AUCTORES
Globalize your Research

Journal of Cancer Research and Cellular Therapeutics
A. Krishna sailaja *

Open Access

Review Article

Phytochemical Investigation and Pharmacological Activities of Propolis

L. Shirisha, K. Kalpana, K. Sravya, L. Manasa, Sudhaparimala, A. Krishna sailaja *

Department of pharmaceutics RBVRR Women's college of pharmacy, Affiliated to Osmania University, Hyderabad.

***Corresponding Author:** A. Krishna sailaja., Department of pharmaceutics RBVRR Women's college of pharmacy, Affiliated to Osmania University, Hyderabad.

Received Date: January 14, 2026; **Accepted Date:** January 26, 2026; **Published Date:** February 06, 2026

Citation: L. Shirisha, K. Kalpana, K. Sravya, L. Manasa, Sudhaparimala, A. Krishna sailaja, (2026), Phytochemical Investigation and Pharmacological Activities of Propolis, *J. Cancer Research and Cellular Therapeutics*. 10(1); **DOI:10.31579/2640-1053/257**

Abstract

Propolis, a resinous bee product, protects hives and contains over 500 bioactive compounds, including flavonoids, phenolic acids, vitamins, and minerals. Its composition varies regionally, influencing therapeutic potential. Traditionally valued, modern studies confirm antibacterial, antioxidant, and anticancer effects. Despite commercialization, standardization challenges persist, requiring improved extraction and clinical validation. Propolis, a resinous bee product, has been valued since antiquity for healing and preservation. Its composition, exceeding 300 compounds, varies with regional flora, yielding diverse types such as European, Brazilian, and Cuban. Rich in phenolics, propolis exhibits antimicrobial, antioxidant, anti-inflammatory, and antitumor activities, supporting applications in medicine, food, and health supplements. Propolis demonstrates antimicrobial, anticancer, antioxidant, and immunomodulatory activities. It supports diabetes management via flavonoids, reduces inflammation in rheumatoid arthritis, induces apoptosis in cancer cells, protects gastrointestinal health, shows promise in COVID 19 therapy, and alleviates asthma through anti allergic effects. Its diverse bioactive compounds highlight broad therapeutic potential across diseases.

Keywords: hplc; antimicrobial activity; pharmacological activities; phytochemical constituents

Introduction

Propolis: Nature's Protective Bee Product

Propolis is a sticky, resin-like material made by honeybees, especially Apis mellifera. Bees collect plant resins, saps, and gums, mix them with their saliva and beeswax, and form propolis. Inside the hive, it acts like a natural shield—sealing cracks, reducing airflow, preventing excess moisture, and stopping harmful microbes. This helps keep the hive healthy and stable. Propolis extracts are prepared through purification, grinding, and ethanol-based extraction. Method A uses 10 g powder stirred in ethanol, centrifuged, and concentrated; Method B involves freezing, fine grinding, and 70% ethanol with sonication. Extract yields are determined gravimetrically. Solvent choice—ethanol, methanol, glycerol, water, or DMSO—depends on analytical or biological applications [1,2]. Liquid–Liquid Extraction (LLE) efficiently isolates phenols and flavonoids from propolis for chromatographic analysis. Using methanol–water dissolution, acidification, and organic solvents (ether, ethyl acetate), phenolics are recovered and concentrated. Fractionation with hexane, chloroform, ethyl acetate, and butanol separates compounds by polarity. Resulting extracts, dried under vacuum, enable reproducible phytochemical profiles. Samples prepared in methanol/ethanol or DCM, spotted on silica gel TLC plates. Mobile phases vary (hexane–ethyl acetate, toluene–chloroform–ethanol, ethyl acetate–formic acid–acetic acid–water). Development in saturated chambers. Visualization under UV (254/366 nm) or spray reagents (Dragendorff, ferric chloride, vanillin, anisaldehyde). Propolis shows antimicrobial action against Bacillus cereus and Staphylococcus aureus, correlating with polyphenol content and synergizing with antibiotics. Antiangiogenesis is demonstrated via CAM assays, inhibiting blood vessel growth at varying concentrations. Insecticidal activity reduces grain damage and pest mortality in maize and cowpea, confirming broad biological efficacy. Propolis exhibits diverse pharmacological activities. It shows antimicrobial effects against Bacillus cereus and Staphylococcus aureus, linked to polyphenol content and synergistic with antibiotics. Antiangiogenic potential is demonstrated in CAM assays, suppressing blood vessel growth. Insecticidal activity reduces grain damage and pest mortality in maize and cowpea, confirming broad biological efficacy

