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Potential of Propolis for Women's Reproductive Health as The Source of Vitamins and Minerals, Antiemetic, Anti-inflammatory and Analgesic

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Abstract

Women's reproductive health problems, including anemia, emesis gravidarum, and primary dysmenorrhea, are problems that require effective and safe treatment. Conventional therapies often cause side effects, so alternatives based on natural ingredients are needed. Propolis, a natural product from honey bees, contains bioactive compounds with anti-inflammatory, analgesic, antiemetic, vitamins, and minerals that have the potential to be used as complementary therapy. This review aims to evaluate the therapeutic potential of propolis for women's reproductive health problems by synthesizing relevant literature published between 2015 and 2025. The reviewed evidence includes experimental, preclinical, and clinical studies conducted in both human and animal models that explore the effectiveness of propolis in addressing the three conditions. This literature provides the latest review of the potential of propolis as a natural therapy for anemia, emesis gravidarum, and primary dysmenorrhea in women. Existing literature suggests that propolis enhances hemoglobin levels through the content of iron, vitamins, and flavonoids that facilitate the absorption and utilization of iron. Propolis also has an antiemetic effect through compounds that inhibit dopamine and serotonin receptors, and protect the gastric mucosa. This effect is equivalent to antiemetic drugs such as metoclopramide. In addition, propolis shows anti-inflammatory and analgesic effects through inhibition of COX and LOX enzymes and relaxation of uterine smooth muscle, thus effectively reducing menstrual pain. Studies show that propolis contains active compounds such as CAPE, kaempferol, and pinocembrin, which play a role in this mechanism

Keywords: Propolis, Reproductive health, Anemia, Emesis Gravidarum, Primary Dysmenorrhea

1. Introduction

Anaemia, emesis gravidarum, and primary dysmenorrhea represent three prevalent and clinically significant conditions that affect women across different stages of the reproductive life course. These conditions contribute substantially to morbidity, reduced daily productivity, impaired physical performance, and diminished quality of life, and therefore constitute important public health concerns. [1–3]

Based on global data, around 30% of women of childbearing age worldwide suffer from anaemia, with a prevalence ranging from 4.3% to 20% in developed countries and 30% to 48% in developing countries. Children (43%), pregnant women (38%), and non-pregnant women (29%) are among the many vulnerable groups affected by anemia, which is linked to negative consequences such as persistent fatigue, decreased productivity, and an increased risk of pregnancy-related problems.[1,4–6] The main cause of IDA is inadequate iron intake, and the most widely used treatment for this condition is oral iron supplementation.[7] Side effects such as digestive disorders and less than optimal absorption indicate the need to also develop oral iron supplement formulations that are more effective, safe, and easily absorbed by the body.[8]

Emesis gravidarum, or what is often known as nausea and vomiting in pregnancy, is experienced by around 70–80% of pregnant women; 10% continue with symptoms of nausea and vomiting until full term, and even 0.3–2% experience hyperemesis gravidarum, which can cause dehydration and electrolyte disorders and require hospitalization.[9–10] Pregnant women who experience emesis gravidarum will generally receive various forms of therapy from medical personnel, one of which[11] is the administration of vitamin B6 (pyridoxine). Although this therapy is quite effective and safe, recent studies have begun to reveal the potential of complementary therapies based on natural ingredients as a promising alternative[12].

Approximately 50% of adult women and up to 90% of adolescent girls experience dysmenorrhea, and 10–20% of them report that the pain they experience is severe enough to interfere with daily activities.[13–14] Pharmacological management of primary dysmenorrhea is generally with non-hormonal therapies such as acetaminophen, paracetamol, and nonsteroidal anti-inflammatory drugs (NSAIDs)[15] and hormonal therapy. Unfortunately, this therapy often causes side effects, ranging from impaired cognitive function to the risk of drug dependence.[16–17] These limitations highlight the need to explore safer complementary approaches, including therapies derived from natural products with lower adverse-effect profiles.

1.1 Background

In recent decades, natural materials have been proposed for the development of future drugs due to their broad therapeutic effects, rare side effects, and low toxicity.[18–19] Propolis has emerged as a natural product of interest for reproductive health-related conditions.[20]

Propolis is a naturally occurring resinous substance collected by honeybees from plant exudates and is characterized by a complex chemical composition.[20] Traditionally, propolis has been used for health maintenance and the management of various conditions, supported by evidence indicating anti-inflammatory, analgesic, and antiemetic activities. [21–23]

Propolis contains a wide range of bioactive compounds, including polyphenols and flavonoids, as well as essential minerals and vitamins that contribute to its biological properties. It has been reported to provide minerals such as iron, calcium, and magnesium, along with vitamins of the B complex, vitamin C, vitamin E, and provitamin A, which are relevant to physiological and metabolic functions [24–28] Evidence from experimental and preclinical studies indicates that propolis exhibits anti-inflammatory and analgesic activities, primarily demonstrated in in

vivo and laboratory models.[21,29–30] These biological effects have been associated with the modulation of inflammatory responses and pain-related processes, although most supporting evidence remains preclinical in nature.[31] Propolis has also demonstrated antiemetic activity in experimental models, which has been attributed to the presence of multiple bioactive constituents.[22]

1.2 Objectives

Although propolis has been widely used and investigated for various health-related applications, focused reviews examining its relevance to specific women's reproductive health conditions remain limited. Therefore, this review aims to summarize and critically discuss available evidence regarding the potential role of propolis and its chemical constituents in relation to anaemia, emesis gravidarum, and primary dysmenorrhea. Relevant literature published between 2015 and 2025 was identified from multiple scientific sources and synthesized using a narrative review approach. The discussion is organized into thematic sections reflecting the reported effects of propolis on selected reproductive health conditions and includes evidence derived from both human and animal studies. An overview of the included studies and their main findings is presented in Table 1.

2. Related Work

Propolis has been widely researched for its putative therapeutic applications in women's reproductive health. Clinical investigation has demonstrated that providing 500 mg of bee propolis twice daily to women with endometriosis-related infertility resulted in a 60% conception rate compared to 20% in the QuillBot placebo group [32]. Furthermore, propolis possesses antibacterial, anti-inflammatory, anesthetic, and immunostimulatory qualities; additionally, its flavonoid content has anti-allergic, immunomodulatory, anti-cancer, anti-fungal, and anti-hyperlipidemia capabilities [33]. Propolis contains vital vitamins like B1, B2, B6, C, and E, as well as minerals like magnesium, calcium, potassium, sodium, copper, zinc, manganese, and iron. SciELO Brazil [20]. Numerous preclinical investigations have shown ample evidence of propolis's analgesic and anti-inflammatory qualities. Propolis ethanol extract possesses analgesic properties and shows dose-dependent anti-inflammatory effects in models of carrageenan-induced paw edema, Freund's adjuvant-induced arthritis, and foreign body-induced granuloma [34]. A standardized ethanol extract of Bulgarian propolis reduces acetic acid-induced stomach contractions and causes considerable pain relief in rats at relatively modest doses (Springer) [23]. These anti-inflammatory effects are generally related to inhibition of cyclooxygenase and the resultant prostaglandin, as well as the free radical scavenging activity of Hindwi [35]. Although more research is required to determine the safety and effectiveness of propolis specifically as an antiemetic agent during pregnancy, propolis samples from Indonesia have been tested for their high antiemetic activity and potential use in the treatment of nausea and vomiting during pregnancy [22].

