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Review Article

VAAZHAI VADAGAM IN THE MANAGEMENT OF *PERUMBADU* (MENORRHAGIA) - SYSTEMATIC DRUG REVIEW

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ABSTRACT

Menorrhagia, known as *Perumbadu* in the Siddha system of medicine, is a common gynecological disorder characterized by excessive menstrual bleeding. *Vaazhai Vadagam*, a classical Siddha formulation prepared mainly from Musa paradisiaca flower along with other medicinal ingredients, has been traditionally used for *Perumbadu*, but scientific validation of its pharmacological basis is still limited. **Objective:** This systematic review aimed to compile and analyse Siddha textual references and modern scientific evidence regarding the phytochemical constituents and pharmacological activities of *Vaazhai Vadagam* and its ingredients in relation to the pathophysiology of menorrhagia. **Methods:** A comprehensive literature search was carried out in electronic databases including PubMed, Google Scholar, Science Direct, Springer Link, Wiley, Embase, and Semantic Scholar. Studies were selected based on their relevance to the ingredients of *Vaazhai Vadagam*, pharmacological activities, and therapeutic implications for menorrhagia. In vitro, in vivo, clinical, and review studies were included, while irrelevant or methodologically inadequate studies were excluded using predefined inclusion and exclusion criteria. **Results:** The constituents exhibit pharmacological activities relevant to menorrhagia, including hemostatic, anti-inflammatory, antioxidant, hormonal modulatory, anti-angiogenic, uterotonic, and hematinic effects. Buffalo buttermilk used in processing may enhance phytochemical bioavailability. The formulation targets key pathogenic mechanisms such as impaired endometrial hemostasis, inflammation, oxidative stress, hormonal imbalance, abnormal angiogenesis, and anemia. **Conclusion:** *Vaazhai Vadagam* shows a multi-targeted pharmacological potential that supports its traditional use in the management of *Perumbadu*. Nevertheless, further well-designed preclinical and clinical studies are required to establish its safety, efficacy, and standardization for evidence-based clinical application.

INTRODUCTION

Menorrhagia (heavy menstrual bleeding) is a significant reproductive health problem affecting women of reproductive age. According to the World Health Organization (WHO), menorrhagia is defined as menstrual blood loss greater than 80 ml per menstrual cycle or bleeding duration exceeding 7 days.[1] Women with HMB commonly report prolonged menstruation, passage of large clots and frequent changing of sanitary absorbents.

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Menstrual blood loss can be quantified using validated tools such as the Pictorial Blood Loss Assessment Chart (PBAC) or by Gravimetric measurement of used sanitary products to estimate blood volume. These assessments aid in distinguishing physiological menstrual variations from pathological bleeding. Early and accurate diagnosis is crucial to mitigate associated complication such as anaemia and impaired quality of life. HMB affects a substantial proportion of women globally and represents a significant public health concern. A pooled prevalence of nearly 49% has been reported across multiple low- and middle-income country (LMIC) settings, indicating that approximately one in two women in these regions experience HMB, which can markedly affect their health and daily functioning. Globally, prevalence estimates vary widely depending on the assessment method, with reported rates of 38.9% in America, 27.2% in Europe and 8% to 27% in developing countries[2]. In the siddha system of medicine, menorrhagia is correlated with *Perumbadu,* a condition described in classical Siddha texts as excessive uterine bleeding resulting from derangement of the humoral factors (*Vatham, Pitham, Kabam*) and uterine pathology. Siddha therapeutics emphasizes the use of herbal and herbo mineral formulations possessing stypic, cooling and tonic properties for the management of *Perumbadu. Vazhai (Musa paradisiaca)* is an important medicinal plant extensively documented in Siddha literature. Preparations such as *Vaazhai Vadagam* are traditionally employed in the management of menorrhagia due to their astringent and hemostatic properties. Classical Siddha texts and ethnomedical practices highlight the therapeutic potential of banana flower preparations in controlling menstrual bleeding. In recent years, there has been growing scientific interest in validating traditional medical systems through modern pharmacological and clinical research. However, systemic reviews integrating Siddha textual evidence with contemporary biomedical research on *Vaazhai Vadagam* remain limited. Therefore, the present study aims to comprehensively review Siddha literature and modern scientific evidence on the role of *Vaazhai Vadagam* in the management of *Perumbadu* (Menorrhagia), thereby, providing a scientific basis for its traditional therapeutic application.

