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SHORT REVIEW

Systematic Drug Review on *Mookirattai Chooranam* in the Management of Musculoskeletal Diseases and Gastrointestinal Diseases

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Abstract

Background: Based on earlier reports from the World Health Organization (WHO), about 60% of the world's population relies on herbal medicine, while 80% of people in developing countries primarily depend on herbs for their healthcare needs. The *Siddha* system, known as the oldest and most well-documented Indian medical system, has traditionally used herbal remedies to treat numerous ailments. *Mookirattai chooranam* is a *Siddha* polyherbal formulation, mentioned in the classical literature *Siddha Vaithiya Thirattu*. The formulation includes four herbal ingredients, and all of them must be purified using traditional methods before obtaining the medicine. This review outlines the scientific overview of the pharmacological effects of all the ingredients with traditional indications. **Aim:** This study set out to assess the pharmacological parameters by the indications mentioned in the literature compared with scientific evidence. **Methods:** The information was gathered from various *Siddha* texts and electronic databases spanning the period from 1997 to the present. **Results:** The findings of the review indicated that the pharmacological effects and therapeutic applications of the drug were in complete alignment with each component of the formulations. Based on the literature review, the *Mookirattai chooranam* is proven to have antioxidant, anti-inflammatory, anti-arthritic, antimicrobial, and hepatoprotective activity as evident from the current review. **Conclusion:** Further studies for the evaluation of pharmacological efficacy may proceed to assess the efficacy of the drug.

Major Finding: *Mookirattai Chooranam*, composed of hot potency and compatible tastes, aligns with Siddha principles to effectively streat deranged Vali and Iyam conditions. Its ingredients exhibit pharmacological actions supporting its traditional therapeutic use. This study lays a foundation in bridging a gap between traditional wisdom with modern findings.

Keywords: Drug Review, Herbal Medicine, *Mookirattai chooranam*, Pharmacological Activity, *Siddha* Medicine

1. Introduction

Herbal medicines, rooted in ancient medical systems like Unani, Ayurvedic, *Siddha*, and Chinese medicine, use plant-based ingredients such as leaves, roots, and flowers to treat physical and psychological disorders[1,2]. The World Health Organization emphasises the importance of researching these plants for their therapeutic efficacy, safety, and active compounds, with *Siddha* medicine alone documenting around 600 medicinal plants[3,4]. *Siddha* medicine categorises medicines as internal or external, with *choornam* being an important medicinal form. It is a powdered mix of medicinal substances, taken orally with adjuvants like water or honey to enhance its effects[5]. The fine particle size of *choornam* ensures rapid dissolution and assimilation in the body, making it an efficient mode of drug delivery in *Siddha* medicine[6]. *Mookirattai chooranam* is a *Siddha* Polyherbal formulation consisting of roots of *Boerhaavia diffusa* Linn., *Abrus pulchellus* Wall. *ex* Thwaites, *Cassia roxburghii* DC, and fruit of *Terminalia chebula* Retz[7]. The medicine is widely

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prescribed as per indication for the treatment of ascites, skin diseases, Gouty arthritis, and constipation[7,8]. *B. diffusa* (commonly known as *Punarnava*) is widely used in *Siddha* medicine, particularly for treating *Vatha* diseases (disorders related to the *Vata dosha*). In *Siddha* literature, it is metaphorically described as "Like a snake silently in the cage," which suggests it's potent yet subtle in action. This analogy implies that *B. diffusa* remains dormant but highly effective when needed, just as a snake stays quiet in a cage but can act powerfully when required[8]. Any derangement in the balance of *Vali, Azhal, Iyam* humors can lead to illness. The *Vali* humor controls bodily movements, including the functioning of organs, reflexes, and coordination. When *vali* becomes disturbed in a specific organ, it can cause symptoms such as pain, weakness, tremors, stiffness, and loss of function, known as *vali* disorders. *Siddha* texts describe 85 types of *vali*-related conditions, mostly musculoskeletal in nature, although other issues like hernias are also included[9]. Musculoskeletal Disorders (MSDs) are a global health issue, causing pain and disability across various populations. These conditions, affecting bones, joints, and muscles, result from factors like inflammation, mechanical stress, and genetic predisposition. MSDs led to structural damage, functional loss, and chronic pain[10,11]. These conditions are a major focus of treatment in *Siddha* medicine[9]. This review aims to assess the pharmacological action such as anti-inflammatory, anti-arthritic, analgesic, antioxidant, anti-microbial, anthelmintic activity, gastroprotective, and hepatoprotective activity relevant to the indication in the literature and scientific evidence from efficacy studies derived from published data bases. This review also discusses the importance of the combination of above formulation following the philosophy of *pagai suvai* (inimicable) and *natpu suvai* (compatible) tastes along with its potency[12].