[3,4]. Chemically, propolis is very rich and complex. Scientists have identified more than 500 compounds, including flavonoids, phenolic acids, terpenes, sugars, vitamins, and minerals. Common substances include caffeic acid, quercetin, rutin, pinocembrin, and caffeic acid phenethyl ester (CAPE). It also contains vitamins A, B, C, and E, along with minerals such as calcium, magnesium, iron, and zinc. The exact composition depends on the plants available in each region. For example, Brazilian propolis is high in artepillin C, Cuban propolis contains benzophenones, and tropical propolis has unique terpenoids. Propolis has been used for centuries in traditional medicine, including Ayurveda, Chinese medicine, and folk remedies. Modern research confirms its antibacterial, anti-inflammatory, antioxidant, and anticancer properties. It has shown benefits in wound healing, oral health, cardiovascular protection, liver support, and even in managing diabetes and neurodegenerative diseases. Recently, it has been studied for possible roles in COVID-19 treatment. Today, propolis is available in many forms such as capsules, powders, mouthwashes, lozenges, cosmetics, and even beverages. Propolis powder is made by drying and grinding raw propolis, and it is widely used in supplements and topical remedies. Despite its many benefits, challenges remain in standardizing its quality because its chemical makeup varies widely with geography and season. Future studies aim to improve extraction methods, understand its molecular actions, and confirm its safety through large-scale clinical trials. With its long history of use and growing scientific support, propolis continues to be valued both in folk medicine and modern healthcare for its wide range of natural benefits [5,6].

Geographical Distribution of Propolis

Propolis has been valued since ancient times for its healing properties. The Greeks used it to treat wounds and abscesses, while Egyptians applied it during mummification. Propolis is made by honeybees of the genus Apis, especially Apis mellifera (found in Europe, Asia, and Africa) and Apis cerana (common in South and Southeast Asia). Bees mix plant resins with wax and their own secretions to create this sticky material, which is one of the most biologically active products of the hive [7,8]. The chemical composition of propolis changes depending on the plants available in each region. Raw propolis contains more than 300 compounds, including triterpenes, waxes, volatile oils, and phenolic substances. These compounds give propolis its aroma and strong medicinal properties. Based on plant sources, propolis is broadly classified into Poplar (temperate), Birch, Tropical, Mediterranean, and Pacific types. Three major forms are well known: European (poplar-type), Green Brazilian (from Baccharis dracunculifolia), and Red Cuban (from Clusia rosea). Each has unique chemical features and health benefits. For example, Chilean propolis shows strong antibacterial and antifungal activity, with high levels of pinocembrin, quercetin, and caffeic acid phenethyl ester (CAPE). Lithuanian propolis, derived mainly from poplar buds, is rich in p coumaric and caffeic acids, showing strong antioxidant and antimicrobial effects. Poplar-type propolis is the most widely distributed, found across Europe, Asia, and North America. Other plants such as pine, acacia, and willow also contribute to its production. Brazilian propolis is divided into green and red types, while Russian propolis comes from birch trees. Cuban and Venezuelan red propolis originates from Clusia species. Scientific studies confirm that these regional varieties share common bioactive properties, including antimicrobial, anti-inflammatory, antioxidant, and antitumor effects. However, the exact compounds responsible for these benefits are still being investigated. Overall, the biological activities of propolis are linked to plant-derived secondary metabolites, especially phenolic compounds. Its chemical diversity, shaped by geography and local flora, makes propolis a unique natural product with wide applications in medicine, food, and health supplements [9,10].

Chemical Constituents of Propolis

Advances in modern analytical techniques—such as HPLC, thin layer chromatography, gas chromatography (GC), and identification tools like mass spectrometry (MS), nuclear magnetic resonance (NMR), and GC MS—have revealed a wide range of compounds in propolis. These include flavonoids, terpenes, phenolics and their esters, sugars, hydrocarbons, and minerals. Interestingly, some common plant metabolites like alkaloids and iridoids are absent. Between 2000 and 2012, researchers reported 241 new compounds, classified by chemical type, geographic distribution, and plant origin[11,12].

Flavonoids

Flavonoids are the most abundant constituents and serve as quality markers for temperate propolis. They show antibacterial, antiviral, and anti inflammatory activity. Structurally, they include flavones, flavanols, flavanones, flavanonols, chalcones, dihydrochalcones, isoflavones, isodihydroflavones, and neoflavanoids. From 2000–2012, 112 flavonoids were newly reported, including rare glycosides like isorhamnetin 3 O rutinoside.