3. Methodology

3.1 Study Design

This study was conducted employed a systematic literature review approach following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to aimed at synthesizing current evidence on the potential role of propolis in women's reproductive health, particularly anemia, emesis gravidarum,

and primary dysmenorrhea. The review focuses on the nutritional properties of propolis, including its vitamin and mineral content, as well as its reported antiemetic, anti-inflammatory, and analgesic effects. This approach was chosen to allow a descriptive and thematic exploration of findings derived from diverse study designs, including experimental, animal, and human studies

3.2 Search Strategy

To identify studies relevant to the narrative synthesis, a literature search was conducted. The databases searched included: PubMed/MEDLINE (via NLM interface), Scopus (via Elsevier), Web of Science (via Clarivate Analytics), ScienceDirect (via Elsevier), Google Scholar

The search strategy was developed using a combination of Medical Subject Headings (MeSH) terms and free-text keywords related to the main concepts of the review. The key search terms included: Concept 1 (Propolis): "propolis" OR "bee propolis" OR "bee glue" OR "propolis extract", Concept 2 (Women's Reproductive Health): "women's health" OR "reproductive health" OR "female reproductive" OR "gynecological" OR "pregnancy" OR "endometriosis" OR "PCOS" OR "polycystic ovary syndrome" OR "infertility" OR "ovarian health" OR "menstrual", Concept 3 (Properties): "vitamins" OR "minerals" OR "nutrients" OR "antiemetic" OR "anti-nausea" OR "anti-inflammatory" OR "analgesic" OR "pain relief" OR "antioxidant",

Boolean operators (AND, OR) were applied as appropriate, and search strings were adapted to the syntax and indexing systems of each database. The search covered articles published between 2015 and 2025.

3.3 Eligibility Criteria

Studies included in this review based on the following criteria. (1) examined propolis or its bioactive compounds; (2) focused on women's reproductive health conditions, specifically anemia, emesis gravidarum, or primary dysmenorrhea; (3) original research articles or relevant review studies; (4) published in the English language; and (5) available in full-text form. Studies that did not align with the research objectives or lacked sufficient methodological or outcome-related information were excluded.

3.4 Study Selection Process

The selection of studies was conducted through a relevance-based screening process appropriate for a narrative review. Retrieved records were screened based on titles and abstracts to identify potentially relevant studies. Full-text articles were then assessed to confirm their relevance to the scope and objectives of the review.

Duplicate records were removed using reference management software. The selection process emphasized conceptual relevance and contribution to thematic synthesis rather than formal risk-of-bias scoring.

3.5 Data Extraction

Relevant information from the included studies was extracted descriptively to support the thematic analysis. The extracted data encompassed authorship, year of publication, and study location, as well as study design and population characteristics, including human, animal, or experimental models. Information regarding the characteristics of propolis, such as its origin, preparation method, and type of extract, was documented when available. Reported outcomes related to nutritional content and antiemetic, anti-inflammatory, and analgesic effects were also collected, along with key findings relevant to women's reproductive health. In addition, data on safety profiles and reported adverse effects were noted where applicable. The data extraction process was intended to facilitate qualitative comparison across studies.

3.6 Data Synthesis

Data synthesis was carried out utilizing a narrative and thematic approach because to the significant heterogeneity between study designs, study populations, interventions, and outcome measures. The synthesis framework was predefined based on the key biological and clinical properties of propolis reported in the literature, including its nutritional composition (vitamins and minerals) and its antiemetic, anti-inflammatory, and analgesic effects. Evidence within each thematic category was synthesized descriptively to allow for structured comparison across studies, with explicit consideration of consistency and divergence in reported outcomes as well as methodological limitations. Findings from animal studies and mechanistic investigations were analyzed separately from those derived from human clinical studies to maintain interpretative clarity.

4. Results

4.1 Chemical Constituents of Propolis

Propolis is a natural resinous product characterized by a highly complex chemical composition. It is mainly composed of resins and vegetable balms (45–55%), along with wax (8–35%), essential oils (5–10%), fatty acids (approximately 5%), pollen (5%), and other minor organic constituents. The color of propolis varies from greenish-yellow to dark brown, a variation influenced by differences in botanical sources and geographic origin, which in turn affect its chemical profile and biological potency [36–38].

The therapeutic properties of propolis are closely linked to its rich content of bioactive compounds, particularly phenolic compounds and flavonoids [39]. Findings show that, out of 16 compounds present at concentrations exceeding 1%, 11 demonstrated antiemetic activity, indicating a broad and cooperative pharmacological mechanism [22]. In addition to its bioactive compounds, propolis contains essential vitamins such as vitamins A, B1, B2, B6, C, and E, which play crucial roles in erythrocyte formation and the maintenance of normal physiological functions. These vitamins are vital for supporting red blood cell production and overall health [40].

Table 1. Summary of potential effect of propolis for women's reproductive health problems

No	Author (Year)	Study Design	Population	Health Outcome	Evidence Type	Key Findings	Notes
1	Rohmatin et al. (2022)	Quasi-experimental study	44 adolescent girls	Anaemia	Human (clinical)	Propolis supplementation significantly increased hemoglobin levels (mean increase: 2.873 g/dL), exceeding the increase observed with conventional iron supplementation.	Effect attributed to minerals and vitamins (Fe, Zn, vitamins B and C) enhancing erythropoiesis and iron absorption.

No	Author (Year)	Study Design	Population	Health Outcome	Evidence Type	Key Findings	Notes
2	Touzani et al. (2022)	Experimental in vivo study	360 streptozotocin-treated fish	Anaemia (functional)	Animal	Propolis, particularly when combined with honey, significantly improved hemoglobin levels by reducing oxidative stress and protecting erythrocyte membranes under hyperglycemic conditions.	Demonstrates antioxidant-mediated hematological protection; indirect relevance to human anaemia.
3	Fikri et al. (2018)	Experimental antiemetic assay	32 young chicks injected with CuSO ₄	Emesis	Animal	Propolis extracts inhibited retching by 44.96–98.51%, showing strong antiemetic activity through modulation of dopamine, 5-HT ₃ , 5-HT ₁ , and NK ₁ receptors.	Widely used preclinical emesis model; mechanistic relevance to nausea in pregnancy.
4	Mahani et al. (2021)	Clinical intervention study	50 tuberculosis patients (12–45 years)	Nausea and vomiting	Human (indirect)	Propolis supplementation significantly reduced nausea prevalence by inhibiting emetic triggers, inducing protective enzymes, and exerting hepatoprotective effects.	Indirect evidence; population not pregnant, but mechanisms relevant to emesis gravidarum.
5	Jenabi et al. (2019)	Randomized controlled trial	86 female students	Primary dysmenorrhea	Human (clinical)	Bee propolis significantly reduced menstrual pain severity compared to	Direct clinical evidence supporting analgesic and anti-

No	Author (Year)	Study Design	Population	Health Outcome	Evidence Type	Key Findings	Notes
						placebo, as measured by visual analog scale scores.	inflammatory effects.
6	Al-Hariri & Abualait (2020)	Experimental in vivo study	18 rats	Pain and inflammation	Animal	Alcoholic extract of Brazilian green propolis significantly reduced nociceptive responses and inflammatory pain induced by formalin and acetic acid.	Supports antinociceptive mechanism relevant to dysmenorrhea.
7	Sokeng et al. (2020b)	Experimental in vivo study	100 Wistar albino rats	Inflammation and pain	Animal	Arachic acid ethyl ester (AAEE) isolated from propolis inhibited acute and chronic inflammation, reduced edema and granuloma formation, and showed dose-dependent analgesic activity.	Mechanistic evidence for anti-inflammatory and analgesic pathways.
8	Sahlan et al. (2019)	Experimental in vivo study with LC-MS/MS analysis	53 male Sprague Dawley rats	Inflammation	Animal	Indonesian Tetragonula propolis contained multiple anti-inflammatory biomarkers and significantly reduced carrageenan-induced paw inflammation via NF- κ B inhibition.	Mechanistic support for inflammation-related menstrual pain modulation.