2. Materials and Methods

The data was collected through an extensive review of various electronic databases, including Google Scholar, PubMed, Wiley, Science Direct, ACS Publications, Springer Link, Semantic Scholar, and Embase, using keywords such as "*Boerhavia diffusa*", "*Abrus pulchellus*", "*Abrus monospermus*", "*Abrus reticulosis*", "*Cassia roxburghii*", "*Cassia marginata*", "*Terminalia chebula* fruit," "Pharmacological activity," "Hepatoprotective activity," "Antiulcer activity", "Antioxidant", "Anti-inflammatory", "Analgesic", "Anti-nociceptive", "Anti-arthritic", "Gastroprotective", "Antibacterial", "Antimicrobial," and "Anthelmintic activity," along with their combinations. Special emphasis was placed on keywords related to pharmacological actions, ethnopharmacology, traditional medicine, *Siddha*, and herbal medicine. The data collected primarily covered the period from 1997 to 2024, and the analysis took about six months.

All the articles were included based on their relevance to the ingredients of *Mookiratai chooranam* and its therapeutic indications, the availability of full-text articles, and the study design, such as clinical trials, mechanistic studies, and reviews. Articles were excluded if they were duplicates, not relevant to the subject, or lacked adequate methodological details. Studies that did not focus on treatments or not directly applicable to the topic were also excluded. The selection process involved several steps: screening titles and abstracts, reviewing full texts, and applying inclusion and exclusion criteria to ensure only relevant and high-quality studies were included. This process ensured that the studies provided valuable information on the role of *Mookiratai chooranam* in the treatment of musculoskeletal and gastrointestinal diseases.

Table 1. Drug profile of *Mookirattai chooranam*

Tamil name	Qty	Botanical name	Family	Part used	Taste	Potency	Division
Mookirattai Ver	50g	*Boerhavia diffusa* Linn.[8]	*Nyctaginaceae*[13]	Root	Bitter	Hot	Pungent
Kundri Ver	50g	*Abrus pulchellus* L. Wall. ex Thwaites[8] Synonym: *Abrus fruticulosus*[14]	*Fabaceae*[13]	Root	Bitter and sweet	Hot	Pungent
Kondrai Ver	50g	*Cassia roxburghii* DC[8] Synonym: *Cassia marginata* Roxb[15]	*Fabaceae*[13]	Root	Bitter	Hot	Pungent
Kadukkai Thol	150g	*Terminalia chebula* Retz[8]	*Combretaceae*[13]	Fruit	Pungent	Hot	Sweet

3. Methodology

3.1 Preparation

All the raw drugs depicted in Table 1 was purchased from a raw drug store and any contaminants were removed (Figure 1). Necessary drugs were purified according to the standard procedure, then pulverised and ground. These powdered drugs were steamed (*pittaviyal*) using milk, after which they were powdered and dried in sunlight. This process helped the *chooranam* lose its undesirable or toxic effects, thereby aiding in better dosage efficacy and preventing early spoilage[5].

(i) Indications: Ascites, stomach pain, constipation, arthritis, and skin diseases.

(ii) Shelf-life: 6 Months

3.2 Phytochemical Composition

Phytochemical components in the herbs used in this study are summarised in Table 2. *Boerhaavia diffusa* Linn. has antioxidant and anti-inflammatory properties with xanthone and flavonoids[16-18]. *Abrus pulchellus* Wall. ex Thwaites shows antioxidant and anti-bacterial effects, containing pulchellin[19]. *Cassia roxburghii* DC offers antioxidant and liver protection with alkaloids and flavonoids[20]. *Terminalia chebula* Retz provides antioxidant and hepatoprotective activity, with corilagin and punicalagin[21].

