"A Review On Management Of The Otitis Media From *Caryocar Coriaceum Wittm, Elettaria Cardomomum Maton* And *Cassia Occidentalis L*"

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ABSTRACT
Otitis media, a prevalent inflammatory condition of the middle ear, poses significant healthcare challenges globally. This review explores the management of otitis media through the application of natural remedies derived from *Caryocar coriaceum Wittm*, *Elettaria cardamomum Maton,* and *Cassia occidentalis L*., three botanicals known for their therapeutic properties. *Caryocar coriaceum*, commonly known as the pequi, possesses anti-inflammatory and analgesic qualities that may alleviate ear pain and inflammation. *Elettaria cardamomum*, or cardamom, has been traditionally used for its antimicrobial properties, which could help in combating bacterial infections associated with otitis media. *Cassia occidentalis*, known for its broad-spectrum anti-inflammatory and antioxidant effects, may support the reduction of middle ear inflammation. This review synthesizes existing research on these plants, evaluates their efficacy and safety profiles, and discusses their potential roles as complementary treatments in managing otitis media. The findings suggest that integrating these botanicals could offer a multifaceted approach to otitis media management, potentially enhancing patient outcomes and reducing reliance on conventional pharmacological treatments. However, further clinical studies are required to establish standardized dosages and confirm their therapeutic benefits.

Keyword: Otitis media, *Caryocar coriaceum Wittm*, *Elettaria cardomomum maton*, Cassia occidentalis L

1.1 INTRODUCTION

OTITIS MEDIA

The term "otitis media" refers to an infection or inflammation of the middle ear. Otitis media, sometimes referred to as "middle ear inflammation," was documented in over 24.5 million cases in 1990[1]. One of the most prevalent conditions affecting young infants globally is otitis media (OM)[2]. Otitis media can cause lifelong ear dysfunction and hearing loss, even though it often goes away on its own without any problems. Numerous pathogens, including Haemophilus influenzae and streptococcus pneumoniae, are the cause of it. Approximately two-thirds of children with acute otitis media have a bacterial pathogen isolated from their middle ear secretions; the most common pathogen is Streptococcus pneumonia, which is followed by non-typable strains of Moraxella catarrhalis and Haemophilus influenza [4-5].

Acute otitis media (AOM), otitis media with effusion (OME; "glue ear"), and chronic suppurative otitis media (CSOM) are among the various conditions that fall under the umbrella of otitis media (OM), also known as middle ear inflammation[6]. The presence of fluid in the middle ear combined

with an acute sickness symptom is the hallmark of acute otitis media [1]. The existence of fluid in the middle ear without any indications of an acute infection is what is known as otitis media with effusion [1]. The most common symptom of chronic suppurative otitis media (CSOM) is persistent or recurrent ear discharge through a tympanic membrane perforation or a ventilation tube. CSOM is described as chronic inflammation of the middle ear and mastoid cavity [7].

1.2 Epidemiology

Acute otitis media is a condition that primarily affects infants and young children, peaking in occurrence between the ages of six and eighteen months [1]. It is unlikely that children who experience recurring middle ear infections later in life if they have few bouts of acute otitis media before the age of three [1]. Although otitis media can occur at any time of year, the majority of cases are reported in the fall, summer, and winter, which is consistent with the seasonal increase in respiratory tract infections [8]. When assessed as a single or recurrent episode of middle ear inflammation, the incidence of acute otitis media is much higher in males than in girls, and it is caused by hereditary factors [9].

In addition to factors associated with risk for recurrent and severe otitis media include : young age [10], male sex [11], Malnutrition [14], Lack of breast-feeding [12], Poor hygiene [13], Upper respiratory tract infections(URTI) [9], Group day care, and Exposure to tobacco smoke [15].Breast-feeding is an important factor in the prevention of respiratory infections, including otitis media for infancy [12].Among children in boston, breast-feeding was strongly associated with decrease the risk for acute otitis media during first year of life [12].