MATERIALS AND METHODS

Data were collected through a comprehensive literature search in electronic databases including Google Scholar, PubMed, Wiley, ScienceDirect, ACS Publications, SpringerLink, Semantic Scholar, and Embase. Search terms such as *Musa paradisiaca*, *Syzygium aromaticum*, *Myristica fragrans*, *Cannabis sativa*, *Murraya koenigii*, *Rhus succedanea*, buffalo buttermilk, pharmacological activity, phytochemicals, antifibrinolytic activity, hemostatic/styptic activity, uterotonic activity, hormonal modulatory activity, anti-inflammatory activity, antioxidant, and vasoconstrictor activity were used individually and in various combinations. Particular emphasis was placed on studies related to pharmacological activities, ethnopharmacology, traditional medicine, the Siddha system, and herbal medicine. The review was conducted over a three-month period.

Articles were included based on their relevance to the ingredients of *Vaazhai Vadagam* and its therapeutic indications, availability of full-text articles, and study design, including clinical, mechanistic, and review studies. Studies were excluded if they were duplicates, irrelevant, or lacked adequate methodological details. Titles and abstracts were initially screened, followed by full-text evaluation, and predefined inclusion and exclusion criteria were applied to ensure the selection of relevant and high-quality studies. This systematic approach ensured that the included studies provided meaningful evidence on the potential role of *Vaazhai Vadagam* in the management of menorrhagia.

Vaazhai Vadagam in Siddha Literature[3]

Table 1: Literature review of *Vaazhai vadagam*

Book Name	Siddha Vaithiya Thirattu
Author	Dr. K. Kuppusamy Mudaliar, Dr. K. Uthamaraayan
Year of Publication	2009 (3rd publication)
Page Number	228
Drug Name	Vaazhai Vadagam
Dosage	Kazharchi kaai alavu urundai (2.7g)
Indication	Perumbadu

Table 2: Drug Profile of *Vaazhai Vadagam*[4]

Tamil name	Qty	Botanical name	Family	Part used	Taste	Potency	Division
Vaazhai poo	10.5g	*Musa paradisiaca*	Musaceae	Flower	Astringent	Heat	Sweet
Kirambu	10.5g	*Syzygium aromaticum*	myrtaceae	Floral bud	Pungent	Heat	Pungent
Saathikaai	10.5g	*Myristica fragrans*	Myristiceae	Dried seed	Astringent, Pungent	Heat	Pungent
Saathipathiri	10.5g	*Myristica fragrans*	Myristiceae	Aril	Astringent, Pungent	Heat	Pungent
Ganjah	10.5g	*Cannabis sativa*	Cannabaceae	Inflorescence	Bitter	Heat	Pungent
Karivembu	10.5g	*Murraya koenigii*	Rutaceae	Leaf	Mild pungent	Heat	Pungent
Karkatshringi	4.2g	*Rhus succedanea*	Anacardiaceae	Galls	Astringent	Heat	Pungent

METHODOLOGY

Preparation

The raw drugs listed in Table 2 were procured from an authenticated raw drug store and all foreign matter and contaminants were removed. The selected ingredients were purified according to standard Siddha purification procedures. The outer sheaths of the Mundan banana flower were removed, and the inner core was split into two parts. Clove, nutmeg, mace, cannabis, and curry leaves were added in equal quantities (two *Varagan* (10.5g) each), along with one *Varagan* (4.2g) of *Karkadaga Singi*. The ingredients were lightly roasted and powdered.

The powdered mixture was wrapped in cloth and tied with thread to form a bundle, which was immersed in buffalo buttermilk and cooked while ensuring complete submersion. After cooking, the material was ground and rolled into pills of *Kazharchi kai* (2.7g) size and dried. The formulation was administered orally at a dose of one pill in the morning and evening.

Indication: *Perumbadu* (Menorrhagia)

Shelf life: 3 months[5]

Phytochemical Composition

Musa Paradisiaca

Quantitative phytochemical analysis of *Musa paradisiaca* flower revealed a high tannin content (88.31±4.53mg/100g), which is known for its astringent and hemostatic properties. Gravimetric analysis showed the presence of alkaloids (1.56±0.2 g/100g) and saponins (1.43±0.14g/100g). Spectrometric analysis further confirmed the presence of total phenolics (5.83±0.78g/100g), flavonoids (3.98 ±0.01mg/100g)[15], and tannins. In addition, terpenoids, steroids, and glycosides were detected in different solvent extracts. The methanolic extract of the tepal (floral bract) showed the highest phenolic and flavonoid content, with values of 4.27mg GAE/g and 0.25mg QE/g, respectively[16]. Preliminary phytochemical screening indicated the presence of phenolics, flavonoids, alkaloids, tannins, and terpenoids in methanolic, ethanolic, and aqueous extracts, with the methanolic extract exhibiting the richest phytochemical profile.