3.3 Antioxidant Activity

3.3.1 *Boerhaavia diffusa* Root

Using a 1,1-diphenyl picrylhydrazyl (DPPH) free radical scavenging experiment, Richa Bhardwaj *et al.*, assessed the total antioxidant capacity of the methanol extract of the leaves, stem, and root of *B. diffusa*. They also estimated the flavonoid, total phenolic, and ascorbic acid contents using spectrophotometric methods. The highest reported total phenolic content in leaves was 24.5±1.703 mgGAE/gdw. Additionally, leaves had the highest total flavonoid concentration (79.86±3.757)

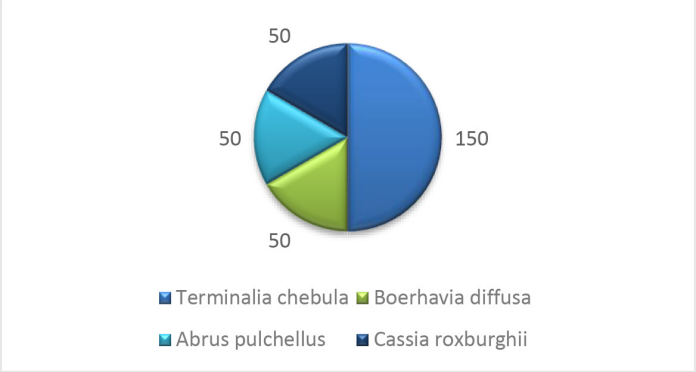


Figure 1. Representation of drug profile of *Mookirattai chooranam*.

Table 2. Pharmacological action and Phytochemical constituents of *Mookirattai Chooranam*

Botanical name	Action	Phytochemical constituents
Boerhaavia diffusa Linn.	Antioxidant, Anti-inflammatory, Analgesic, Anti-arthritic, Antimicrobial, Gastrointestinal disorders, Hepatoprotective	Xanthone, sterol ester, sterol, purine nucleoside, Lignin, Isoflavone, Hydrocarbons, Flavanol, flavonoid glycoside, Flavone, fatty acid, ecdysteroid, Coccineone-E, Coccineone-B, Boeravinone-A – O (a group of rotenoids), 10-O Demethyl boeravinone C[16-18]
Abrus pulchellus Wall. ex Thwaites	Antioxidant, Anti-bacterial, Insecticidal activity	Pulchellin, Kaikasaponin[19]
Cassia roxburghii DC	Antioxidant, Antimicrobial Hepatoprotective	alkaloids, glycosides, flavonoids, steroids, saponins, triterpenoids and carbohydrate[20]
Terminalia chebula Retz	Antioxidant, Anti-inflammatory, Analgesic, Anti-arthritic Antimicrobial, Gastrointestinal disorders, Hepatoprotective	Corilagin, chebulanin, chebulagic acid, maslinic acid, succinic acid, punicalagin, terchebulin, Myrobalan[21]

mQE/gdw). Ascorbic acid content ranged from 0.333±0.166 mg/gdw in leaves to 0.026±0.002 mg/gdw in roots. Stems exhibited the better radical scavenging action, with an IC_{50} value of 90.8±2.275[21].

The antioxidant potential of *Andrographis echioides* (L.) Nees and *B. diffusa* was evaluated by measuring enzymatic and non-enzymatic antioxidants. Both plant extracts showed significant antioxidant levels, indicating their role in maintaining cell survival, interaction, and membrane structure. These plants have therapeutic antioxidant potential against inflammatory diseases[22].

3.3.2 *Terminalia chebula* Fruit

The following metrics were used to evaluate the antioxidant activity of the polyphenolic extract from the fruit of *T. chebula in vitro*: The assay for reducing power demonstrated a significant increase, with r2 = 0.989. Additionally, the total antioxidant capacity was found to range between 0.140 and 0.387 at graded concentrations of 50-500 µg/mL (r^2 = 0.963), with the highest concentrations of nitric oxide radicals (IC_{50} 30.51 µg/mL), DPPH radicals (IC_{50} 14±0.05 µg/mL), and hydrogen peroxide scavenging activity (IC_{50} 265.53 µg/mL). The findings of this study suggest that the extract has a significant capacity to decrease and scavenge nitric oxide. It also scavenges the radicals that hydrogen peroxide produces. The total polyphenolic content of the extract may be responsible for its action. The antioxidant activity of the extract is concentration-dependent and significantly higher than that of ascorbic acid standard[23].