- **Poplar propolis:** flavones and flavanones.
- **Pacific propolis:** prenylated flavanones with strong antimicrobial effects.
- **Nepalese, Portuguese, Australian propolis:** flavanonols.
- **Red Brazilian propolis:** rich in flavanones, isoflavones, isodihydroflavones, chalcones, and dihydrochalcones, derived from Dalbergia ecastophyllum.
- **Cuban and Canadian propolis:** isoflavones and dihydrochalcones.
- **Nepalese propolis:** unique

Phenolic and Other Constituents of Propolis

Propolis is a complex bee product rich in diverse chemical compounds. Modern analytical techniques have revealed phenolics, sugars, hydrocarbons, minerals, vitamins, and other natural substances that contribute to its biological activity.

Phenolics

Brazilian green propolis contains many phenylpropanoids such as cinnamic, p coumaric, caffeic, and ferulic acids. Prenylated cinnamic acids are distinctive and strongly antimicrobial. Chlorogenic acid and quinic acid derivatives are abundant in Citrus derived Brazilian propolis. Poplar propolis shows caffeic and isoferulic acid derivatives.

Stilbenes

Though rare in plants, stilbenes are found in propolis. Kenyan and Solomon Island propolis contain geranyl and farnesyl stilbenes from Macaranga species. Australian Kangaroo Island propolis is especially rich in prenylated stilbenes, showing strong antioxidant activity.

Lignans

Lignans are prominent in tropical propolis. Kenyan and Brazilian samples revealed three lignans, while additional phenolics were reported from

Brazil, Indonesia, France, Iran, and Malta. Nemorosone from Clusia rosea marks brown propolis, while Iranian propolis contains Ferula derived compounds such as tschimgin and ferutinin.

Sugars

Sugars in propolis may originate from nectar, honey, or plant mucilage. Egyptian propolis revealed unique sugars like galactitol and galacturonic acid. Evidence supports mucilage as a major source.

Hydrocarbons

Hydrocarbons include alkanes, alkenes, esters, fatty acids, and steroids. Studies show propolis waxes are secreted by bees and genetically determined, not plant derived.

Mineral Elements

Trace elements such as Ca, K, Mg, Na, Fe, and Zn are common, while toxic elements like As, Cd, Hg, and Pb have also been detected. Elemental composition helps distinguish propolis by geographic origin.

Carbohydrates

Carbohydrates come from nectar, honey, and resins, adding to the sugar profile of propolis.

Vitamins

Propolis contains vitamins E, C, B1, B2, and B6. Thiamine and riboflavin originate from flower pollen, enhancing its nutritional and therapeutic value.

Flower Pollen

Pollen contributes over 96 nutrients, including amino acids, vitamins, minerals, and hormones, making it vital

Resin

Resin is a tree exudate, typically secreted from branches and trunks during spring. Bees collect these resins, modify them within the hive, and employ them as sealants, polishers, disinfectants, and even for preserving dead insects.

Wax

Bee wax is a soft, yellowish material with high absorbency. It consists of esters, fatty acids, long-chain alcohols, and occasionally free hydrocarbons. Although wax is moisture-resistant and chemically stable, it is vulnerable to heat and mechanical stress.

Preparation of Propolis Extracts

1. Purification of Raw Propolis

- Remove plant debris and dead bees manually.
- Heat propolis at 70°C in an oven → wax and contaminants rise to the top.
- Cool → propolis solidifies.
- Grind and sieve through No. 180 mesh (180 µm) to obtain fine powder.

2. Ethanol Extraction (Method A)

- Weigh 10 g of propolis powder.
- Dissolve in 100 ml ethanol (1:10)
- Stir for 24 h at 37°C, 300 rpm.
- Centrifuge for 10 min at 3000 rpm.
- Collect supernatant (crude extract).
- Re-extract residue with fresh solvent (100 ml) 3 times.
- Filter (Whatman No. 41), pool extracts, and concentrate using rotary evaporator at 40°C under vacuum.

3. Alternative Extraction (Method B)

- Freeze propolis overnight at −20°C.
- Grind to 10–80 µm particle size.
- Mix with 70% ethanol (1:30 w/v).
- Keep for 24 h at room temperature OR sonicate for 20 min at 20°C.
- Filter suspension.
- Re-extract trapped residue once more (third extraction unnecessary – negligible yield).