1.3 Pathogenesis

Despite the great prevalence of the condition, otitis media in affluent nations typically resolves on its own, seldom leading to long-term hearing loss or developmental delays [16]. Acute otitis media in early childhood appears to be related in large part to eustachian-tube dysfunction [17]. Early-life acute otitis media seems to be largely associated with eustachian-tube dysfunction. At least three crucial physiological roles for the Eustachian tube exist in avoiding infection and building up middle-peripheral effusion: First, defense against masopharyngeal sound pressure and secretion; second, nasopharynx middle ear secretion drainage and clearing; and third, middle ear ventilation to balance gas pressure with ambient pressure. Because their Eustachian tubes are shorter, larger, and more horizontally positioned than those of older children, as well as because the musculature controlling the opening and closure of tibe is incomplete [1].

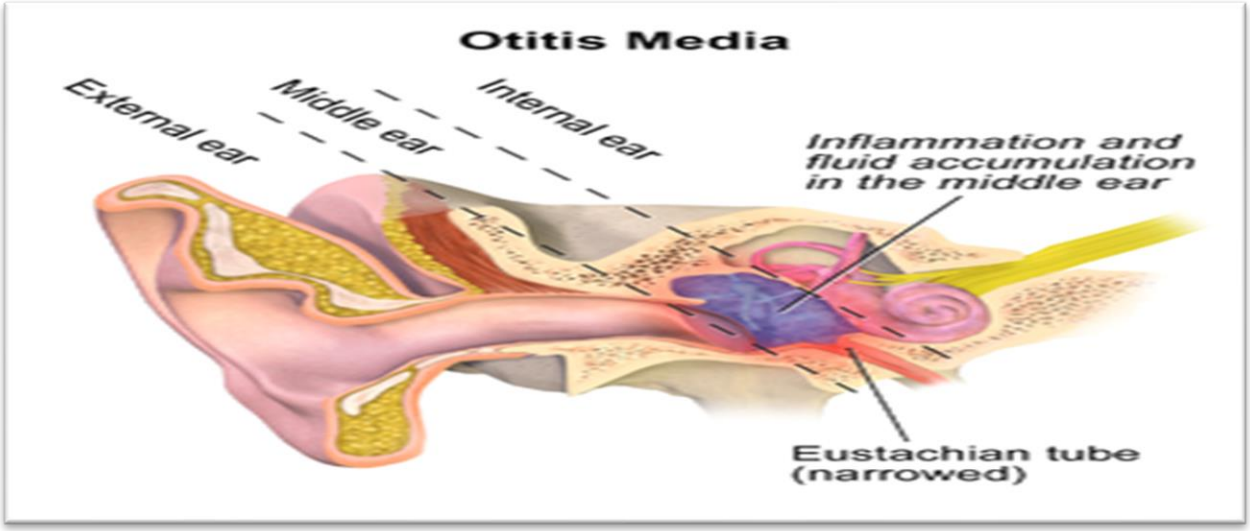


Figure 1 OTITIS MEDIA OCCURANCE DUE TO INFLAMMATION IN THE EUSTACHIAN TUBE

Otitis media persists in children with cleft palates and craniofacial anomalies due to the Eustachian tube's incapacity to shield the middle ear from the growth of microbiological infections in the nasopharynx [1].

The following sequence of events typically causes an acute otitis media: if the patient has an allergy reaction or viral infection that clogs the upper respiratory tract's mucosa, or if the patient has congestion of the Eustachian tube's mucosa, which obstructs the tube at its narrowest point (the isthmus)[18].Before blockage, if harmful bacteria that inhabit the nasopharynx are present in the middle ear secretions, they grow and cause chronic suppurative otitis media. The primary cause of hearing loss in cases of chronic suppurative otitis media is malfunction of the tympanic membrane [19-20].

1.4 Sign and Symptoms

The most common sign of acute otitis media is ear discomfort, although only 50–60% of children with the condition report having ear pain [21-22].

Acute otitis media patients might present with systemic symptoms such as fever, irritability, headache, fatigue, anorexia, or vomiting, as well as symptoms exclusive to ear diseases such as pain, otorrhea, and hearing loss. The unusual symptoms of an ear infection are vertigo, nystagmus, and tinnitus. The atypical tympanic membrane may be red, immovable, retracted, or bulging; these observations point to an acute inflammation and a fluid-filled cavity [23-24].