The antioxidant properties of *T. chebula* were evaluated using various extracts and methods, showing significant anti-superoxide radicals, anti-lipid peroxidation, and free radical scavenging activities. Hexane extracts demonstrated strong antioxidant effects and high phenolic content. The aqueous extract helped balance oxidants and antioxidants in rat heart tissues, reducing age-related oxidative stress. Methanolic extracts from different fruit parts showed a correlation between phenolic content and antioxidant activity. Oral administration of ethanolic extracts reduced oxidative stress markers and increased antioxidant levels in rats. Comparative studies of unfermented and fermented extracts revealed distinct antioxidative patterns. Combined with other medicinal plants like in Triphala, *T. chebula* Retz exhibited synergistic antioxidant effects[24-31].

3.4 Anti-inflammatory Activity

3.4.1 *Boerhavia diffusa* Root

The anti-inflammatory activity of *B. diffusa* hydroalcoholic extract was assessed in Wistar Albino rats of 4 groups. For 21 days, different dosages of a hydroalcoholic plant extract and indomethacin (3 mg/kg) were given every day. Joint diameter, pro-oxidant (MDA) and antioxidant (GSH) marker levels, and histopathological examination were ruled out. The impact of *B. diffusa* on anti-inflammatory (IL-10), pro-inflammatory (IL-1), TNF-α and its receptor, TNF-R1, angiogenesis (VEGF), Nrf-2, and NF-κB was assessed by immunohistochemical analysis. The study showed that different doses of *B. diffusa* significantly ($p<0.05$) reduced inflammation by lowering levels of oxidative stress indicators. A substantial reduction in inflammation and joint dysfunction was observed at a dose of 200 mg/kg of *B. diffusa,* with a significance level of $p<0.001$[32,33].

3.4.2 *Terminalia chebula* Fruit

In the *in vivo* investigation, Atopic Dermatitis was produced in NC/Nga mice using *Dermatophagoides farinae* extract (Dfe). The effects of *Terminalia chebula* Retz concentrations of 30, 100, and 300 mg/kg were examined after 14 days of oral administration by visual inspection of morphological changes, measurement of serum levels of inflammatory chemokines/cytokines, IgE, histamine, RANTES, TARC, MDC, and TSLP using ELISA kits, and count of infiltrated mast cells. The administration of *Terminalia chebula* Retz drastically reduced the thickness of the ears, the dermatitis score, the keratinization, and the infiltration of mast cells, as well as the AD-like symptoms *in vivo*. In comparison to the Dfe therapy group, it also led to lower serum levels of histamine, IgE, and inflammation-related mediators MDC, RANTES, TSLP, and TARC[29].

3.5 Analgesic Activity

3.5.1 *Boerhavia diffusa* Root

The analgesic activity of *Boerhavia diffusa* Linn. root in acetic acid-induced writhings test on mice by administering 150mg/kg of *B. diffusa* root powder for

15 days and found that there is a decrease in number of writhings after the test drug treatment[34,35].

3.5.2 *Terminalia chebula* Fruit

The hot plate method was employed to evaluate the analgesic efficacy of *Terminalia chebula* Retz. 250 mg/kg and 500 mg/kg of *T. chebula* ethanolic extract were compared to the standard ketorolac and control group, the test demonstrated a considerable increase in the mean reaction time to heat stimuli doses throughout the observation period in 30 min and 60 min after treatment[36].

The crude extract of *Terminalia bellerica* (Gaertn.) Roxb demonstrated analgesic and anti-secretory properties. At doses of 300-1000 mg/kg, the extract significantly reduced castor oil-induced intestinal fluid secretion in mice. Additionally, in a dose-dependent manner (50-100 mg/kg), the extract reduced the number of acetic acid-induced writhing episodes in mice. These findings support the potential use of *T. bellerica* is a therapeutic agent for managing pain and diarrhoea, highlighting its antisecretory and antinociceptive effects[37].

3.6 Anti-arthritic Activity

3.6.1 *Boerhavia diffusa* Root

The anti-arthritic effects of various extracts of *Boerhavia diffusa* Linn. were evaluated *in vivo*. Among all the extracts, the methanolic extract notably reduced paw volume in all treated groups. It also significantly restored body weight. The findings of the study indicated that all extract-treated groups resulted in substantial changes in hematological parameters, with the most significant effects observed at a dose of 400 mg/kg. Since the methanolic extract exhibited the most pronounced activity in the arthritic model, and its phytochemical analysis identified the presence of flavonoids and phenolic compounds, the anti-arthritic activity of the root extracts is likely attributed to the flavonoids[34].