Syzygium Aromaticum

Phytochemical analysis of *Syzygium aromaticum* (clove) essential oil revealed the presence of eugenol as the major bioactive compound, along with saponins, alkaloids, flavonoids, glycosides, tannins, and steroids[6]. In addition, clove is rich in various classes of phytochemicals, including sesquiterpenes, monoterpenes, hydrocarbons, and phenolic compounds. Among these, eugenol, eugenyl acetate, and β-caryophyllene are considered the principal active constituents of clove essential oil[7].

Myristica fragrans

Comprehensive phytochemical analyses of *Myristica fragrans* (nutmeg) have identified a wide range of bioactive compounds, including lignans (such as macelignan and meso-dihydroguaiaretic acid), phenylpropanoids (myristicin, elemicin, safrole, and eugenol), neolignans, terpenoids, flavonoids, tannins, and saponins. Several studies have reported that nutmeg contains lignans, neolignans, diphenylalkanes, phenylpropanoids, and terpenoids, which contribute to its diverse pharmacological activities. Among these, macelignan, meso-dihydroguaiaretic acid, myristicin, and malabaricone C are considered major bioactive compounds[23].

Cannabis sativa

Cannabis sativa has been reported to produce more than 500 bioactive compounds. Radwan et al. identified 125 cannabinoids, along with non-cannabinoid phenolics, flavonoids, terpenes, and alkaloids[29]. Similarly, Yadav et al. reported more than 588 bioactive compounds categorized into cannabinoid and non-cannabinoid classes, including terpenes, alkaloids, flavonoids, and phenolic compounds[30]. The major pharmacologically active phytocannabinoids include Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD), cannabinol (CBN), cannabigerol (CBG), and cannabichromene (CBC). Terpenes such as myrcene, limonene, β-caryophyllene, and linalool contribute to the “entourage effect” and possess independent biological activities[31].

Murraya koenigii

Murraya koenigii (curry leaf) is rich in carbazole alkaloids, including mahanimbine, koenimbine, girinimbine, murrayacine, murrayazoline, koenigine, and koenidine, along with flavonoids, tannins, coumarins, terpenoids, sterols, and carotenoids[39-41]. The leaves also contain essential oils such as pinene, sabinene, caryophyllene, cadinol, and cadinene, and are a significant source of minerals including iron, calcium, and zinc[42,43].

Rhus succedanea

Rhus succedanea (family Anacardiaceae; synonym *Toxicodendron succedaneum*) contains a distinctive range of biflavonoids and other bioactive compounds. Major phytoconstituents include robustaflavone, volkensiflavone, agathisflavone, succedaneaflavanone, rhusflavone, amentoflavone, cupressuflavone, hinokiflavone, and morelloflavone[48]. Urushiols are present in the resinous latex[49], and the novel compound rhusflavone, a flavanoflavone derivative, was first isolated from the drupes[50]. Antioxidant and cytotoxic hydroquinone derivatives, such as heptadecatrienylhydroquinone and heptadecadienylhydroquinone, have also been isolated from the plant sap[51].

Table 3: Comparative Phytochemical Profile Analysis (Across the Given Plants)

Plant	Major Dominant Phytochemicals	Quantitative / Key Notes
Musa paradisiaca	Tannins, phenolics, alkaloids, saponins, flavonoids	Tannins very high (88.31 mg/100 g); total phenolics 5.83 g/100 g
Syzygium aromaticum (Clove)	Eugenol (phenolic), terpenes, flavonoids, tannins	Eugenol is major bioactive
Myristica fragrans (Nutmeg)	Lignans, phenylpropanoids, terpenoids, flavonoids, tannins	Macelignan, myristicin highly active
Cannabis sativa	Cannabinoids, terpenes, flavonoids, phenolics	>500 compounds; CBD, THC, CBG
Murraya koenigii (Curry leaf)	Carbazole alkaloids, flavonoids, terpenoids, tannins	Mahanimbine, koenimbine etc.
Rhus succedanea	Biflavonoids, hydroquinones, urushiols	Robustaflavone, amentoflavone etc.