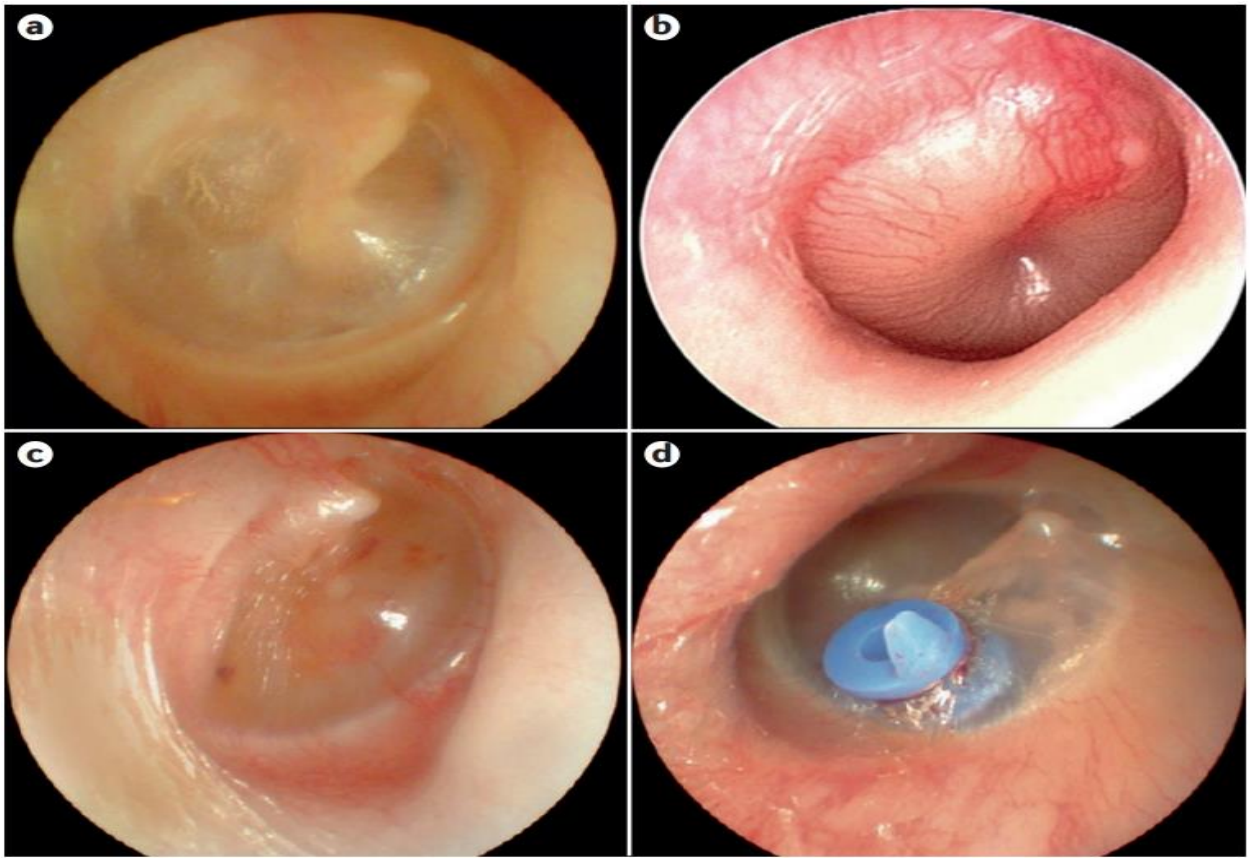


Figure 2 Otoscopical images. a | Normal tympanic membrane. Nature Reviews b | Red and bulging | Disease Primers tympanic membrane indicative of acute otitis media. c | Otitis media with effusion. d | Presence of a ventilation tube in the tympanic membrane[25]

2. *DETAILED PLANT STUDIES:*
[2.1] *CARYOCAR CORIACEUM*:

Figure 3 *CARYOCAR CORIACEUM WITTMACK*

[2.1.1] Taxonomical classification:-[26]

Kingdom	Plantae
Division	Streptophyta
CLASS	Equisetopsida
Order	Malpighiales
Family	Caryocaraceae
Genus	Caryocar
Species	*Caryocar coriaceum*
Binomial Name	*Caryocar coriaceum wittm*ack