4.2 Potential of Propolis for Anaemia

Anaemia remains a major public health concern, particularly among women and adolescents, due to its association with impaired cognitive performance, increased maternal and perinatal morbidity, and reduced work productivity. The etiology of anaemia is multifactorial, with iron deficiency related to menstruation, nutritional inadequacy, chronic disease, and impaired iron metabolism being the most common causes.[41] Oral iron supplementation is the primary intervention for iron deficiency anaemia (IDA), [1] by vitamin C which enhances iron absorption.

Evidence from a quasi-experimental human study demonstrated that propolis supplementation significantly increased hemoglobin levels in adolescent girls with anaemia, showing a greater mean increase compared to conventional iron supplementation.[40] This effect is attributed to the rich micronutrient composition of propolis, including iron, zinc, folic acid, and vitamins B and C, which support erythropoiesis and enhance iron absorption. In addition, flavonoids present in propolis may facilitate hemoglobin synthesis through improved iron bioavailability. Propolis also benefits conditions like hyperglycemia, which damages red blood cells and can lead to functional anaemia due to impaired erythrocyte production and iron metabolism.[42–43]

Supporting evidence from animal studies further suggests that propolis may alleviate functional anaemia associated with metabolic disorders. In streptozotocin-induced hyperglycemic models, propolis administration improved hemoglobin levels by reducing oxidative stress and protecting erythrocyte membranes, thereby supporting normal red blood cell function and iron metabolism [44]. These findings indicate that propolis may serve as a complementary intervention for anaemia by enhancing dietary iron utilization, supporting hemoglobin synthesis, and protecting erythrocytes from oxidative damage.

4.3 Emesis Gravidarum

Emesis gravidarum, or nausea and vomiting during pregnancy, is a common issue linked to gastrointestinal, hormonal, or genetic factors and can lead to serious health risks, including depression and preeclampsia [9]. Preclinical and indirect clinical evidence suggests that propolis possesses significant antiemetic activity. Experimental studies using established animal models demonstrated that propolis extracts markedly reduced emetic responses, likely through modulation of neurotransmitter pathways involved in nausea and vomiting, including serotonergic and dopaminergic receptors. In addition, indirect human evidence from clinical populations reported that propolis supplementation reduced the prevalence and severity of nausea, potentially through hepatoprotective effects and inhibition of nausea-inducing stimuli. [22,45] Several studies have reported the antiemetic potential of propolis, which is largely attributed to its bioactive compounds, particularly flavonoids and phenolic substances. These compounds have demonstrated antioxidant, gastroprotective, and hepatoprotective effects in preclinical and experimental models, suggesting a role in reducing gastric irritation and metabolic stress associated with nausea and vomiting.[46–48] Most of the current evidence comes from animal studies or non-pregnant human populations, while direct clinical data in pregnant women remain very limited. As a result, the applicability of these findings to managing emesis gravidarum in pregnancy is still not well established.

4.4 Potential of Propolis for Primary Dysmenorrhea

Propolis has demonstrated significant anti-inflammatory effects that may alleviate menstrual pain associated with primary dysmenorrhea. Clinical evidence from a randomized controlled trial demonstrated that propolis supplementation significantly reduced pain severity in women with primary dysmenorrhea compared to placebo, indicating its potential as an effective natural analgesic.[49–50] These findings are supported by experimental

animal studies showing that propolis exhibits strong anti-inflammatory and antinociceptive effects across various pain models. [51] Studies also have highlighted the analgesic potential of propolis, which is largely linked to its bioactive components, including isoflavonoids and phenolic acids. These compounds have been shown in experimental models to inhibit inflammatory enzymes such as cyclooxygenase (COX) and lipoxygenase (LOX), leading to reduced prostaglandin production. In addition, specific constituents, such as arachidic acid ethyl ester (AAEE), demonstrated both acute and chronic anti-inflammatory effects as well as central analgesic activity in vivo. Propolis also exhibits antispasmodic properties that may facilitate uterine muscle relaxation, further supporting its potential to relieve menstrual pain. [52] Overall, these results confirm the traditional usage of propolis and emphasize its potential as a supplemental treatment approach by suggesting that it may affect inflammatory and pain-related pathways involved in primary dysmenorrhea.

5. Discussion

5.1 Chemical Constituents of Propolis

The components of propolis vary in quantity and include: 45–55% resins and vegetable balms (esters, phenolic acids, and flavonoids); 8–35% wax (mostly beeswax); 5–10% aromatic and essential oils (pinene, viridiflorol, tricosane, and eudesmo); 5% fatty acids (usually from wax, with the remaining amount depending on botanical origins); 5% pollen; and 5% other organic components (sugars, quinones, lactones, ketones, steroids, and microelements (Fe and Zn)).[36–37] Its color ranges from greenish-yellow to brown, reflecting differences in plant sources and maturity.[38]

A wide range of bioactive compounds have been identified in propolis, particularly flavonoids (e.g., quercetin, kaempferol, galangin, pinocembrin), phenolic acids (e.g., caffeic acid, p-coumaric acid, ferulic acid), and esters such as caffeic acid phenethyl ester (CAPE) [39,53]. These constituents are closely associated with the biological activities of propolis, including antioxidant, anti-inflammatory, antiemetic, and hematopoietic effects, which are relevant to women's reproductive health conditions.[39,53]

Propolis also composed of a variety of bioactive compounds, vitamins, and minerals, which contribute to its pharmacological properties. In addition to flavonoids and phenolic acids, propolis contains vitamins A, B1, B2, B6, C, and E, as well as folic acid, which are important for erythrocyte formation and overall hematological health.[40] In propolis, there are a total of 16 constituents with concentrations exceeding 1%, culminating in an aggregate concentration of 84.46%. The role of these constituents has been described, especially their antiemetic properties. Of the 16 constituents with concentrations greater than 1%, 11 constituents showed antiemetic activity, either directly or indirectly; one constituent showed biological activity different from the antiemetic effect; and three constituents had no biological activity whatsoever. Compounds that showed antiemetic effects included (1) Methyl- α -D-glucopyranoside, (2) 5-Azulenemethanol, 1,2,3,3a, 4,5,6,7 octahydro- α , α , 3,8-tetramethyl, (3) 1,2,3-Propanetriol, (4) Hexadecanoic acid, (5) 3-Hydroxy-Tridecanoic acid ethyl ester, (6) 2,6-Dimethoxyphenol, (7) Pentadecanoic acid, 14-methyl-, methyl ester, (8) 1,6-Anhydro-Beta-D-Glucopyranose, (9) (2S, 3R) -3-Allyl-3-methylapfelsaure-4-ethyl ester, (10) 1,4,5-Trimethylnaphthalene, (11) Tetradecanoic acid. Compounds that show biological activity include isosorbide. In contrast, three compounds have not shown any biological activity, namely: (1) 2-Methoxyethyl acetate, (2) 8-Oxabicyclo [5.1.0] octane, and (3) Dimethyl 2-hydroxy-2-methylbutane-1,4-dioate.[48] Propolis exerts its antiemetic effects through various mechanisms.