Pharmacological Activities Relevant to Menorrhagia

Musa Paradisiaca

The flower extract of *Musa paradisiaca* has demonstrated significant antioxidant activity, as evidenced by DPPH free radical scavenging with an IC_{50} value of 66.92±0.31μg/mL for the ethyl acetate extract. The inflorescence also exhibited blood clotting–related properties, suggesting potential hemostatic effects. The n-hexane extract was reported to contain high levels of phenolic compounds (26.40± 0.033mg gallic acid equivalents/g) and flavonoids (83.40±0.099mg quercetin equivalents/g)[17], which are known for their antioxidant and vascular protective activities.

In vivo studies have shown that the flower extract modulates estrogen and progesterone levels, indicating hormonal regulatory activity. Experimental studies in rat models demonstrated that treatment with floral crude extract corrected hormonal imbalances and reduced tumor progression in mammary carcinogenesis models, suggesting endocrine-modulating effects that could influence menstrual physiology[19]. Furthermore, banana blossom extract administered at doses of 200–800mg/kg ameliorated mifepristone-induced polycystic ovary syndrome (PCOS) in rats by restoring hormonal balance, which is clinically relevant as PCOS is a common cause of abnormal uterine bleeding[20].

Molecular docking studies have explored banana inflorescence compounds against PCOS-related molecular targets, supporting its traditional use in painful menstruation and heavy menstrual bleeding. Ethnomedical reports from tribal communities in India also describe the use of banana florets for the management of heavy menstrual bleeding and uterine fibroids[21].

However, despite promising preclinical evidence, no randomized controlled trials or well-designed observational studies have evaluated *M. paradisiaca* flower for menorrhagia in humans. While mechanistic evidence suggests that tannins provide astringent and hemostatic effects, flavonoids exert anti-inflammatory and vasoprotective actions, and the extract exhibits hormonal modulation, clinical validation remains lacking. In contrast, *Punica granatum* flower has been evaluated in a double-blind randomized controlled trial for heavy menstrual bleeding, highlighting the need for similar clinical studies on *M. paradisiaca*[22].

Syzygium Aromaticum

Syzygium aromaticum (clove) contains several bioactive flavonoids, including quercetin and kaempferol, which are known to strengthen capillary walls and reduce vascular fragility, thereby potentially decreasing excessive menstrual bleeding. These flavonoids also contribute to the anti-inflammatory properties of the plant[11].

Clove essential oil contains sesquiterpenes such as β-caryophyllene, which acts as a selective CB2 cannabinoid receptor agonist with potent anti-inflammatory effects, suggesting a role in modulating prostaglandin-mediated uterine bleeding. Eugenyl acetate and other terpenoid constituents also exhibit anti-inflammatory activity and may act synergistically with eugenol[12].

Gallic acid present in clove extracts contributes to antioxidant and hemostatic activities. Additionally, clove contains significant amounts of tannins, which are well-known astringent compounds that precipitate proteins and constrict blood vessels. This astringent action on uterine tissue may help reduce menstrual blood flow.

Eugenol, the major constituent of clove oil, inhibits cyclooxygenase-2 (COX-2) and suppresses pro-inflammatory cytokines such as TNF-α and IFN-γ. Since prostaglandin overproduction is a recognized mechanism in menorrhagia, COX inhibition by eugenol may reduce menstrual blood loss, similar to the mechanism of nonsteroidal anti-inflammatory drugs such as mefenamic acid. Eugenol has also been shown to induce vasorelaxation in uterine arteries via nitric oxide and calcium channel modulation[8], demonstrating direct effects on uterine vasculature. Furthermore, eugenol exhibits dose-dependent anti-angiogenic activity, reducing vascular formation, which may help control excessive endometrial vascularization associated with heavy menstrual bleeding[9].

Myristica Fragrans

Nutmeg (*Myristica fragrans*) exhibits notable effects on platelet function and thrombosis, representing a double-edged pharmacological profile in the context of menorrhagia. Nutmeg volatile oil has been shown to inhibit platelet aggregation through modulation of prostaglandin biosynthesis pathways. Eugenol and isoeugenol were reported to be equipotent to indomethacin in inhibiting arachidonic acid–induced platelet aggregation in rabbit platelets[25]. Other constituents such as safrole, myristicin, elemicin, limonene, α-terpineol, terpinene-4-ol, and linalool also demonstrated anti-aggregating activity, although with comparatively lower potency[26].