The anti-arthritic activity of *Boerhavia diffusa* Linn. was studied in Wistar albino rats using Freund's Adjuvant-induced arthritis. The study contained 4 groups *viz*: Control, Standard, 500mg/kg, 1000mg/kg. The mean change in rat paw oedema was monitored periodically. On the 21st day, the percentage of inhibition of paw oedema was calculated and Group 2 (Standard) was found to inhibit 77.07 % Group 4 (1000mg/kg) was found to inhibit 62.88%. Thus comparatively, the study drug is significantly effective in the treatment of arthritis[35].

3.6.2 *Terminalia chebula* Fruit

The standard ethanolic extract (NDI10218) of *T. chebula* was evaluated to treat collagen-induced arthritis. DBA/1J mice were immunised with bovine Type II collagen to cause arthritis, and the mice were then treated with NDI10218 once a day for five weeks following the development of the disease. In a concentration-dependent manner, standard ethanolic extract inhibited synovial hyperplasia and decreased the arthritis index[38].

The anti-arthritic activity of chebulanin derived from the fruit of *Terminalia chebula* Retz by administering chebulanin, intragastrically to DBA/1 mice with collagen-induced arthritis. Using immunohistochemical staining to measure the expression of inflammatory cytokines and relative enzymes, the histopathological evaluation of the joints was used to score the severity of arthritis. Micro-CT was used to confirm bone erosion and destruction concurrently. Chebulanin considerably reduced the severity of arthritis. To be more precise, when compared to control mice, the histological features of the tissues improved and the expression of interleukin 6, tumor necrosis factor, matrix metalloproteases, and COX2 declined gradually with increasing concentration in the paws and joints of the treated animals. Additionally, chebulanin caused a dose-dependent decrease in bone erosion and cartilage degradation[39].

3.7 Anti-spasmodic Activity

3.7.1 *Boerhavia diffusa* Root

The roots of *Boerhavia diffusa* Linn. contain nonprenylated rotenoids and boeravinone E which act as powerful spasmolytic agents. The methanolic root extract was effective in relieving spasms caused by exogenous agents (such as acetylcholine, histamine, and barium chloride) and electrically induced contractions in the isolated ileum. While intracellular calcium provides negative regulation for intestinal motility, extracellular calcium may be involved in the spasmolytic effect[40].

3.7.2 *Terminalia chebula* Fruit

Vasoconstriction and intestinal spasms all are decreased in many investigations on *Terminalia Chebula* Retz, suggesting the "anti-*vata*" or "anti-spasmodic" qualities suggesting efficacy for digestive problems, such as spastic colon, among others[41].

3.8 Anti-Microbial Activity

3.8.1 *Boerhavia diffusa* Root

The antimicrobial potential of both aqueous and methanolic extracts of *Boerhavia diffusa* Linn. was assessed through the good diffusion method against various bacterial strains, including *Streptococcus* species, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Escherichia coli*, and *Bacillus subtilis*. The study revealed that the methanolic extract showed considerable antimicrobial activity, as evidenced by the inhibition zones which ranged from 8 to 18 mm. In comparison, the aqueous extract also displayed significant antimicrobial effects, though the inhibition zones were smaller, ranging from 8 to 10 mm. These findings suggest that both extracts possess antimicrobial properties, with the methanolic extract being somewhat more effective than the aqueous one in inhibiting bacterial growth[42].

3.8.2 *Terminalia chebula* Fruit

The antimicrobial activity of the aqueous extract of *Terminalia chebula Retz* done using agar well diffusion method zones of inhibition was 13.46-26.56 mm for Gram-positive, 11.5-18.33 mm for Gram-negative, and 14.46-18.53 mm for fungal strains. *Proteus mirabilis* had the largest zone (26.56 mm), while *P. aeruginosa* was the most resistant (19.5 mm). Variations are attributed to chemical permeability and bacterial resistance[43]. The methanol extract had the maximum efficacy against *E. coli*, followed by *S. boydii* and *S. fascalis*, with an inhibition zone mean diameter of 14 mm and a Minimum Inhibitory Concentration (MIC) of 1 mg/ml[44].