Hydroxycinnamic acids found in propolis function as δ receptor antagonists (enkephalinergic) and inhibit dopamine receptors. In addition, propolis contains triterpenes, which act as antagonists for 5-HT₃, 5-HT₄, and/or NK₁ receptors. These receptors are involved in the stimulation of emesis.[22]

Several flavonoids, cinnamic acid derivatives, phenolic acids, and caffeic acid have been associated with anti-inflammatory and antinociceptive effects in preclinical studies. For instance, alcoholic extracts of propolis have reduced pain responses in experimental models, as indicated by decreased frequency of acetic acid-induced abdominal contractions and hind limb stretching. These effects are likely mediated through modulation of inflammatory mediators and peripheral nociceptive signaling, although detailed mechanisms vary among specific compounds. Most mechanistic evidence regarding these constituents is derived from preclinical and experimental studies, emphasizing the need for further investigation in human clinical settings.[51]

5.2 Propolis for Anemia

Anaemia remains a significant public health concern, particularly among women, due to its adverse impact on cognitive development, maternal and perinatal outcomes, and overall physical productivity.[41] Iron deficiency anaemia (IDA) is the most prevalent form, often resulting from menstrual iron loss, inadequate dietary intake, and deficiencies in vitamin B₁₂ and folate [40,54]. Early identification of iron deficiency and timely intervention are essential to prevent progression to IDA [1].

Oral iron supplementation is the conventional treatment for IDA; however, limitations such as suboptimal absorption and gastrointestinal side effects have motivated the exploration of complementary natural therapies [7–8]. Propolis, a resinous substance produced by bees, has been investigated for its potential to support hemoglobin regeneration through enhanced utilization of dietary iron and overall blood health [42–43]. Limited clinical and experimental studies suggest that propolis supplementation may increase hemoglobin levels more effectively than conventional iron therapy, with mean increases reported at 2.87 g/dL versus 1.39 g/dL in control groups [40].

The hematological benefits of propolis are linked to its rich composition of bioactive compounds, vitamins, and minerals. Propolis contains iron, zinc, and vitamins B₁, B₆, B₁₂, C, A, and E, which are critical for erythropoiesis and hemoglobin synthesis [40,55]. Analysis of propolis has identified phenolic and flavonoid compounds such as pinobanksin-3-o-acetate, pinocembrin, caffeic acid phenylethyl ester (CAPE), kaempferol, and chrysin, as well as minerals including calcium, magnesium, and sodium, contributing to its overall nutritional value [44]. These constituents support erythrocyte integrity and may improve hemoglobin levels by maintaining red blood cell quality.

Experimental evidence further indicates that propolis may mitigate factors that compromise hemoglobin synthesis, such as oxidative stress and hyperglycemia-induced erythrocyte damage, as observed in streptozotocin-induced rat models [44,56]. Propolis has also been associated with indirect support of erythropoietin (EPO) production, which promotes erythrocyte formation, thereby aiding in hemoglobin regeneration [57].

These findings highlight propolis as a promising complementary agent for improving hemoglobin levels and managing anaemia. However, further rigorously designed human studies with standardized dosing are needed to establish its effectiveness and safety.

5.3 Propolis for Emesis Gravidarum

Emesis gravidarum, often known as nausea and vomiting in pregnancy (NVP), is a common problem in early pregnancy with an unknown origin that may be related to gastrointestinal, hormonal, or genetic factors.[9] Although NVP is often considered a normal pregnancy discomfort, it is associated with a higher risk of major health problems such as depression, preeclampsia, and arterial hypertension.[58–59] Conventional antiemetic drugs are limited in pregnancy due to potential teratogenic effects, prompting interest in natural remedies including propolis.[60–61]

Propolis, a resinous substance collected by bees, contains bioactive compounds such as flavonoids and phenolics with antibacterial, antioxidant, and antiemetic properties.[22,45] Experimental studies have demonstrated significant antiemetic activity. For example, Indonesian propolis reduced nausea in chicks administered CuSO₄, showing effects comparable to the antiemetic drug metoclopramide, with inhibition rates ranging from 44.96% to 98.51%.[22,62]

Propolis exerts its antiemetic effects through several mechanisms, including:

- 1) Direct Inhibition of 5-HT₄ Stimulus

Propolis contains compounds that directly inhibit 5-HT₄ stimulation, which is known to trigger nausea and vomiting. Terpenoids and flavonoids, the main components of propolis, contribute to this direct antiemetic activity. Specifically, 5-Azulenemethanol (a terpenoid) and Methyl- α -D-glucopyranoside (a flavonoid) have been identified to have antiemetic activity through this mechanism.[48]

- 2) Induction of Glycerol Kinase Enzyme

Propolis indirectly reduces nausea by inducing the formation of the enzyme glycerol kinase in the body.[48] Glycerol, which is present in propolis, plays a role in the metabolic pathway of gluconeogenesis in the liver. Glycerol kinase enzyme deficiency can cause nausea and vomiting symptoms, so the ability of propolis to induce this enzyme helps prevent these symptoms.[48,63]

- 3) Hepatoprotective Activity

Propolis acts as a hepatoprotector, protecting the liver from damage caused by toxic compounds, especially those from ATD.(Sulaeman, Fikri, et al., 2018) ATD can cause liver injury, which causes nausea and vomiting due to impaired detoxification.[64] By maintaining liver function, propolis helps minimize vomiting symptoms caused by liver toxicity.[65] Compounds with antioxidant and anti-inflammatory activities, such as 2,6-dimethoxyphenol and various fatty acids, contribute to this hepatoprotective effect.[48,66]

Propolis from *Wallacetrigona incisa* in South Sulawesi, Indonesia, has shown antiemetic activity in clinical contexts, such as reducing nausea in patients receiving antituberculosis drugs (ATD). Phytochemical analysis identified 11 compounds at concentrations above 1% that contribute to antiemetic effects either directly or indirectly, with a total concentration of 75.47% in propolis. [22]

These findings indicate that propolis may serve as a complementary option for the management of nausea and vomiting, acting through mechanisms such as receptor modulation, metabolic support, and organ protection. Thus, direct evidence from studies involving pregnant women with emesis gravidarum remains limited. Further clinical trials are therefore required to determine its safety, effectiveness, and appropriate dosage.

5.4 Propolis for Primary Dysmenorrhea

Propolis is known for its anti-inflammatory, analgesic, and antispasmodic properties, which make it a potential natural agent for managing primary dysmenorrhea. The main cause of menstrual pain is the excessive production of endometrial prostaglandins, particularly $\text{PGF2}\alpha$, during the late luteal phase due to decreased progesterone. These prostaglandins induce uterine smooth muscle contractions, vasoconstriction of spiral arteries, tissue ischemia, and hypoxia, which activate sensory nerves and cause pain. [49–50] Several studies have shown that propolis can modulate this pathway:

- 1) Anti-inflammatory effects

Flavonoids and phenolic compounds in propolis, such as quercetin, galangin, CAPE, and arachidic acid ethyl ester (AAEE), inhibit key enzymes including cyclooxygenase (COX) and lipoxygenase (LOX), reducing prostaglandin and leukotriene synthesis. Propolis also reduces pro-inflammatory cytokines (TNF- α , IL-1 β , IL-6) and other mediators involved in nociception (PGE2, nitrite), effectively decreasing local inflammation and pain perception. [52,67–69]

- 2) Analgesic effects

Propolis demonstrates both central and peripheral analgesic properties. Its anti-nociceptive action has been observed in animal studies, reducing formalin-induced and acetic acid-induced pain, indicating effectiveness in both immediate and prolonged pain phases. Some bioactive compounds in propolis, including AAEE, interfere with inflammatory cascades and modulate neurotransmitters such as serotonin and kinins, contributing to pain relief. [51–52]

- 3) Antispasmodic activity

Propolis relaxes uterine smooth muscles, reducing cramps associated with dysmenorrhea. Compounds such as p-coumaric acid derivatives regulate calcium channels, decreasing Ca^{2+} influx necessary for muscle contraction. This antispasmodic effect has been supported by studies on smooth muscle tissues in animals. [23,50,69–70]

- 4) Molecular mechanisms via NF- κ B inhibition

Several compounds identified in propolis (e.g., dehydrogingerdione, alpha-tocopherol succinate, adhyperforin, 6-epiangustifolin, deoxypodophyllotoxin, kurarinone, xanthoxyletin) inhibit NF- κ B, a key transcription factor in inflammatory signaling. By downregulating NF- κ B, propolis reduces the expression of iNOS, COX-2, and TNF- α , further contributing to decreased pain and inflammation. [29]

Clinical studies suggest that propolis reduces menstrual pain scores significantly compared to placebo, supporting its traditional use for dysmenorrhea. [50,69] However, direct comparative studies between propolis and conventional therapies are limited. Further well-controlled studies are required to determine its efficacy relative to standard treatments and to optimize dosing regimens.

