]. Jishim. 2004;

8. Dry Hcw. Theoretical Basis Of Unani Medicine. More Textb. :568.

9. Ahmad A. Amraz Kabid [Hepatic Disorders] In Classic Literature OF UNANI SYSTEM OF MEDICINE [PART IV]. J Indian Med Herit. 2011;41[2]:221–47.

10. Khan AS, Ansari SA, Devi U, Kashyap S, Ansari FA, Jahan R, et al. Physico-Chemical And Microscopical Standardization Of Classical Unani Formulation: Jawarish-E-Falafali. 2024;

11. Khare CP. Indian Herbal Remedies. New York: Springer; 2004. 67–69, 100, 130–32, 144, 367–70, 467–69, 488–91 p.

12. Shah SS, Shah GB, Singh SD, Gohil PV, Chauhan K, Shah KA, et al. Effect of piperine in the regulation of obesity-induced dyslipidemia in high-fat diet rats. Indian J Pharmacol. 2011;43[3]:296–9.

13. Jin Z, Borjihan G, Zhao R, Sun Z, Hammond GB, Uryu T. Antihyperlipidemic compounds from the fruit of Piper longum L. Phytother Res Int J Devoted Pharmacol Toxicol Eval Nat Prod Deriv. 2009;23[8]:1194–6.

14. Mansi K, Abushoffa AM, Disi A, Aburjai T. Hypolipidemic Effects of Seed Extract of Celery [Apium graveolens] in Rats. Pharmacogn Mag. 2009;5:301–5.

15. Indu Sharma IS, Deepali Gusain DG, Dixit V. Hypolipidaemic and antiatherosclerotic effects of Zingiber officinale in cholesterol fed rabbits. 1996;

16. Boskabady MH, Alitaneh S, Alavinezhad A. Carum copticum L.: a herbal medicine with various pharmacological effects. BioMed Res Int. 2014;2014[1]:569087.

17. Khan RM, Ahmad W, Ahmad M, Hasan A. Phytochemical and pharmacological properties of Carum carvi. Eur J Pharm Med Res. 2016;3[6]:231–6.

18. Agrahari P, Singh DK. A review on the pharmacological aspects of Carum carvi. J Biol Earth Sci. 2014;4[1]:1–13.

19. Khan M, Safdar M, Khattak KN, Anderson RA. Cinnamon improves glucose and lipids of people with type 2 diabetes. Diabetes Care. 2003;26[12]:3215–8.

20. Abeysekera WPKM, Arachchige SPG, Ratnasooriya WD. Bark Extracts of Ceylon Cinnamon Possess Antilipidemic Activities and Bind Bile Acids In Vitro. Evid Based Complement Alternat Med. 2017;1–10.

21. Devi VS, Rao MG. Valeriana wallichii-a rich aroma root plant-a review. 2014;

22. Singhal HK. Neetu and Lovelyn J. A comprehensive review on Tagara [Valeriana wallichii]. Ayurpharm Int J Ayur Alli Sci. 2013;2[5]:144–50.

23. Si X yun, Jia RH, Huang C xin, Ding GH, Liu HY. Effects of Valeriana officinalis var. latifolia on expression of transforming growth factor beta 1 in hypercholesterolemic rats. Zhongguo Zhong Yao Za Zhi Zhongguo Zhongyao Zazhi China J Chin Mater Medica. 2003;28[9]:845–8.

24. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd edn. Delhi: Periodical Expert Book Agency; 2005. 993, 1199, 1201, 1311 p.

25. Hardani A, Afzalzadeh MR, Amirzargar A, Mansouri E, Meamar Z. Effects of aqueous extract of celery [Apium graveolens L.] leaves on spermatogenesis in healthy male rats. Avicenna J Phytomedicine. 2015;5[2]:113–9.

26. Iyer D, Patil UK. Assessment of Antihyperlipidemic and Antitumor Effect of Isolated Active Phytoconstituents from Apium graveolens L. through Bioassay-Guided Procedures. J Diet Suppl. 2018;

27. Gurav S, Gurav N. A Comprehensive review: Bergenia ligulata Wall-A controversial clinical candidate. Int J Pharm Sci Res. 2014;5[5]:1630.

28. Nardev Singh NS, Vijay Juyal VJ, Gupta A, Manoj Gahlot MG. Evaluation of ethanolic extract of root of Bergenia ligulata for hepatoprotective, diuretic and antipyretic activities. 2009;

29. ElRokh ESM, Yassin NA, El-Shenawy SM, Ibrahim BM. Antihypercholesterolaemic effect of ginger rhizome [Zingiber officinale] in rats. Inflammopharmacology. 2010;18[6]:309–15.

30. Anonymous. The Unani Pharmacopeia of India. Vol. 1,2,3,4. New Delhi: CCRUM, Department of AYUSH, Ministry of Health & Family Welfare, Government of India; 2007. 15, 38, 88, 82, 93, 92 p.

31. Kasilo OMJ, Wambebe C. Traditional and Complementary Medicine in Global Health Care. In: Kickbusch I, Ganten D, Moeti M, editors. Handbook of Global Health [Internet]. Cham: Springer International Publishing; 2021. p. 1459–505. Available from: https://doi.org/10.1007/978-3-030-45009-0_63