3.9 Gastroprotective Activity

3.9.1 *Boerhavia diffusa* Root

The protective effect of *Boerhavia diffusa* Linn. on gastrointestinal issues, especially peptic ulcers, is due to its ability to restore the balance between protective and damaging factors in the stomach. Protective factors include bicarbonate secretion, mucosal blood flow, prostaglandins, and mucus, while harmful factors such as *Helicobacter pylori*, gastric acid, and pepsin contribute to ulcer formation. The anti-ulcer properties of *Boerhavia diffusa* Linn. involve promoting healing, regulating gastric secretions, reducing inflammation, and stimulating mucus production. Research has shown that the root extract of *T. chebula* both alone and in combination with omeprazole, effectively reduces gastric ulcer formation in rats induced by indomethacin, pylorus ligation, and stress. This healing effect is associated with a decrease in gastric secretion and acidity[45].

3.9.2 *Terminalia chebula* Fruit

The gastroprotective activity of *Terminalia chebula* Retz was assessed *in vivo*. Rats were given oral sulfasalazine and intracolonic acetic acid, which resulted in the development of colitis in the rats. The ethanolic extract of *T. chebula* was found to enhance tissue regeneration by decreasing lymphocytic infiltration, reducing free radical concentrations, and increasing antioxidant activity in the colonic mucosal homogenate. Additionally, the extract led to a considerable decrease in the colonic injury score, as well as decreases in both weight loss and adhesion formation[46]. In mice given castor oil to induce diarrhoea, the antidiarrheal effect was observed along with any visible alterations in the liver and small intestine. The active component of the *Chebulae fructus* aqueous extract, decreased diarrhea[47]. In Charles Foster rats, gastric emptying was noted. It had been found that *T. chebula* increased gastric emptying increased ((86.57 +/- 6.65%). The extracts of *T. chebula* undergo *in vivo* testing, and the results of rat faecal production are contrasted with those of the reference medication, bisacodyl[48].

3.10 Hepatoprotective Activity

3.10.1 *Boerhavia diffusa* Root

The petroleum, chloroform, and methanol extracts from both root and aerial parts exhibit anti-hepato-toxic properties, as demonstrated by a decrease in elevated levels of transaminases and Serum Alkaline Phosphatase (SALP) in rats with hepatotoxicity induced by carbon tetrachloride[49]. The *B. diffusa* extract is studied by Patel Monali *et al.,* concerning

carbon tetrachloride (CCl4)-induced hepatotoxicity in mice. *B. diffusa* extract was co-treated with CCl4 (1/10 of the LD_{50} value) in Swiss albino female mice at three distinct doses (100, 200, and 300 mg/kg body weight/day). Lipid peroxidation, histological examination, and serum marker enzymes were employed to assess the hepatoprotective potential of the *B. diffusa* plant extract. There is a dose-dependent reduction in bilirubin levels, lipid peroxidation, and the activity of liver enzymes that was statistically significant ($p<0.05$). Additionally, co-treatment of *B. diffusa* extract greatly reduced the histopathological alterations caused by CCl4[50]. A study evaluated the *in vivo* hepatoprotective activity against thioacetamide toxicity of various *B. diffusa* roots collected at different seasons and sizes. The elevated serum liver enzyme levels were significantly lowered by the aqueous extract from the thin roots of *B. diffusa,* in contrast to the thick roots. This suggests that the extract derived from the thin roots offers greater hepatoprotective effects[50].

3.10.2 *Terminalia chebula* Fruit

The hepatoprotective effects of the water extract of *T. chebula* (TCW) and its associated pharmacological activities were examined in a C57/BL6 mouse model of acute liver damage caused by tert-butyl hydroperoxide (t-BHP). Mice were orally administered TCW (at doses of 0, 50, 100, or 200 mg/kg) or gallic acid (100 mg/kg) for five days before receiving an injection of t-BHP (2.5 mM/kg). Liver samples were collected 18 hours after t-BHP administration, and mRNA expression levels of markers such as TNF-α, iNOS, Interleukin-1β, Interleukin-6, CAT, and CYP2E1, as well as antioxidant enzymes (SOD-1, SOD-2, SOD-3 GSH-Rd, GSH-Px, and GSH-Sy,) were analyzed. TCW pretreatment notably reduced the alterations in these markers, with the observed effects linked to changes in gene expression. Histopathological analysis also supported these findings[51].

3.11 Antihelminthic Activity

3.11.1 *Terminalia chebula* Fruit

The anthelmintic activity of aqueous and alcoholic extracts from *T. chebula* fruits was studied by observing the paralysis and death times of test organisms at various concentrations. Both extracts showed a concentration-dependent response, with increasing concentrations resulting in longer paralysis and death times. The alcoholic extract demonstrated more potent effects than the aqueous extract, with paralysis and death occurring more quickly at similar concentrations. However, the standard drug albendazole was more effective than both extracts, showing significantly faster paralysis and death times at all tested concentrations[52].