Anti-inflammatory activity of nutmeg has been demonstrated in experimental models, where chloroform extracts inhibited carrageenan-induced paw edema in rats and reduced acetic acid–induced writhing in mice. The extract also provided protection against thrombosis induced by ADP/adrenaline, indicating modulation of inflammatory and thrombotic pathways[27].

Nutmeg essential oil also exhibits strong antioxidant activity, showing 88.68% inhibition of linoleic acid oxidation and an EC_{50} of 181.4µg/mL for reducing power. Oxidative stress is implicated in endometrial dysfunction and abnormal uterine bleeding; therefore, the antioxidant properties of *M. fragrans* may be mechanistically relevant. However, the antiplatelet effects of nutmeg suggest that its role in menorrhagia management should be interpreted cautiously, as excessive inhibition of platelet aggregation could potentially exacerbate bleeding[28].

Cannabis Sativa

***Cannabis sativa* and the Endocannabinoid System in the Uterus**

The endocannabinoid system (ECS) plays an important regulatory role in female reproductive physiology. Das et al. demonstrated that CB1 receptor mRNA is expressed in the uterus and that the uterus synthesizes the endocannabinoid anandamide endogenously. In their study, tetrahydrocannabinol (THC) and anandamide inhibited forskolin-stimulated cyclic AMP formation in uterine tissue, and cannabinoid ligand-binding sites were identified in the uterine epithelium and stroma, indicating direct cannabinoid signaling within uterine tissues[33].

A comprehensive review by Maia et al. reported that the ECS regulates decidualization, implantation, and placentation, and that dysregulation of this system is associated with various gynecological disorders[34]. Similarly, Luschnig and Schicho highlighted that the ECS regulates multiple aspects of female reproduction and suggested that cannabinoid agonists and antagonists may represent potential therapeutic targets in gynecological conditions[35].

Cannabis and Hemostasis

The effects of cannabinoids on hemostasis are of particular relevance to menorrhagia. Coetzee et al. reported that THC and cannabinol (CBN) exhibit anticoagulant activity, inhibiting thrombin-induced clot formation and significantly prolonging clotting time in animal models. This finding is clinically important, as impaired coagulation is a recognized mechanism in heavy menstrual bleeding[36]. Davies and Kadir further emphasized that tissue factor, thrombin generation, and fibrinolysis regulation are critical for controlling menstrual blood loss, and disturbances in these pathways contribute to menorrhagia. Therefore, the anticoagulant properties of cannabinoids may potentially exacerbate heavy menstrual bleeding rather than alleviate it[37].

Cannabis and Uterine Smooth Muscle Activity

Experimental studies have also demonstrated effects of *C. sativa* on uterine smooth muscle. Araújo et al. reported that an aqueous extract of *C. sativa* roots reduced uterine contractions and showed spasmolytic activity in a mouse model of primary dysmenorrhea. Bioactive compounds distinct from typical cannabinoids were identified in the root extract, suggesting that different plant parts may exert varying pharmacological effects on uterine function[38].

Murraya Koenigii

Curry leaf (*Murraya koenigii*) has demonstrated several pharmacological activities relevant to the management of menorrhagia. A preclinical study reported that curry leaf extract significantly shortened bleeding time in Wistar rats in a dose-dependent manner, suggesting hemostatic potential, which was attributed to its tannin and flavonoid content.

Menorrhagia frequently leads to iron-deficiency anemia; in this context, *M. koenigii* aqueous extract showed significant anti-anaemic effects in experimental models, improving hemoglobin levels, red blood cell count, and serum iron levels. These effects were further enhanced when combined with *Emblica officinalis*, indicating potential synergistic benefits[44].

The plant also exhibits anti-inflammatory and analgesic activities, which may help reduce prostaglandin-mediated inflammation implicated in abnormal uterine bleeding[45,46]. Additionally, methanolic extracts of *M. koenigii* were reported to influence reproductive physiology by advancing puberty onset and increasing ovarian follicle numbers in female rats, suggesting possible estrogenic or gonadotropic effects relevant to hormonal regulation in menorrhagia[47].