4. Determination of Extract Concentration

- Evaporate 2 ml of extract to dryness under vacuum.
- Weigh residue (g).
- Calculate yield:C={g}/{2} {mg/ml}
- Average across 3 replicants

Solvents used

- Common solvents: methanol, ethanol-water mixtures (80–96%), absolute ethanol, glycerol, water, DMSO
- Choice of solvent depends on intended analysis or biological testing.

Phytochemical Profiling of Propolis Extracts

Phytochemical profiling of local propolis extracts was carried out to ensure quality and consistency. High Performance Liquid Chromatography (HPLC) was employed using a Zorbax Eclipse XDB C18 column (4.6 × 150 mm, 5 µm). The mobile phase consisted of methanol, acetonitrile, and water with formic acid. Detection was performed at 260 nm with a flow rate of 1.2 ml/min. Retention times of approximately 30 minutes were compared with standards such as gallic acid, quercetin, and Trolox to confirm the presence of flavonoids [13,14].

Total Flavonoid Content (TFC)

Flavonoid quantification involved sequential reactions with $NaNO_2$, $AlCl_3$, and NaOH solutions. A 10 µl sample was incubated with these reagents, and absorbance was measured at 415 nm. Quercetin served as the standard, and all tests were performed in triplicate to ensure reproducibility.

Total Phenolic Content (TPC)

Phenolic content was determined using the Folin–Ciocalteu method. Samples were mixed with Folin reagent and Na_2CO_3 solution, incubated at 37°C for 30 minutes, and absorbance measured at 760 nm. Gallic acid was used as the reference standard, and results were expressed as gallic acid equivalents (mg/g extract).

Antioxidant Activity (DPPH Assay)

Antioxidant capacity was assessed using the DPPH radical scavenging assay. Propolis samples were incubated with freshly prepared DPPH solution in methanol for 30 minutes in the dark. Absorbance was measured at 517 nm. Trolox, a vitamin E analogue, was used as the

standard, and results expressed as Trolox Equivalent Antioxidant Capacity (TEAC).

Standard Liquid–Liquid Extraction (LLE) of Phenols and Flavonoids from Propolis

Liquid–Liquid Extraction (LLE) is a widely used method to isolate phenolic compounds and flavonoids from propolis for further analysis by HPLC, LC DAD, or GC MS.

Fractionation for phenols

Materials and Equipment

- **Propolis crude extract (EEP):** Prepared by macerating ground propolis in 70–80% ethanol, followed by filtration and solvent evaporation.
- **Solvents:** Methanol, diethyl ether, ethyl acetate, n hexane, chloroform, n butanol, water, hydrochloric acid.
- **Equipment:** Separation funnel, rotary evaporator, centrifuge, pH meter, syringe filters.

Procedure

1. **Initial Dissolution:** Dissolve dry propolis extract in methanol, dilute with water to 50% methanol/water, and adjust pH to 2 with HCl. Acidification ensures phenolics remain neutral, favouring extraction into organic solvents.
2. **Primary Extraction:** Transfer solution to a separation funnel, add diethyl ether (1:1 volume), shake for 15 minutes, and allow phases to separate. Collect the organic layer. Repeat at least once to maximize recovery.
3. **Optional Extraction:** Ethyl acetate may be used in place of ether to capture phenolics of varying polarity.
4. **Solvent Removal:** Pool organic fractions and evaporate under reduced pressure at 40°C to obtain concentrated phenolic residue.
5. **Final Preparation:** Dissolve residue in HPLC grade methanol, filter (0.45 µm), and inject into analytical instruments.

Fractionation for Flavonoids

1. **Nonpolar wash:** Partition crude ethanolic extract with n hexane to remove waxes/terpenes.
2. **Medium polarity:** Extract hydroalcoholic phase with chloroform or dichloromethane to isolate phenolic acids and aglycones.
3. **Flavonoid enrichment:** Adjust aqueous phase to 40–50% ethanol, extract with ethyl acetate to concentrate flavonoid aglycones.
4. **Polar flavonoids:** Partition remaining aqueous phase with n butanol to recover glycosides and caffeoylquinic derivatives.
5. **Final aqueous fraction:** Retains sugars, proteins, and polysaccharides. All fractions are dried under vacuum (≤40°C) and stored in amber vials at 4°C.