[2.1.2] Vernacular Names of *Caryocar coriaceum*:- [27]

- English: Pequi

[2.1.3] Geographical Distributions:

From Costa Rica to Paraguay and the southeast of Brazil, *Caryocar coriaceum* is extensively dispersed throughout Central and South America[28]. A native species found in the states of Ceara, Pernambuco, and Piauí stands out among the immense diversity of plant species found in Brazil's flora[29].Various phytogeographic domains, including Amazonia, Cerrado or Savannah, Atlantic Forest, and Caatinga or Seasonally Dry Tropical Forest, are home to species of the genus Caryocar[30–31]. *Caryocar coriaceum* a species called Wittmack is mostly found in the Caatinga[32]. It is a tree known by its indigenous name, pequi, which means "your endocarp is covered in numerous slender thorns." The tree has a strong trunk that is about 2 meters in diameter and 12 to 15 meters high. *Caryocar coriaceum* bears compound, trifoliolate leaves that have opposite phyllotaxis. The petioles on each leaf range in length from 1.5 to 4 cm. Serrate or crenate leaf edges are both possible. The leaflets are short petiolate, with an oval limb rounded to a somewhat rectilinear apex, and measure 3.7 to 7 cm long by 5 to 10 cm wide [33–35].

[2.1.4] Botanical Description:

Caryocaraceae is formed mainly by trees and may also occur in shrubs lifeforms .Here we summarized the key description found for the pollen, flowers, fruits, seeds, leaves, and woods.

Pollen: The appearance of pollen grains differs significantly throughout genera. Anthosdiscus displays pollen grains with polar diameters of 25 to 44 μm and equatorial diameters of 12 to 32 μm. The grain surface is reticulate, and the form can occasionally be subprolate or prolate. Tricolporate grains are common, and tetracolporate grains are uncommon. It might contain a few unusually big grains. *Caryocar* pollen grains have polar diameters of 36 to 120 μm and equatorial diameters of 30 to 114 μm. The grain surface is either ornate or reticulate, and the form might be subprolate or prolate spheroidal. The grains are usually tricolporate, tetracolporate, or dicolporate infrequently. The prominence between the furrows and the surfaces is a unique characteristic of the *Caryocar* genus [36].

Flowers: They are hermaphrodite, big, and actinomorphic. The corolla typically has four or five petals, while it is sporadic to have more than these. The chalice typically displays five sepals in the same design. The petals are deciduous and imbricate. They gather into a calyptra in Anthodiscus. There are between 55 and 750 stamens in each flower, and the filaments often affix to a ring near the base of the bloom. Stamen fillets are usually lengthy, however they can sometimes appear as small, sterile fillets. The bilocular anthers might be connected to the center or basified. Four to six carpels in *Caryocar* and eight to twenty in Anthodiscus make up the rough ovary. Atrophic and basal, the eggs [37].

Fruits: Drupe-type fruits, with one to four seeds in *Caryocar* and eight to twenty in Anthodiscus, are found in both genera. The mesocarp is thick and indecent. The endocarp is prickly and stiff. It has an inside mesocarp of sorts that is connected to the endocarp on the outside to generate the pyrenes, which are separated into individual seeds.[28]

Seeds: Typically reniform, they have a thin or nonexistent endosperm and two cotyledons. The embryo may have a fleshy hypocotyl and a straight, arched, or spiral root.[28]

Leaves: Although certain Anthodiscus species are hyphodromous, the typical patterns include camptodromous and brochidodromous nerves. Sclerenchymal idioblasts are branching and found in the petioles and mesophyll of leaves. Although anomocytic stomata predominate, parasitic or anisocytic types can also exist. The abaxial portion of the leaves is where they are most concentrated [38].

Woods: The morphology of Anthodiscus and *Caryocar* differs greatly. There are differences in vessel abundance between species; Anthodiscus has a larger vessel abundance (15 mm2) compared to *Caryocar* (3 mm2). Anthodiscus vessels can be single or in multiples of two to six cells, with an average diameter of 50 to 100 mm. Vascular structures in *Caryocar* are solitary or occur in multiples of two to six cells, with diameters ranging from 74 to 577 mm. The wood's specific gravity falls between 0.802 and 0.906, meaning it can be classified as either moderately hard and heavy or exceptionally hard and heavy. It is thought to be reasonably straightforward to work with and durable on most species [39].