Rhus Succedanea

The plant exhibits significant anti-inflammatory activity, which is relevant to the pathophysiology of menorrhagia. Methanolic extracts from immature fruits were reported to dose-dependently inhibit lipopolysaccharide (LPS)-induced interleukin-1β (IL-1β) and nitric oxide production in RAW 264.7 macrophages, along with suppression of NF-κB activation, a key transcription factor in inflammatory pathways. Additionally, the extract reduced TPA-induced ear swelling in vivo, further confirming its anti-inflammatory potential[52]. Similarly, aqueous extracts of galls at doses of 50 and 100 mg/kg demonstrated dose-dependent anti-inflammatory effects in carrageenan-induced paw edema models, comparable to the standard drug diclofenac sodium, suggesting potent anti-inflammatory efficacy[53].

The plant also possesses antioxidant and hepatoprotective properties. Aqueous and ethanol extracts exhibited significant DPPH radical scavenging activity, with the n-butanol fraction showing the highest antioxidant activity. These extracts demonstrated cytotoxic effects against Huh7 hepatoma cells and hepatoprotective activity against carbon tetrachloride-induced acute hepatitis, indicating free radical scavenging and protective effects on vital organs. Since oxidative stress is implicated in endometrial dysfunction and abnormal uterine bleeding, antioxidant activity may contribute to therapeutic benefits in menorrhagia.

Furthermore, antimicrobial activity was observed in methanolic leaf gall extracts, which showed inhibition zones ranging from 16±2 to 23±1mm against *Escherichia coli*, *Salmonella typhi*, *Micrococcus luteus*, and *Staphylococcus aureus*, comparable to standard antibiotics[54]. Root flavonoid fractions also exhibited antibacterial activity with inhibition zones of 15–25mm against multiple bacterial strains[55]. These antimicrobial properties may be beneficial in preventing secondary infections associated with gynecological disorders.

Table 4: Mechanistic Classification Table

Pathogenesis of Menorrhagia	**Relevant Pharmacological Activity**	**Plant Sources**
Failure of endometrial hemostasis	Hemostatic, Astringent	*Musa paradisiaca, Murraya koenigii, Syzygium aromaticum*
Prostaglandin excess	Anti-inflammatory (COX inhibition)	*Syzygium aromaticum, Myristica fragrans, Rhus succedanea*
Oxidative stress	Antioxidant	*Musa paradisiaca, Myristica fragrans, Rhus succedanea*
Hormonal imbalance (PCOS, estrogen dominance)	Hormonal modulatory	*Musa paradisiaca, Murraya koenigii*
Excessive angiogenesis	Anti-angiogenic	*Syzygium aromaticum*
Uterine hypercontractility	Spasmolytic	*Cannabis sativa*
Chronic blood loss → anemia	Anti-anaemic	*Murraya koenigii*
Coagulation impairment	Anticoagulant (negative)	*Cannabis sativa, Myristica fragrans*

Buffalo Buttermilk

Composition and Nutritional Value

The most directly relevant scientific evidence on buffalo buttermilk was reported by Al Musa and Al Garory (2023), who investigated Iraqi buffalo buttermilk prepared by fermenting raw buffalo milk using commercial starter cultures. The study demonstrated that fermentation did not significantly alter the gross chemical composition but influenced physicochemical and bioactive parameters such as pH, titratable acidity, carbohydrate concentration, and organic acid profiles. The reported values (pH 4.37, ash 0.65%, protein 2.73%, fat 1.24%, and lactose 3.30%) indicate that buffalo buttermilk retains substantial nutritional content even after fermentation. Importantly, the buttermilk exhibited antioxidant activity, and GC–MS analysis identified several bioactive compounds, suggesting potential health-promoting properties[56].

Buffalo milk is known to be nutritionally superior to cow milk, containing higher levels of total solids, fat, protein, lactose, and minerals. Ahmad et al. documented that buffalo milk contributes significantly to national milk production and provides a rich source of macronutrients and micronutrients, which are retained to a considerable extent in fermented products such as buttermilk[57]. More recently, Liao et al. highlighted the presence of bioactive compounds such as δ-valerobetaine and acetyl-L-carnitine in buffalo milk, which possess antioxidant and anti-inflammatory activities. These properties are relevant to gynecological disorders such as menorrhagia, where oxidative stress and inflammatory pathways contribute to endometrial dysfunction and excessive bleeding[58].