TLC of propolis

TLC OF PHENOLS

Sample Preparation for TLC

Dissolve the concentrated extract in a small volume of a suitable solvent (e.g., methanol or ethanol) to achieve a final concentrated of approximately 1% (10mg/ml). The sample should be concentrated enough to be visible on the TLC plate.

Filter the final sample solution, if needed, through a 0.45µm filter to remove any fine particles before spotting's

TLC Plate Preparation

- Use silica gel-coated TLC plates.
- Draw a pencil line 1 cm from the bottom edge of the plate.
- Spot small volumes (1–2 µL) of the propolis extract along the line.

Mobile Phase Selection

Common solvent systems for phenol separation include:

- Hexane: ethyl acetate (5:2)
- Ethyl acetate: dichloromethane (2:5)
- Ethyl acetate: formic acid: acetic acid: water (100:11:11:26)

Development

- Pour 10 mL of the mobile phase into a TLC chamber and allow it to saturate.
- Place the spotted TLC plate inside the chamber.
- Let the solvent rise until it reaches about 1 cm from the top.
- Take the plate out and indicate the solvent front using a pencil.

Visualization

- Dry the plate and observe under UV light (254 or 366 nm).
- Alternatively, use iodine vapor or spray with ferric chloride or vanillin-sulfuric acid to detect phenolic spots

TLC of Alkaloids:

Preparation of the drugs extracts for TLC.

1 gm of the powdered drug is thoroughly mixed with 1 ml of the 10% NH3 solution or 10% Na2CO3 solution; it is then subjected to extraction by shaking for about 5 minutes with 5 ml of methanol at 60°C (on a water bath). The filtrate is cooled and concentrated.

Adsorbent: Silica gel 60 F254 pre-coated TLC plates.
Solvent system: Toluene: chloroform: ethanol (28.5:57:14.5)

Acetone: water: conc.NH3 (90:7:3)

Toluene: acetone: ethanol: conc.NH3 (40:40:6:2)

Chloroform: methanol (85:15)

Detection

- Without chemical treatment: A lot of alkaloids show a pronounced quenching of fluorescence in UV 254nm. Some alkaloids are fluorescence blue or yellow in UV 365nm.
- Spray reagents: Usually Dragendroffs reagent is used. Brown or orange zones appear immediately on spraying. Since the colors are not stable, the alkaloidal zones are made more distinct by spraying first with Dragendroffs reagent and then with 5% sodium nitrite solution or 5% ethanolic H2SO4.

TLC of flavonoid

Preparation of the sample for TLC:

1gm of powdered sample is subjected to extraction with 10ml of methanol for 5 minutes on a water bath 60oC. The clear filtrate is used for TLC.

Adsorbent:

Silica gel 60 F254 pre-coated plates.

Solvent system:

Ethyl Acetate-Formic Acid-Glacial Acetic Acid-H2O (100:11:11:27)

Detection:

Without chemical treatment:

All flavonoids cause fluorescence quenching, which is seen as dark blue zones on the yellow background of the TLC plate at UV 254nm. Depending on the structural type, flavonoids fluoresce yellow, blue or green at UV 365nm.

Spray reagents:

Typical fluorescent colors in UV 365nm after spraying with PEG. Fluorescence behavior is structure-dependent.

Pharmacological activities of propolis

Antimicrobial activity

These extracts were serially diluted in agar, in Petri dishes. The dishes were then inoculated with the bacteria Bacillus cereus, Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa, and the fungus Candida albicans, and incubated at 37˚C or 20 25˚C for 48h.The growth of B. cereus and S. aureus, was inhibited by propolis at concentrations ranging from 125 to 500 µg/ml, but usually not that of the other two bacteria, or the fungus, even at concentrations higher than 1000 ug/ml (Shub et al., 1978).A correlation was observed between the polyphenol content of alcoholic extracts of propolis (AEP) and their antimicrobial activity against Bacillus cereus. In 91% of cases a high polyphenols content (59% or higher) was associated with significant antimicrobial activity (Malimon et al., 1980). In chickens, propolis was effective against S. aureus and S. epidermidis in vitro (Glinnik and Gapanovich, 1981). One hundred and six strains of S. aureus showed susceptibility to 0.5–1.0 mg/ml propolis Strains resistant to benzyl/penicillin, tetracycline, and erythromycin were sensitive to propolis [15,16].