Figure 4 General aspect of *Caryocar coriaceum Wittm*. (*Caryocaraceae*). (A) = Habit; (B) = Stem; (C) = Leaves; (D) = Flower and floral buds; (E) = Fruit; (F) = Fruit with endocarp exposed after the removal of part of the epicarp by ants

[2.1.5] Phytochemical Profile:-

Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek phyto, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.

Plant Parts	**Chemical constituent**
Fruit[40-43]	Palmitic acid, Oleic acid, Arachidic acid, Palmitoleic acid, Linolenic acid, Heptadecenoic acid
Leave[44-46]	Catechin, Epicatechin, Isoquercitrin, Gallic acid, Chlorogenic acid, Caffeic acid, Ellagic acid
Seed[47]	Methyl-18-methylnonadecanoate, Docosanoic acid, Lignoceric acid, Heneicosanoic acid, Eicosenoic acid, Palmitic acid, Oleic acid,
Bark[48]	Rutin

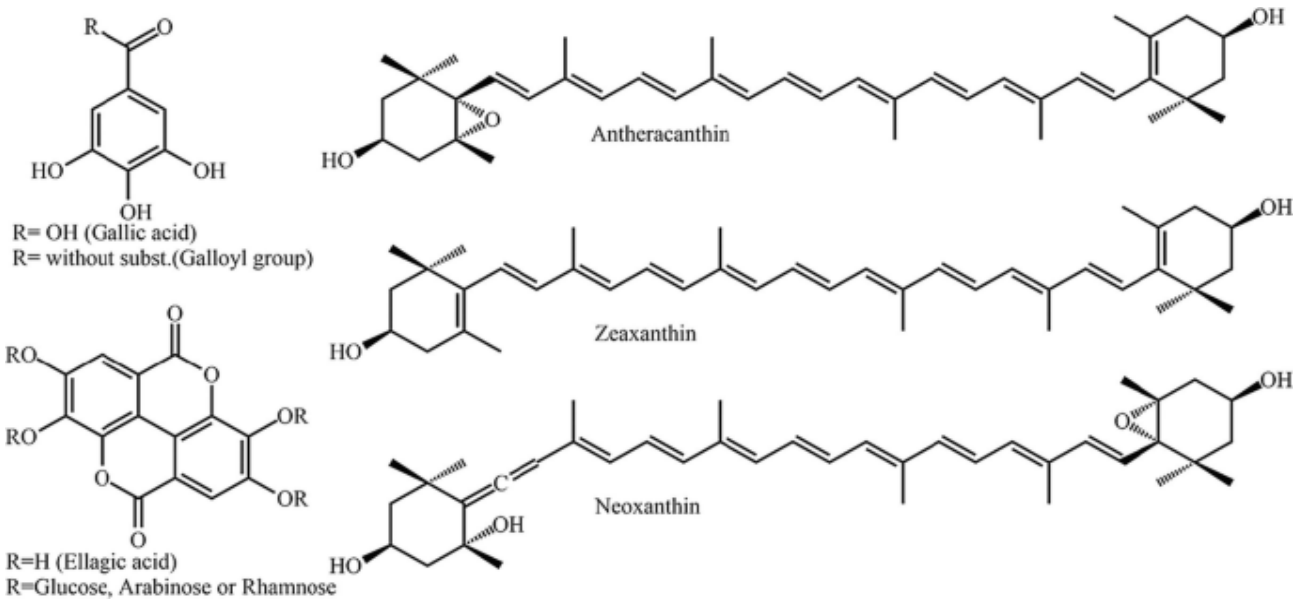


Figure 5 Diagram 2.1.5 Molecular structure of the major essential oil constituents in *Caryocar coriaceum*

[2.1.6] Pharmacological Profile of *Caryocar coriaceum*:

[1] Anti-Microbial activity:

For Escherichia coli ATCC 25922, EC 27, Staphylococcus aureus ATCC 12692, and Staphylococcus aureus SA 358, the oil has a minimum inhibitory concentration (MIC) of 512 µg/mL; however, it was ineffective against Pseudomonas aeruginosa ATCC 15442 and Proteus vulgaris ATCC 13315. The leaf extracts of *Caryocar coriaceum* have the ability to alter antibiotics, according to Araruna et al. [46]. The results of this investigation showed that the methanolic fraction and hydroethanolic extracts might boost the effectiveness of several aminoglycoside antibiotics against Staphylococcus aureus 358 and E. coli 27. Moreover, Lacerda-Neto et al. [49] found that *Caryocar coriaceum* hydroalcoholic leaf extracts strengthen the anti-Escherichia coli activity of penicillins such benzylpenicillin.

[2] Anti-Oxidant Activity:-

In this assay, recognized antioxidants like vitamin C (ascorbic acid) or BHT (butylhydroxytoluene) are utilized as a positive control. Paraquat (1,10-dimethyl-4,40-bipyridinium dichloride) is an oxidant that Drosophila melanogaster (fruit fly) is protected from by leaf extracts and oil from the pulp of *Caryocar coriaceum* fruits [50].

[3] Healing and Anti-Inflammatory Activity:

Oliveira et al. [51] demonstrated the anti-inflammatory properties of *Caryocar coriaceum* by demonstrating a dose-dependent reduction in xylene-induced inflammatory edema in albino Swiss mice (Mus musculus). The animals were divided into nine groups at random as part of the methodology. Only xylene (positive control) was given to the first, whereas the second group received the natural preserved *Caryocar coriaceum* oil. Two groups got oral dexamethasone (2.5 mg/kg) and indomethacin (5 mg/kg) for three days, while the remaining four groups received the oil at different concentrations (6%, 12%, 25%, and 50%). Xylene was administered to the mice one hour following their final oral dose. Topical xylene administration to the inner and outer surfaces of the right ear lobe resulted in edema. The control ear was thought to be the left ear.The mice were killed with an excess of ether anesthesia fifteen minutes or one hour after the inflammation was induced, and both ears were removed. A 5 mm cork drill bit was used to cut circular portions, which were then weighed. The weight difference between the right and left ears was used to quantify the edematous response. In just 15 minutes, the study found that the crude oil decreased inflammation

by 38.01%. These writers validate the popular usage of *Caryocar coriaceum* fixed oil by stating that it speeds up the healing process for cutaneous lesions. After tendinitis was created by intratendinous collagenase injections into the calcaneal tendon, Silva et al. [52] confirmed the anti-inflammatory properties of the fixed oil in rats.

[4] Anti-Fungal Activity:
When *Caryocar coriaceum* oil and fluconazole were combined, the growth of Candida krusei was significantly altered, despite the oil's modest antifungal effectiveness when tested alone against strains of Candida albicans and Candida tropicalis. Additionally, the oil's composition contains both saturated and unsaturated fatty acids, with unsaturated oleic acid constituting the majority. This underscores the oil's medicinal potential in the development of drugs intended to treat infectious fungus infections [53].

[**5**] **Gastroprotective Activity:**
Several publications have provided evidence of *Caryocar coriaceum's* gastroprotective properties. Leite et al. [54] discovered that the oil from the *Caryocar coriaceum* fruit pulp was able to block 60.5% of the ethanol-induced stomach mucosal lesions in Swiss mice (M. musculus) at a dose of 200 mg/Kg. In order to accomplish these goals, the animals were starved for 12 hours and then forced to consume either a vehicle (ten milliliters of tap water per kilogram as a control) or *Caryocar coriaceum* oil at concentrations of 200 and 400 mg/kg. Each animal had 0.2 mL of 96% ethanol orally an hour later, and 30 minutes later they were all put to death. The mucosal lesion area was assessed by planimetry using a clear grid placed on the surface of the glandular mucosa after their stomachs were removed and opened along the greater curvature. The pharmacological impact of *Caryocar coriaceum* pulp oil on ethanol-induced ulcers was also confirmed by Quirino et al. [40]. They also showed that α2-receptor mechanisms, endogenous prostaglandins, nitric oxide, and K+ATP are involved in this activity.