6. Conclusions

Propolis's antifungal mechanisms—disruption of cell structure and function, inhibition of biofilm formation and morphogenesis, and robust clinical and in vivo activity—highlight its potential as a versatile therapeutic agent. Its bioactive compounds, including phenolic acids, flavonoids, and benzophenones, target fungal membranes, biofilms, and virulence factors with high specificity and efficacy. The ability to synergize with conventional antifungals and enhance immune responses further amplifies its therapeutic value. From Brazilian red and green

propolis to varieties from Brunei, Bulgaria, and beyond, the global diversity of propolis underscores its adaptability and potency. These findings pave the way for developing novel propolis-based therapies, such as nanoemulsions, hydrogels, and PDT, to address the growing challenge of antifungal resistance and improve clinical outcomes in fungal infections

The current body of research supports propolis as a promising complementary therapeutic agent for women's reproductive health. Its rich content of vitamins, minerals, and bioactive compounds, combined with demonstrated anti-inflammatory and analgesic properties. However, the antiemetic properties specifically require further clinical investigation. Future research should focus on standardizing propolis preparations, determining optimal dosing regimens, conducting large-scale clinical trials, and establishing comprehensive safety profiles for use during pregnancy and reproductive years.

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8. Nomenclature

- AAEE: Arachic Acid Ethyl Ester
- AGEs: Advanced Glycation End-products
- CAPE: Caffeic Acid Phenylethyl Ester
- COX: Cyclooxygenase
- CP/CPPS: Chronic Prostatitis/Chronic Pelvic Pain Syndrome
- EPO: Erythropoietin
- Hb: Hemoglobin
- HbA1c: Glycated Hemoglobin
- ID: Iron Deficiency
- IDA: Iron Deficiency Anemia
- IL: Interleukin
- LOX: Lipoxygenase
- NF-kB: Nuclear Factor kappa B
- NSAIDs: Nonsteroidal Anti-Inflammatory Drugs
- NVP: Nausea and Vomiting in Pregnancy
- OAT/ATD: Antituberculosis Drugs
- RBC: Red Blood Cell
- ROS: Reactive Oxygen Species
- STR: Streptozotocin
- TB: Tuberculosis
- TNF: Tumor Necrosis Factor
- 5-HT: 5-Hydroxytryptamine (Serotonin)

Chemical Compounds:PGF2 α : Prostaglandin F2-alpha

PGE2: Prostaglandin E2

Ca²⁺: Calcium ionsCuSO₄: Copper Sulfate**Units:**

g/dl: grams per deciliter

mg/kg: milligrams per kilogram

mg GAE/100g: milligrams Gallic Acid Equivalent per 100 grams

mg QE/100g: milligrams Quercetin Equivalent per 100 grams

9. Declarations

Conflict of interest/Competing interests

The authors confirm that there are no conflicts of interest associated with this publication.

Author(s) Contribution

ER designed the study, conducted the primary literature search, and drafted the manuscript. MSM contributed to data analysis, visual presentation, and technical editing. MS supervised the interpretation of phytochemical data and provided scientific consultation. HU evaluated clinical relevance and supported methodology development. W revised the discussion section and improved the overall structure of the paper. HH coordinated all project stages, reviewed the final content, and approved the final manuscript. All listed authors have reviewed and approved the publication of this article.

References

- [1] Petraglia, F., & Dolmans, M. M. (2022). Iron deficiency anemia: Impact on women's reproductive health. *Fertility and Sterility*, 118(4), 605–606. <https://doi.org/10.1016/j.fertnstert.2022.08.850>
- [2] Tinti, S., Praticò, F., Bonaldo, V., Rovetto, M. Y., Barattini, D. F., Casolati, E., Piccolo, E., Piazza, R., Liberati, M., Locci, M., & Cetin, I. (2023). Prevalence and burden of nausea and vomiting in pregnant women: Interim analysis of the PURITY survey. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, 290(May), 135–142. <https://doi.org/10.1016/j.ejogrb.2023.09.016>
- [3] Unnisa, H., Annam, P., Gubba, N. C., Begum, A., & Thatikonda, K. (2022). Assessment of quality of life and effect of non-pharmacological management in dysmenorrhea. *Annals of Medicine and Surgery*, 81(June), 104407. <https://doi.org/10.1016/j.amsu.2022.104407>
- [4] Cappellini, M. D., Santini, V., Braxs, C., & Shander, A. (2022). Iron metabolism and iron deficiency anemia in women. *Fertility and Sterility*, 118(4), 607–614. <https://doi.org/10.1016/j.fertnstert.2022.08.014>
- [5] Critchley, H. O. D., Maybin, J. A., Armstrong, G. M., & Williams, A. R. W. (2020). Physiology of the endometrium and regulation of menstruation. *Physiological Reviews*, 100(3), 1149–1179. <https://doi.org/10.1152/physrev.00031.2019>