Anti-Angiogenesis Activity of Propolis

Method-1

Chick embryo chorioallantoic membrane (CAM) assay

The CAM assay was conducted following the method of Park et al. (2014), with minor modifications. In brief, fertilized chicken eggs were incubated under humidified conditions at 37 °C. About 4 mL of albumin was drawn from the eggs using a hypodermic syringe (20 gauge) through a small hole drilled at the narrow end of the eggs on day 5 post-incubation, the small CAM and yolk sac were separated from the shell membrane. The opening was resealed with adhesive tape, and the eggs were subsequently returned to the incubator. Subsequently, on day 6, 10 µL of benzyl caffeate (10–200 nmol/egg) or retinoic acid (5 nmol/egg) as a positive control was mixed with 1% methylcellulose and injected into silicon rings (2 mm), The material was placed on the surface of the growing CAM. After 2 days of incubation, a 20% lipid emulsion was injected into the CAM to visualize the blood vessels. A minimum of 15 eggs were used per sample, and the experiment was repeated 5 times. The results were based on the suppression ratio (% of control) of new blood vessels within the range surrounded by a white ring.

Method-2

Chick chorio allontoic membrane is an extra embryonic membrane which is rich in blood vessels and is widely used in assessment of angiogenic and anti -angiogenic products. In the present study we have used 9 days old fertilized eggs. The eggs were surface sterilized and then incubated at 370C for one day4. Then the eggs were observed under egg candling box to visualize the presence of blood vessels.A small hole was drilled in the air space, allowing the air to be drained out. Further a small square shaped window was drilled out on the egg shell without damaging the membrane beneath. 10 eggs were used for each experiment. Different concentrations of the propolis were used for the study. The concentration used for the study was 5, 10 and 15 microgram per ml. The sample was loaded into a sterilized methyl cellulose disc, which was subsequently placed in the window created in the egg. The eggs were then incubated for further 3 more days at 37°C. After incubation the egg was opened and the extent of angiogenesis was observed. Saline was used as negative control and SLS was used as positive control. Testing the insecticidal activity of the propolis extracts on stored grains pests. 50g sample of maize was weighed in 250 m3 Kilner jars using Mettler weighing balance. 5 ml of 10% concentration of the propolis extracts was added to the maize grain sample with the aid of a syringe. They were carefully mixed and left for 1 hour to allow evaporation of the ethanol used for dilution. Thereafter, Kilner jar was infested with 10 pairs of 1–5 days old S. zeamias. The treatments were replicated four times and organized in the laboratory following a completely randomized design. Then the protocol was repeated for the rest of extract concentrations and control (ethanol). Thereafter the same procedure was repeated for the second grain (cowpea) with C. maculatus as pest species. Feeding activities of the maize weevil and cowpea weevil were monitored each for 35 days. Thereafter, insects were removed by sieving, damaged and undamaged grains were sorted and weight loss of the grain as a result of insect feeding activities determined. Data were collected on insect mortality, grain damage, and grain weight loss. Inability of the insects to move or respond to three probing using a blunt probe showed that insects had died. The percentage weight loss and percentage grain damage were calculated using the formula (Odeyemi & Daramola, 2000) ⁒grain damage=number of damaged grains⁄Total number of grains×100

Uses Of Propolis

Propolis shows strong antimicrobial, anticancer, antioxidant activities and has been explored in COVID-19 management. Accordingly, bioactive constituents of propolis associated with their therapeutic effects against different diseases have been widely documented.

Diabetes Mellitus

Type 2 diabetes mellitus (T2DM) is a metabolic disorder marked by elevated blood glucose due to impaired insulin secretion or action. Natural products have gained attention for their potential in managing T2DM, with propolis emerging as a promising candidate. Rich in flavonoids such as apigenin, chrysin, galangin, kaempferol, luteolin, genistein, pinocembrin, and quercetin, propolis exhibits antioxidant, anti-inflammatory, and free-radical scavenging properties. These compounds demonstrate antidiabetic potential by lowering blood glucose, enhancing insulin detection, and regulating secretion. Notably, naringin, a flavanone glycoside in propolis, mimics insulin activity, reduces lipid levels, and

improves insulin sensitivity. Apigenin and naringin further enhance glucose uptake in muscle tissues and inhibit glycogen phosphorylase, contributing to improved glycaemic control. Collectively, propolis-derived flavonoids support metabolic balance and reduce hyperglycaemia, highlighting their therapeutic relevance in T2DM.