[2.2] ***Elettaria cardomomum maton***:

Figure 6 ***Elettaria cardomomum maton***

[2.2.1] Taxonomical Classification: [55]

Kingdom	Plantae
Division	Spermatophyta
CLASS	Liliopsida
Order	Zingiberales
Family	Zingiberaceae
Genus	Elettaria Maton
Species	Elettaria cardamomum (L.) Maton
Binomial Name	Elettaria cardamomum

[2.2.2] Vernacular Names of *Elettaria cardomomum maton*: [55]

- Sanskrit: Sukshmaila
- Hindi: Elaichi
- English: Cardamom
- Gujarati: Elaichi

[2.2.3] Geographical Distributions:-

Elettaria cardamomum Maton is a plant that is produced in Tanzania, Costa Rica, Guatemala, Sri Lanka, Nepal, India, and Indonesia. It is sometimes referred to as *little cardamom*, *green cardamom*, or *real cardamom*. *Elettaria cardomomum maton* is a perennial shrub that can reach a height of eight feet and has thick, meaty lateral roots[56]. This shrub is grown commercially in southern India, yet it is native to both India and Sri Lanka. In India, cardamom is grown in three southern states: Kerala, Karnataka, and Tamil Nadu, at elevations between 900 and 1400 meters above mean sea level. It is mostly grown in Kerala's Indian Cardamom Hills, which are classified as *Cardamom* Hill Reserves and span an area of 1050 square kilometers[57]. The allied genus Amomum contains the *false cardamom*, *giant cardamom*, and *black cardamom*, which are endemic to Nepal, Sikkim, Bengal, and other southeast Asian nations. Native to south-east Africa, including Tanzania, Cameroon, Madagascar, and Guinea, *African cardamom* is scientifically known as Aframomum danielli[58].

[2.2.4] Botanical Description:

Elettaria cardamomum L. Maton, sometimes known as small *cardamom*, is a member of the Zingiberaceae family. Its balanced tetraploid nature is indicated by the fundamental chromosomal numbers, x=12 and 2n=48. *Cardamom* is a perennial herbaceous plant that reaches heights of 2 to 5 meters. It reproduces through the vegetative division of its underground rhizomes[57].

***Seeds*:** The seeds of *Elettaria cardamomum (Linn.) Maton* and its variations (Fam. Zingiberaceae), a robust, big perennial herb that grows naturally in the damp woods of the Western Ghats up to a height of 1500 m, are used to make *cardamom*. The essential oil in the seed has an average yield of 2 to 5% and is highly dependent on storage conditions [60].

Fruits: Fruits are 1-2 cm long, round or oblong, roughly triangular in shape, and have a color ranging from green to pale-buff to yellow. Their apex is small and beaked, and their base is spherical or bears the remnants of a pedicle. The fruit's surface is nearly smooth or has faint longitudinal striations. The fruits are tiny and trilocular, with a double row of roughly 15-20 seeds that stick together to form a compact mass [59].

Flowers: The majority of *cardamom* types and variants have white flowers with a pink smear on the center lip. The blooms are irregular, bisexual, and most often pollinate by cross-pollination. The oval labellum has three separate lobed areas. The calyx is tubular, with three teeth soon after and being split approximately ¼ of the way down one side. The corolla has three lobed sections, the largest one being on the posterior side. The fertile stamen is extended into a brief crest but remains connected in the absence of connective appendages. The stigma is either below or above the crest. The two-lobed anthers dehisce vertically and adhere to the filament [60].

Leaves: Encircling the leaf sheaths forms the aerial stem. The dark green, lanceolate leaves measure 30-35 cm in length and 7-10 cm in width. They have an acuminate tip. Based on the type of panicle, *cardamom* is divided into three categories: Vazhukka (semi-erect panicle), Mysore (erect panicle), and Malabar (prostrate panicle).This is a basic description of the three varieties of *cardamom*:-