- [6] Donnez, J., Carmona, F., Maitrot-Mantelet, L., Dolmans, M. M., & Chapron, C. (2022). Uterine disorders and iron deficiency anemia. *Fertility and Sterility*, 118(4), 615–624. <https://doi.org/10.1016/j.fertnstert.2022.08.011>
- [7] Man, Y., Xu, T., Adhikari, B., Zhou, C., Wang, Y., & Wang, B. (2021). Iron supplementation and iron-fortified foods: a review. *Critical Reviews in Food Science and Nutrition*, 1–22. <https://doi.org/10.1080/10408398.2021.1876623>
- [8] Yao, Y., Chen, Y., Fu, J., Ding, J., Zhou, W., & Chen, X. (2025). A metal-polyphenol network-based iron supplement with improved stability and reduced gastrointestinal toxicity for iron deficiency anemia therapy. *Materials Today Bio*, 31(January), 101598. <https://doi.org/10.1016/j.mtbio.2025.101598>
- [9] Bustos, M., Venkataramanan, R., & Caritis, S. (2017). Nausea and Vomiting of Pregnancy-What's New? *HHS Public Access*, 202, 62–72. <https://doi.org/10.1002/hep.30150.Ductular>
- [10] Lacroix, R., Eason, E., & Melzack, R. (2000). Nausea and vomiting during pregnancy: A prospective study of its frequency, intensity, and patterns of change. *American Journal of Obstetrics and Gynecology*, 182(4), 931–937. [https://doi.org/10.1016/S0002-9378\(00\)70349-8](https://doi.org/10.1016/S0002-9378(00)70349-8)
- [11] Ariyanti, R., Widyawati, M. N., Nurasmi, N., Mardhiana, M., & Yulianti, I. (2023). The effect of dayak ginger (*Zingiber Officinale* Roscoe) extraction in ginger cookies in reducing emesis gravidarum severity among pregnant women. *Healthcare in Low-Resource Settings*, 11(2), 1–17. <https://doi.org/10.4081/hls.2023.11753>
- [12] Panchal, M., Rana, P., Garg, N., Dhankhar, S., Sharma, H., & Chauhan, S. (2024). A Comprehensive Review of Alternative Therapeutic Approaches for Nausea and Vomiting Relief in Pregnancy. *New Emirates Medical Journal*, 5. <https://doi.org/10.2174/0102506882282929231212074538>
- [13] Esan, D. T., Ariyo, S. A., Akinlolu, E. F., Akingbade, O., Olabisi, O. I., Olawade, D. B., Bamigboye, T. O., & Ogunfowokan, A. A. (2024). Prevalence of dysmenorrhea and its effect on the quality of life of female undergraduate students in Nigeria. *Journal of Endometriosis and Uterine Disorders*, 5(December 2023), 100059. <https://doi.org/10.1016/j.jeud.2024.100059>
- [14] Gebeyehu, M. B., Mekuria, A. B., Tefera, Y. G., Andarge, D. A., Debay, Y. B., Bejiga, G. S., & Gebresillassie, B. M. (2017). Prevalence, Impact, and Management Practice of Dysmenorrhea among University of Gondar Students, Northwestern Ethiopia: A Cross-Sectional Study. *International Journal of Reproductive Medicine*, 2017, 1–8. <https://doi.org/10.1155/2017/3208276>
- [15] Burnett, M., & Lemyre, M. (2017). No. 345-Primary Dysmenorrhea Consensus Guideline. *Journal of Obstetrics and Gynaecology Canada*, 39(7), 585–595. <https://doi.org/10.1016/j.jogc.2016.12.023>
- [16] Dharwad, S., & Saldanha, D. R. M. (2012). Species identification of *Candida* isolates in various clinical specimens with their antifungal susceptibility patterns. *Journal of Clinical and Diagnostic Research*, 5(6), 1177–1181.
- [17] Kumar, S., Kumar, A., Roudbary, M., Mohammadi, R., Černáková, L., & Rodrigues, C. F. (2022). Overview on the Infections Related to Rare *Candida* Species. *Pathogens*, 11(963), 1–45. <https://doi.org/10.3390/pathogens11090963>
- [18] Karimi, A., Majlesi, M., & Rafieian-Kopaei, M. (2015). Herbal versus synthetic drugs; beliefs and facts. *Journal of Nephropharmacology*, 4(1), 27–30.

- <http://www.ncbi.nlm.nih.gov/pubmed/28197471><http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC5297475>
- [19] Park, D. K., & Park, H. J. (2013). Ethanol extract of cordyceps militaris grown on germinated soybeans attenuates dextran-sodium-sulfate-(DSS) induced colitis by suppressing the expression of matrix metalloproteinases and inflammatory mediators. *BioMed Research International*, 2013. <https://doi.org/10.1155/2013/102918>
- [20] Pasupuleti, V. R., Sammugam, L., Ramesh, N., & Gan, S. H. (2017). Honey, Propolis, and Royal Jelly: A Comprehensive Review of Their Biological Actions and Health Benefits. *Oxidative Medicine and Cellular Longevity*, 2017, 21. <https://doi.org/10.1155/2017/1259510>
- [21] Alqarni, A. M., Niwasabutra, K., Sahlan, M., Fearnley, H., Fearnley, J., Ferro, V. A., & Watson, D. G. (2019). Propolis exerts an anti-inflammatory effect on pmadifferentiated thp-1 cells via inhibition of purine nucleoside phosphorylase. *Metabolites*, 9(75), 1–21. <https://doi.org/10.3390/metabo9040075>
- [22] Fikri, A. M., Sulaeman, A., Marliyati, S. A., & Fahrudin, M. (2018). Antiemetic activity of Trigona spp. propolis from three provinces of Indonesia with two methods of extraction. *Pharmacognosy Journal*, 10(1), 120–122. <https://doi.org/10.5530/pj.2018.1.21>
- [23] Paulino, N., Dantas, A. P., Bankova, V., Longhi, D. T., Scremin, A., Lisboa De Castro, S., & Calixto, J. B. (2003). Bulgarian propolis induces analgesic and anti-inflammatory effects in mice and inhibits in vitro contraction of airway smooth muscle. *Journal of Pharmacological Sciences*, 93(3), 307–313. <https://doi.org/10.1254/jphs.93.307>
- [24] Abdullah, N. A., Ja'afar, F., Yasin, H. M., Taha, H., Petalcorin, M. I. R., Mamit, M. H., Kusriani, E., & Usman, A. (2019). Physicochemical analyses, antioxidant, antibacterial, and toxicity of propolis particles produced by stingless bee *Heterotrigona itama* found in Brunei Darussalam. *Heliyon*, 5(9), e02476. <https://doi.org/10.1016/j.heliyon.2019.e02476>
- [25] Banskota, A. H., Tezuka, Y., & Kadota, S. (2001). Recent progress in pharmacological research of propolis. *Phytotherapy Research*, 15(7), 561–571. <https://doi.org/10.1002/ptr.1029>
- [26] Kurek-Górecka, A., Górecki, M., Rzepecka-Stojko, A., Balwierz, R., & Stojko, J. (2020). Bee products in dermatology and skin care. *Molecules*, 25(556), 1–17. <https://doi.org/10.3390/molecules25030556>
- [27] Šturm, L., & Ulrih, N. P. (2020). Advances in the Propolis Chemical Composition between 2013 and 2018: A Review. *EFood*, 1(1), 24–37. <https://doi.org/10.2991/efood.k.191029.001>
- [28] Wiczorek, P. P., Hudz, N., Yezerska, O., Horčinová-Sedláčková, V., Shanaida, M., Korytniuk, O., & Jasicka-Misiak, I. (2022). Chemical Variability and Pharmacological Potential of Propolis as a Source for the Development of New Pharmaceutical Products. *Molecules*, 27(1600), 1–28. <https://doi.org/10.3390/molecules27051600>
- [29] Sahlan, M., Devina, A., Pratami, D. K., Situmorang, H., Farida, S., Munim, A., Kusumoputro, B., Yohda, M., Gozan, M., & Ledyawati, M. (2019). Anti-inflammatory Activity of Tetragronula species from Indonesia. *Saudi Journal of Biological Sciences*, 26(7), 1531–1538. <https://doi.org/10.1016/j.sjbs.2018.12.008>
- [30] Zulhendri, F., Lesmana, R., Tandean, S., Christoper, A., Chandrasekaran, K., Irsyam, I., Suwantika, A. A., Abdulah, R., & Wathoni, N. (2022). Recent Update on the Anti-Inflammatory Activities of Propolis. *Molecules*, 27(8473), 1–61. <https://doi.org/10.3390/molecules27238473>