Rheumatoid Arthritis

Rheumatoid arthritis (RA), a chronic autoimmune condition, involves joint pain, swelling, and reduced mobility due to immune-mediated tissue damage. Oxidative stress and inflammation are central to RA progression, with reactive oxygen species (ROS) activating nuclear factor kappa B (NF-KB) and driving cytokine release, including TNF-α, IL-1β, and IL-6. Propolis constituents—terpenoids, phenolic compounds, steroids, alcohols, and sugars—exert anti-inflammatory and antioxidant effects that counteract these processes. By blocking NF-KB activation and reducing ROS, propolis mitigates inflammation and oxidative stress in RA-affected joints. Additionally, propolis supports tissue regeneration, including bone, cartilage, and dental pulp, further enhancing its therapeutic potential. Its chemical composition underscores strong anti-inflammatory activity, making propolis a valuable natural adjunct in RA management.

Anticancer

Cancer is a pathological condition characterized by uncontrolled cell growth, invasion of surrounding tissues, and metastasis to distant organs. Resistance to chemotherapy often reduces the effectiveness of conventional drugs, prompting interest in natural products as alternative therapies. Propolis, a bee-derived substance rich in diverse bioactive compounds, has demonstrated significant anticancer activity across breast, colon, liver, lung, and pancreatic cancer cell lines. Its mechanisms include induction of apoptosis and cell cycle arrest, both critical in halting tumour progression. Flavonoids and other constituents such as apigenin, caffeic acid, CAPE, ferulic acid, galangin, luteolin, myricetin, pinocembrin, and quercetin contribute to chemo preventive and antiproliferative actions. Propolis enhances apoptosis by activating caspase cascades and promoting cytochrome C release from mitochondria, thereby targeting molecules involved in the intrinsic apoptotic pathway. This chemical diversity underscores its potential as a natural anticancer agent.

Gastrointestinal Disorders

Gastrointestinal (GI) disorders impair the normal functioning of the digestive tract, including conditions such as oral mucositis, peptic disorders, gastritis, colitis, and mucosal ulcers. Propolis has been widely studied for its therapeutic role in GI health due to its antioxidant, anti-inflammatory, and mucosal-protective properties. In irritable bowel syndrome (IBS), propolis supplementation alleviates symptoms by reducing visceral hypersensitivity and elevating pain tolerance, largely attributed to quercetin glycosides. It also suppresses inducible nitric oxide synthase (iNOS) transcription via NF-KB regulation, minimizes colon tissue injury, and decreases inflammatory responses. Furthermore, propolis enhances mucin secretion, strengthens intestinal barrier integrity, and supports gut health through its prebiotic components. These actions prevent bacterial translocation and maintain gastrointestinal homeostasis, highlighting propolis as a promising natural adjunct in managing GI disorders.

Coronavirus Diseases

In early 2020, the World Health Organization (WHO) declared a global pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), widely known as COVID-19. This highly transmissible viral infection produced diverse clinical manifestations, including fever, cough, body pain, immune suppression, severe respiratory complications, and, in critical cases, death. During the initial stages, therapeutic options were limited, and the virus's rapid mutation rate complicated treatment development. Consequently, natural products such as propolis attracted significant attention for their potential role in combating COVID-19. Propolis exhibits pharmacological properties including anti-inflammatory activity, immune-enhancing effects, and inhibition of viral replication. These attributes suggest that propolis may serve as a supportive therapy in reducing viral progression and strengthening host immunity against SARS-CoV-2[17].

Asthma

Allergic diseases, including asthma, atopic dermatitis, and allergic rhinitis, represent a major global health challenge due to limited access to medications, high treatment costs, and insufficient therapeutic effectiveness. Asthma, a chronic inflammatory respiratory disorder, is characterized by airway narrowing and swelling, leading to chest tightness, wheezing, and breathing difficulty, especially after allergen exposure. Recent studies have increasingly explored natural therapies such as propolis for asthma management. Bioactive compounds in propolis demonstrate anti allergic, anti asthmatic, and anti inflammatory actions. These effects are largely attributed to the inhibition of mast cell and basophil activation, which are central to allergic inflammatory responses. When allergens bind to immunoglobulin E (IgE), cross linking of IgE receptors activates these cells, triggering the release of histamine and pro inflammatory cytokines such as tumour necrosis factor alpha (TNF α). By modulating these pathways, propolis shows promise as a supportive therapy for both infectious and allergic respiratory diseases.