In traditional medical systems, *Takra* (buttermilk) is classified under *Pathya Kalpana* (dietetic preparations) and is considered both a therapeutic agent and dietary regimen. Classical Ayurvedic texts describe *Takra* as "*Amruta*" for disorders associated with *Mandagni* (reduced digestive fire) and recommend its use in conditions such as *Arsha* (hemorrhoids), *Grahani* (irritable bowel syndrome), *Udara* (ascites), and *Agni Vikruti*. The inclusion of *Takra* as a therapeutic diet highlights its role in improving digestion, metabolism, and systemic health, which are important supportive factors in chronic gynecological conditions[59].

DISCUSSION

Menorrhagia *(Perumbadu)* is a common gynecological disorder that significantly impairs women's physical health, psychological well-being, and quality of life. In Siddha medicine, *Perumbadu* is attributed to derangement of humoral factors *(Vatham, Pitham,* and *Kabam),* uterine pathology, and systemic weakness. Siddha therapeutics traditionally employs herbal and herbo-mineral formulations with styptic, cooling, tonic, and humoral balancing properties for its management. *Vaazhai Vadagam*, a classical Siddha formulation containing *Musa* paradisiaca flower along with multiple adjuvant herbs, has been traditionally prescribed for *Perumbadu*; however, scientific validation of its pharmacological basis has been limited. The present systematic review aimed to correlate Siddha textual concepts with contemporary phytochemical and pharmacological evidence to provide a scientific rationale for its therapeutic use.

The pharmacological activities most relevant to menorrhagia management include hemostatic and astringent effects, anti-inflammatory activity through prostaglandin inhibition, antioxidant protection of endometrial tissue, hormonal modulatory effects, and anti-angiogenic activity reducing excessive endometrial vascularization. The analyzed ingredients exhibited multiple pharmacological actions targeting key pathological mechanisms of menorrhagia, such as impaired hemostasis, inflammation, oxidative stress, hormonal imbalance, and abnormal angiogenesis. Among the ingredients, *Musa paradisiaca* and *Murraya koenigii* demonstrated the strongest direct anti-menorrhagic potential, while Syzygium aromaticum contributed significant anti-inflammatory and anti-angiogenic properties. In contrast, Myristica fragrans and Cannabis sativa showed anticoagulant effects, which may limit their therapeutic usefulness in heavy menstrual bleeding.

Buffalo buttermilk, used as the processing medium in *Vaazhai Vadagam* preparation, contains bioactive compounds with antioxidant and anti-inflammatory properties. Fermentation may enhance the bioavailability of phytoconstituents and facilitate drug delivery, aligning with Siddha principles of *Pathya Kalpana* (therapeutic dietetic preparations). This highlights the formulation's holistic design, integrating pharmacological and dietary therapeutic concepts.

Mechanistically, the ingredients of *Vaazhai Vadagam* collectively address multiple etiopathogenic factors of menorrhagia, including endometrial hemostatic dysfunction, prostaglandin excess, oxidative stress, hormonal imbalance, excessive angiogenesis, and chronic blood loss–induced anemia. This multi-targeted pharmacological profile supports the Siddha holistic therapeutic concept and suggests potential synergistic effects among the formulation's constituents.

However, significant gaps in scientific evidence were identified. Most available studies are in vitro or animal-based, and no randomized controlled clinical trials have directly evaluated *Vaazhai Vadagam* in women with menorrhagia. The pharmacological evidence is largely indirect and derived from individual ingredients rather than the polyherbal formulation. Furthermore, standardization of preparation, dosage, quality control parameters, and safety evaluation are lacking, limiting clinical translation.

Despite these limitations, this systematic review provides a scientific rationale for the traditional use of *Vaazhai Vadagam* in *Perumbadu*. The presence of hemostatic, anti-inflammatory, antioxidant, hormonal modulatory, and hematinic phytochemicals support its potential therapeutic efficacy. Future research should focus on preclinical validation using experimental menorrhagia models followed by well-designed clinical trials to establish safety, efficacy, and standard dosing guidelines. Integrating Siddha theoretical frameworks with modern biomedical research may contribute to evidence-based validation of traditional formulations and improve women's reproductive health care.

CONCLUSION

Vaazhai Vadagam demonstrates promising pharmacological potential in the management of *Perumbadu* due to its hemostatic, anti-inflammatory, antioxidant, hormonal modulatory, and anti-angiogenic properties. The formulation addresses multiple etiopathogenic mechanisms of menorrhagia, supporting its traditional Siddha use. However, the lack of clinical evidence and standardization necessitates further preclinical and clinical research to validate its safety and efficacy and to establish standardized therapeutic guidelines.

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