- [31] Sokeng, S. D., Talla, E., Sakava, P., Fokam Tagne, M. A., Henoumont, C., Sophie, L., Mbafor, J. T., & Tchuenguem Fohouo, F. N. (2020a). Anti-Inflammatory and Analgesic Effect of Arachic Acid Ethyl Ester Isolated from Propolis. *BioMed Research International*, 8. <https://doi.org/10.1155/2020/8797284>
- [32] Ali, A., & Awadallah, A. (2003). Bee propolis versus placebo in the treatment of infertility associated with minimal or mild endometriosis: A pilot randomized controlled trial. *A modern trend. Fertility and Sterility - FERT STERIL*, 80, 32. [https://doi.org/10.1016/S0015-0282\(03\)01886-7](https://doi.org/10.1016/S0015-0282(03)01886-7)
- [33] Sapmaz, T., Sevgin, K., Topkaraoglu, S., Tekayev, M., Gumuskaya, F., Efendic, F., Pence, M. E., Aktas, S., Hekimoglu, G., & Irkorucu, O. (2022). Propolis protects ovarian follicular reserve and maintains the ovary against polycystic ovary syndrome (PCOS) by attenuating degeneration of zona pellucida and fibrous tissue. *Biochemical and Biophysical Research Communications*, 636(Pt 2), 97–103. <https://doi.org/10.1016/j.bbrc.2022.10.098>
- [34] Franco, J. V. A., Turk, T., Jung, J. H., Xiao, Y. T., Iakhno, S., Tirapegui, F. I., Garrote, V., & Vietto, V. (2019). Pharmacological interventions for treating chronic prostatitis/chronic pelvic pain syndrome. *Cochrane Database of Systematic Reviews*, 10. <https://doi.org/10.1002/14651858.CD012552.pub2>
- [35] ACOG. (2018). ACOG PRACTICE BULLETIN No. 189 SUMMARY: Nausea and Vomiting of Pregnancy. *Obstetrics and Gynecology*, 131(1), 190–193. <https://doi.org/10.1097/AOG.0000000000002450>
- [36] Bankova, V. S., Castro, S. L. DE, & Marcucci, M. C. (2000). Propolis: recent advances in chemistry and plant origin. *European Journal of Political Research*, 3–15. <https://doi.org/10.1111/j.1475-6765.1992.tb00316.x>
- [37] Farag, M. R., Abdelnour, S. A., Patra, A. K., Dhama, K., Dawood, M. A. O., Elnesr, S. S., & Alagawany, M. (2021). Propolis: Properties and composition, health benefits and applications in fish nutrition. *Fish and Shellfish Immunology*, 115(March), 179–188. <https://doi.org/10.1016/j.fsi.2021.06.010>
- [38] Wagh, V. D. (2013). Propolis: A wonder bees product and its pharmacological potentials. *Advances in Pharmacological Sciences*, 11. <https://doi.org/10.1155/2013/308249>
- [39] Oruç, H. H., Sorucu, A., Ünal, H. H., & Aydin, L. (2017). Effects of season and altitude on biological active certain phenolic compounds levels and partial standardization of propolis. *Ankara Üniversitesi Veteriner Fakültesi Dergisi*, 64(1), 13–20. https://doi.org/10.1501/vetfak_00000002767
- [40] Rohmatin, E., Krisjayanti, N., Yuliasuti, S., Mintarsih, W., & Sahlan, M. (2022). Propolis As An Alternative To Increase Hemoglobin Levels In Anemic Adolescent Girls. *International Journal of Applied Pharmaceutics*, 14(3), 129–131. <https://doi.org/10.3390/plants8030057>
- [41] WHO. (2017). Nutritional Anaemias : Tools for Effective Prevention. In A. March (Ed.), *World Health Organization*.
- [42] Haro, A., López-Aliaga, I., Lisbona, F., Barrionuevo, M., Alférez, M. J. M., & Campos, M. S. (2000). Beneficial effect of pollen and/or propolis on the metabolism of iron, calcium, phosphorus, and magnesium in rats with nutritional ferropenic anemia. *Journal of Agricultural and Food Chemistry*, 48(11), 5715–5722. <https://doi.org/10.1021/jf000635h>
- [43] Silva, C. R. B., Putarov, T. C., Fruhvald, E., Destro, F. C., Filho, W. C. M., Thomazini, C. M., Barbosa, T. S., Orsi, R. O., & Siqueira, E. R. (2014). Action of Brazilian propolis on hematological and serum biochemical parameters of Blue-fronted Amazons (*Amazona aestiva*, Linnaeus, 1758) in captivity. *Poultry Science*, 93(7), 1688–1694. <https://doi.org/10.3382/ps.2013-03738>

- [44] Touzani, S., Al-Waili, N., Imtara, H., Aboulghazi, A., Hammas, N., Falcao, S., Vilas-Boas, M., El Arabi, I., Al-Waili, W., & Lyoussi, B. (2022). Arbutus Unedo Honey and Propolis Ameliorate Acute Kidney Injury, Acute Liver Injury, and Proteinuria via Hypoglycemic and Antioxidant Activity in Streptozotocin-Treated Rats. *Cellular Physiology and Biochemistry*, 56(1), 66–81. <https://doi.org/10.33594/000000496>
- [45] Mahani, Sulaeman, A., Anwar, F., Damanik, M. R. m., Hardinsyah, & Ploeger, A. (2018). Determination of Indonesian Native Stingless Bee Propolis As Complementary Nutraceutical Candidate of Anti-Tuberculosis Drug. *International Journal of Pharmacy and Pharmaceutical Sciences*, 10(4), 15. <https://doi.org/10.22159/ijpps.2018v10i4.23850>
- [46] Ahmed, S., Hasan, M. M., & Ahmed, S. W. (2014). Natural antiemetics: an overview. *Pakistan Journal of Pharmaceutical Sciences*, 27(5), 1583–1598.
- [47] Giang An, N. T., Huong, L. T., Satyal, P., Tai, T. A., Dai, D. N., Hung, N. H., Ngoc, N. T. B., & Setzer, W. N. (2020). Mosquito larvicidal activity, antimicrobial activity, and chemical compositions of essential oils from four species of myrtaceae from central Vietnam. *Plants*, 9(544), 1–20. <https://doi.org/10.3390/plants9040544>
- [48] Mahani, F. F. E. sulaeman. (2021). Antiemetic Activities of Indonesian Stingless Bee Propolis on Emetic Induced By Anti-Tuberculosis Drugs. *International Journal of Pharmacy and Pharmaceutical Sciences*, 13(4), 39–44. <https://doi.org/10.22159/ijpps.2021v13i4.39618>
- [49] Dmitrovic, R., Kunselman, A. R., & Legro, R. S. (2013). Sildenafil citrate in the treatment of pain in primary dysmenorrhea: A randomized controlled trial. *Human Reproduction*, 28(11), 2958–2965. <https://doi.org/10.1093/humrep/det324>
- [50] Jenabi, E., Fereidooni, B., Karami, M., Masoumi, S. Z., Safari, M., & Khazaei, S. (2019). The effect of bee prepolis on primary dysmenorrhea: A randomized clinical trial. *Obstetrics and Gynecology Science*, 62(5), 352–356. <https://doi.org/10.5468/ogs.2019.62.5.352>
- [51] Al-Hariri, M. T., & Abualait, T. S. (2020). Effects of green Brazilian propolis alcohol extract on nociceptive pain models in rats. *Plants*, 9(9), 1–9. <https://doi.org/10.3390/plants9091102>
- [52] Sokeng, S. D., Talla, E., Sakava, P., Fokam Tagne, M. A., Henoumont, C., Sophie, L., Mbafor, J. T., & Tchuenguem Fohouo, F. N. (2020b). Anti-Inflammatory and Analgesic Effect of Arachic Acid Ethyl Ester Isolated from Propolis. *BioMed Research International*, 2020, 8. <https://doi.org/10.1155/2020/8797284>
- [53] Yang, L., Yan, Q. H., Ma, J. Y., Wang, Q., Zhang, J. W., & Xi, G. X. (2013). High performance liquid chromatographic determination of phenolic compounds in propolis. *Tropical Journal of Pharmaceutical Research*, 12(5), 771–776. <https://doi.org/10.4314/tjpr.v12i5.17>
- [54] Brittenham, G. M., Moir-Meyer, G., Abuga, K. M., Datta-Mitra, A., Cerami, C., Green, R., Pasricha, S. R., & Atkinson, S. H. (2023). Biology of Anemia: A Public Health Perspective. *The Journal of Nutrition*, 153, S7–S28. <https://doi.org/10.1016/j.tjnut.2023.07.018>
- [55] Dye, C., Reeder, J. C., & Terry, R. F. (2013). Research for universal health coverage. In *Science Translational Medicine* (Vol. 5, Issue 199). <https://doi.org/10.1126/scitranslmed.3006971>