Conclusions

Modern analytical techniques (HPLC, GC, MS, NMR) reveal propolis as a complex bee product containing flavonoids, phenolics, stilbenes, lignans, sugars, hydrocarbons, minerals, vitamins, pollen, resin, and wax. Over 241 new compounds were identified between 2000–2012. These diverse metabolites underpin antimicrobial, antioxidant, and anti-inflammatory activities, highlighting propolis' therapeutic potential. This review reveals the extraction procedures and pharmacological activities of Propilis.

References

1. Lim J R, Chua L S and Soo J (2023). Study of stingless bee (Heterotrigona itama) propolis using LC-MS/MS and TGA-FTIR Appl. Food Res. 3 100252
2. Talla E, Tamfu A N, Biyanzi P, Sakava P, Asobo F P, et al. (2014) Phytochemical screening, antioxidant activity, total polyphenols, and flavonoids content of different extracts of propolis from Tekel (Ngaoundal, Adamawa region, Cameroon) *J. Phytopharm*. 3 321–329
3. Anjum S I, Ullah A, Khan K A, Attaullah M, Khan H, et al. (2019) Composition and functional properties of propolis (bee glue): *A review Saudi J. Biol. Sci*. 26 1695–703

4. Mohiuddin I, Kumar T R, Zargar M I, Wani S U D, Mahdi W A, et al (2022) GC-MS Analysis, Phytochemical Screening, and Antibacterial Activity of Cerana indica Propolis from Kashmir Region Separations 9 363
5. Abdelrazeg S, Hussin H, Salih M and Shaharuddin B (2020) Propolis composition and applications in medicine and health Int. Med. J 25 1505–1542
6. Agung E T, Ramadhan R, Khairunnisa B, Amen Y, Matsumoto M, et al (2021) Cytotoxicity effect of honey, bee pollen, and propolis from seven stingless bees in some cancer cell lines Saudi *J. Biol. Sci*. 28 7182–7189
7. Torres A R, Sandjo L P, Friedemann M T, Tomazzoli M M, Maraschin M, et al. (2018). Chemical characterization, antioxidant, and antimicrobial activity of propolis obtained from Melipona quadrifasciata quadrifasciata and Tetragonisca angustula stingless bees *Brazilian J. Med. Biol. Res*. 51
8. Kubiliene L, Laugaliene V, Pavilonis A, Maruska A, Majiene D, et al. (2015) Alternative preparation of propolis extracts: Comparison of their composition and biological activities *BMC Complement. Altern. Med*. 15 1–7
9. Oscar S-A, Antonio C-N, Marina G-V, Elsa R-S and Gabriel V-A (2020). Phytochemical screening, antioxidant activity, and in vitro biological evaluation of leave extracts of Hyptis suaveolens (L.) from south of Mexico *South African J. Bot*. 128 62–66
10. Viji G S, Vasanthe B and Suresh K. (2013). Screening and antibacterial activity analysis of some important medicinal plants *Int. J. Innov. Appl. Stud*. 2 146–152
11. Amoros, M., Sauvager, F., Girre, L., & Cormier, M. (1992). In vitro antiviral activity of propolis. *Apidologie*, 23(3): 231 240.
12. Bankova, V. S., Popov, S. S., & Marekov, N. L. (1982). High-performance liquid chromatographic analysis of flavonoids from propolis. *J. Chromatogr. A*, 242(1): 135-143.
13. Bankova, V. S., De Castro, S. L., & Marcucci, M. C. (2000). Propolis: recent advances in chemistry and plant origin. *Apidologie*, 31(1): 3 15.
14. Barrientos, L., Herrera, C. L., Montenegro, G., Ortega, X., Veloz, J., Aet al. (2013). Chemical and botanical characterization of Chilean propolis and biological activity on cariogenic bacteria Streptococcus mutans and Streptococcus sobrinus. *Brazilian Journal of Microbiology*, 44(2): 577-585.
15. Bobbitt, J. M., Schwarting, A. E., & Gritter, R. J. (1968). Introduction to chromatography. *By Reinhold Book Corporation, Library of congress catalog Card Number*, 69-22: 841.
16. Bonvehì, J. S., & Coll, F. V. (2000). Study on propolis quality from China and Uruguay. *Z Naturforsch C J. Biosci*., 55(9-10): 778 784.
17. Bonvehì, J. S., & Gutiérrez, A. L. (2012). The antimicrobial effects of propolis collected in different regions in the Basque Country (Northern Spain). *World J. Microb. Biot*., 28: 1351-1358.

DOI:10.31579/2640-1053/257