4. Discussion

According to *Siddha* philosophy, *Siddha* medicinal preparations are formulated by combining compatible taste and inimitable taste which are beneficial in enhancing the properties of the medicine by catalyzing each other activity and helping in curing diseases. *Mookirattai chooranam* contains – *Boerhavia diffusa* Linn., *Abrus pulchellus* Wall. ex Thwaites, *Cassia roxburghii* DC which are bitter (Air + Space element) in taste that are compatible with *T. chebula* fruit which is a pungent (Air + Fire element) taste. *Siddha's* philosophy emphasises that compatible taste enhances the efficacy of medicine in curing diseases. Diet and medications undergo inevitable changes when they are digested, but these changes often go unnoticed while the substance is being ingested. Once consumed, the digestive process begins to alter the characteristics of the substance, making it suitable for assimilation into the body. This transformation is not random but is guided by what is referred to as the "digestive fire." The digestive fire is an internal process that modifies the substance in a way that it can be absorbed and utilised by the body. Although some properties of the substance may persist after digestion, the final result of the digestion process is determined by the "division" (*Vipagam*) of the substance. *Vipagam* refers to how the substance is categorised and processed by the digestive system based on its nature and the needs of the body. The ultimate direction of this division is influenced by the individual's unique digestive fire. Each person's digestive fire is different, based on various factors like health, constitution, and environment, and it plays a vital role in biotransforming the ingested substance. This means that the digestive fire does more than just break down food or medicine; it also determines how the body metabolises and uses the nutrients or compounds it contains. Thus, the effectiveness of the ingested drug or food largely depends on how the

digestive fire interacts with the substance[53]. The drug *Mookirattai chooranam* mainly consists of pungent and sweet division. Based on Siddha philosophy of five elements, Pungent is composed of Air and fire elements; Sweet is composed of earth and water elements. Potency is one of the crucial factors in constituting the pharmacology of the drug. Potency in *Siddha* is envisaged as the potential factor by which it performs specific actions in the body. The medicine *Mookiratai chooranam* is composed of drugs of hot potency. Due to the hot potency of *Mookirattai chooranam*, it will be effective in the treatment of deranged *vali* and *iyam*-related diseases[54,55]. The ratio of the three ingredients *Boerhavia diffusa* Linn., *Abrus pulchellus* Wall. ex Thwaites, *Cassia roxburghii* DC, has a pungent taste which in turn equalises the ratio of *Terminalia chebula* RetZ having a sweet taste. This is in perfect accordance with the taste concept in *Siddha* medicine which prevents adverse drug reactions. The potency of the individual drugs of the formulation as well as the whole formulation is hot which is effective in the treatment of deranged *Vali* and *Iyam*[54]. The *Boerhavia diffusa* Linn. root decoction is individually given for the treatment of ascites, and Vali disorders[8]. There is limited research specifically on the roots of the *Abrus pulchellus* Wall. ex Thwaites. However, the methanolic extract of leaves is studied for anti-bacterial, antioxidant and insecticidal activity[56]. This study revealed that most of the ingredient in the formulation demonstrates a range of pharmacological properties, which align with the traditional uses specified for the preparation. These properties include antioxidant, anti-inflammatory, analgesic, hepatoprotective, gastroprotective, and antimicrobial effects. Thus, the pharmacological profile of *Mookirattai Chooranam* supports its traditional uses, confirming the therapeutic relevance of its ingredients.

5. Conclusion

This study concludes that the pharmacological effects, organoleptic characteristics, and chemical makeup of all the ingredients exactly matched the indication of *Mookirattai chooranam* as indicated in the *Siddha* literature. Thus, it will be effective in the treatment of diseases predominantly of *Vali* and *Iyam* origin.

6. Author Contribution

Abarna B – Conceptualization, Writing - Original Draft, Investigation, Methodology, Funding acquisition, Project administration, Writing- review and editing, Resources; Karpagambal R – Writing – Original draft, Methodology, Investigation, Data curation; Raghavi M- Writing- review and editing, Software, Data curation, Formal analysis; Suresh R – Writing- Review and editing, Software, Data curation, Formal analysis; Manjari V – Supervision, Validation. All authors have read and agreed to the published version of the manuscript.

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