- [56] Priyadarshini, K. H., Latha, P. A., Pradnya, S., Juhi, A., Samatha, P., & Ratnam, K. M. (2015). Comparative study of erythrocyte fragility in diabetes mellitus and non diabetes mellitus. *International Journal of Medical Research & Health Sciences*, 4(1), 183–185. <https://doi.org/10.5958/2319-5886.2015.00029.6>
- [57] El Menyiy, N., Al Waili, N., Bakour, M., Al-Waili, H., & Lyoussi, B. (2016). Protective Effect of Propolis in Proteinuria, Crystaluria, Nephrotoxicity and Hepatotoxicity Induced by Ethylene Glycol Ingestion. *Archives of Medical Research*, 47(7), 526–534. <https://doi.org/10.1016/j.arcmed.2016.12.010>
- [58] Attard, C. L., Kohli, M. A., Coleman, S., Bradley, C., Hux, M., Atanackovic, G., & Torrance, G. W. (2002). The burden of illness of severe nausea and vomiting of pregnancy in the United States. *American Journal of Obstetrics and Gynecology*, 186(5), 220–227. <https://doi.org/10.1067/mob.2002.122605>
- [59] Chortatos, A., Haugen, M., Iversen, P. O., Vikanes, Å., Eberhard-Gran, M., Bjelland, E. K., Magnus, P., & Veierød, M. B. (2015). Pregnancy complications and birth outcomes among women experiencing nausea only or nausea and vomiting during pregnancy in the Norwegian Mother and Child Cohort Study. *BMC Pregnancy and Childbirth*, 15(138), 1–11. <https://doi.org/10.1186/s12884-015-0580-6>
- [60] Boltman-Binkowski, H. (2016). A systematic review: Are herbal and homeopathic remedies used during pregnancy safe? *Curationis*, 39(1), 1514. <https://doi.org/10.4102/curationis.v39i1.1514>
- [61] Teng, L., Zu, Q., Li, G., Yu, T., Job, K. M., Yang, X., Di, L., Sherwin, C. M., & Enioutina, E. Y. (2016). Herbal medicines: challenges in the modern world. Part 3. China and Japan. *Expert Review of Clinical Pharmacology*, 9(9), 1225–1233. <https://doi.org/10.1080/17512433.2016.1195263>
- [62] Ahmed, S., Hasan, M. M., Ahmed, S. W., Alam Mahmood, Z., Azhar, I., & Habtemariam, S. (2013). Anti-emetic effects of bioactive natural products. *Phytopharmacology*, 4(2), 390–433. <https://www.researchgate.net/publication/236941612%0AAnti-emetic>
- [63] Sjarif, D. R., Ploos Van Amstel, J. K., Duran, M., Beemer, F. A., & Poll-The, B. T. (2000). Isolated and contiguous glycerol kinase gene disorders: A review. *Journal of Inherited Metabolic Disease*, 23(6), 529–547. <https://doi.org/10.1023/A:1005660826652>
- [64] Arbex, M. A., Varella, M. de C. L., de Siqueira, H. R., & de Mello, F. A. F. (2010). Antituberculosis drugs: Drug interactions, adverse effects, and use in special situations. Part 1: First-line drugs. *Jornal Brasileiro de Pneumologia*, 36(5), 626–640. <https://doi.org/10.1590/s1806-37132010000500016>
- [65] Kalsum, N., Sulaeman, A., Setiawan, B., Wayan, I., & Wibawan, T. (2016). Phytochemical Profiles of Propolis Trigona Spp. from Three Regions in Indonesia Using GC-MS. *Journal of Biology, Agriculture and Healthcare*, 6(14), 31–37. www.iiste.org
- [66] Adelakuna, O. E., Kudangaa, T., Greenb, I. R., Roes-Hilla, M. le, & Burton, S. G. (2012). Enzymatic modification of 2,6-dimethoxyphenol for the synthesis of dimers with high antioxidant capacity. *Process Biochem*, 12, 1–36.
- [67] Al-waili, N. S. (2004). Comparison with Dextrose and Sucrose. *Journal of Medicinal Food*, 7(1), 100–107. [All Papers/A/Al-waili 2004 - Comparison with Dextrose and Sucrose.pdf](http://AllPapers/A/Al-waili%202004%20-%20Comparison%20with%20Dextrose%20and%20Sucrose.pdf)
- [68] Al-Waili, N. S. (2005). Effects of honey on the urinary total nitrite and prostaglandins concentration. *International Urology and Nephrology*, 37(1), 107–111. <https://doi.org/10.1007/s11255-004-0871-8>
- [69] Bueno-Silva, B., Alencar, S. M., Koo, H., Ikegaki, M., Silva, G. V. J., Napimoga, M. H., & Rosalen, P. L. (2013). Anti-inflammatory and antimicrobial evaluation of neovestitol and vestitol isolated from

- brazilian red propolis. *Journal of Agricultural and Food Chemistry*, 61(19), 4546–4550. <https://doi.org/10.1021/jf305468f>
- [70] Koblůvská, R., Macková, Z., Vítková, M., Kokoška, L., Klejdus, B., & Lapčík, O. (2008). Isoflavones in the rutaceae family: Twenty selected representatives of the genera citrus, fortunella, poncirus, ruta and severinia. *Phytochemical Analysis*, 19(1), 64–70. <https://doi.org/10.1002/pca.1016>
- [71] Mahani, Faturachmana, F., Michelle, Lembong, E., Sulaeman, A., Hardinsyah, Nurjanah, N., Sunarno, & Sariadji, K. (2021). Antiemetic Activities of Indonesian Stingless Bee Propolis on Emetic Induced By Anti-Tuberculosis Drugs. *International Journal of Pharmacy and Pharmaceutical Sciences*, 13(4), 39–44. <https://doi.org/10.22159/ijpps.2021v13i4.39618>
- [72] Sahlan, M., Mahira, K. F., Pratami, D. K., Rizal, R., Ansari, M. J., Al-Anazi, K. M., & Farah, M. A. (2021). The cytotoxic and anti-inflammatory potential of *Tetragonula sapiens* propolis from Sulawesi on raw 264.7 cell lines. *Journal of King Saud University - Science*, 33(2), 101314. <https://doi.org/10.1016/j.jksus.2020.101314>
- [73] Sahlan, M., Rizka, N., Hapsari, A., Diah, K., Cahya, A., Lischer, K., Alhazmi, A., Mohammedsaleh, Z. M., Shater, A. F., Saleh, F. M., Alsanie, W. F., Sayed, S., & Gaber, A. (2021). Potential hepatoprotective effects of flavonoids contained in propolis from South Sulawesi against chemotherapy agents. *Saudi Journal of Biological Sciences*, 28(10), 5461–5468. <https://doi.org/10.1016/j.sjbs.2021.08.022>
- [74] Sulaeman, A., Fikri, A. M., Kalsum, N., & Mahani, M. (2018). Trigona propolis and its potency for health and healing process. In *The Role of Functional Food Security in Global Health*. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-813148-0.00025-6>
- [75] Sulaeman, A., Mahani, M., Hardinsyah1, E. D., Mubarakah, S. R., & Nurjanah. (2018). Hepatoprotective Activity of Indonesian Stingless Bee Propolis Against Toxicity of Anti- tuberculosis Drug on Pulmonary Tb Patients. *Journal of Apitherapy and Nature*, 1(3), 8–19.