a) Malabar: Plants of this species mature to a height of 2-3 meters and are best suited at lower elevations of 600–1000 meters above mean sea level. Panicles are completely motionless.This variety is comparatively less prone to infection by shoot borer and thrips. In Tamil Nadu and Kerala, it can blossom even in the absence of much rainfall. The majority of cured capsules are spherical and measure about 18 mm in length.
b) Mysore: This kind can withstand elevations between 900 and 1200 meters above mean sea level. Strong plants reach a mature height of 3 to 4 meters. The panicles are fully upright (Figure 2). It thrives in areas of Kerala and Karnataka with evenly spaced rainfall. The ribbed, three-cornered cured capsules are typically 21 mm in length, which makes them significantly longer than the Malabar variety.
c) Vazhukka: This variety has intermediate traits from both the Malabar and Mysore types, making it a natural hybrid. It is suitable for altitudes between 900 and 1200 meters above mean sea level. Panicles are semi-erect, and plants are sturdy [61].

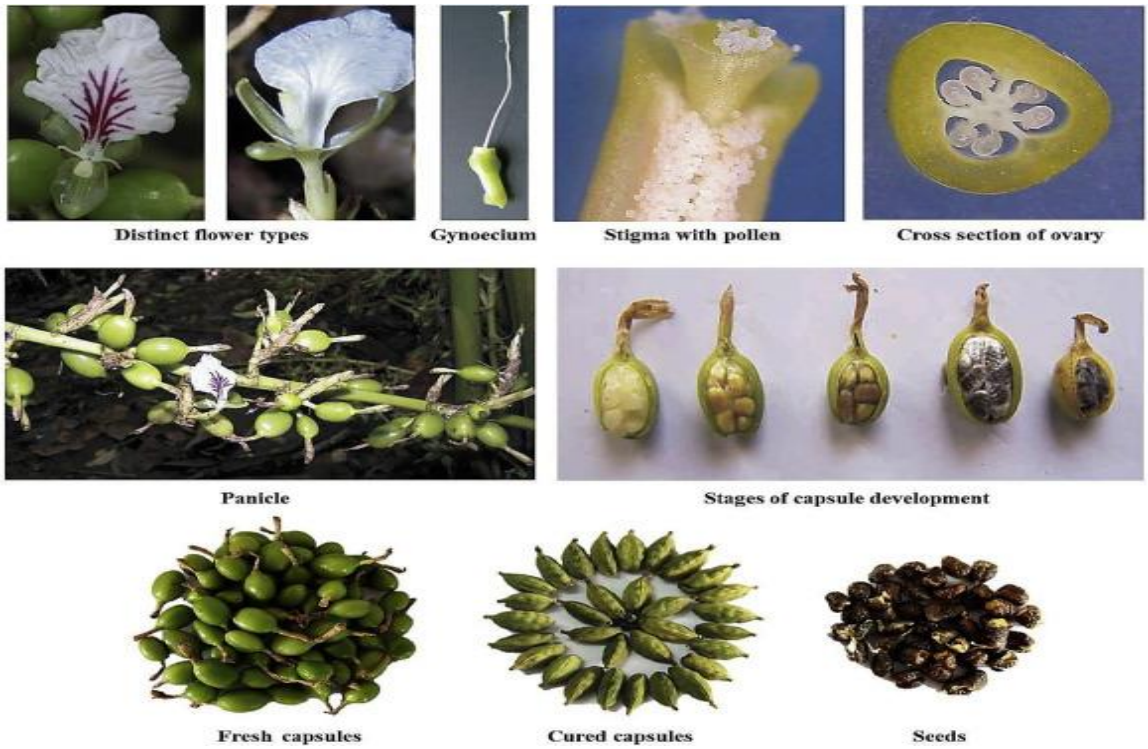


Figure 7 BOTANICAL FEATURE OF *ELETARIA CARDOMOMUM MATON*[62]

[2.2.5] Phytochemical Profile:-
Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek phyto, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.

Plant Parts	Chemical constituents
Seeds[63-64]	α-terpinyl acetate,Linalool, Sabinene, α-terpineol, Geraniol, 1,8-cineole,Linalyl acetate, Myristic acid,Palmitic acid, Palmitoleic acid,Stearic acid,Oleic acid
Leaves[65]	4-terpineol, 1,8-Cineol, α-terpene, Linalool
Fruits[66]	1,8-cineole,α-terpinyl acetate,α-terpineol, Sabinene, Nerol,α-pinene

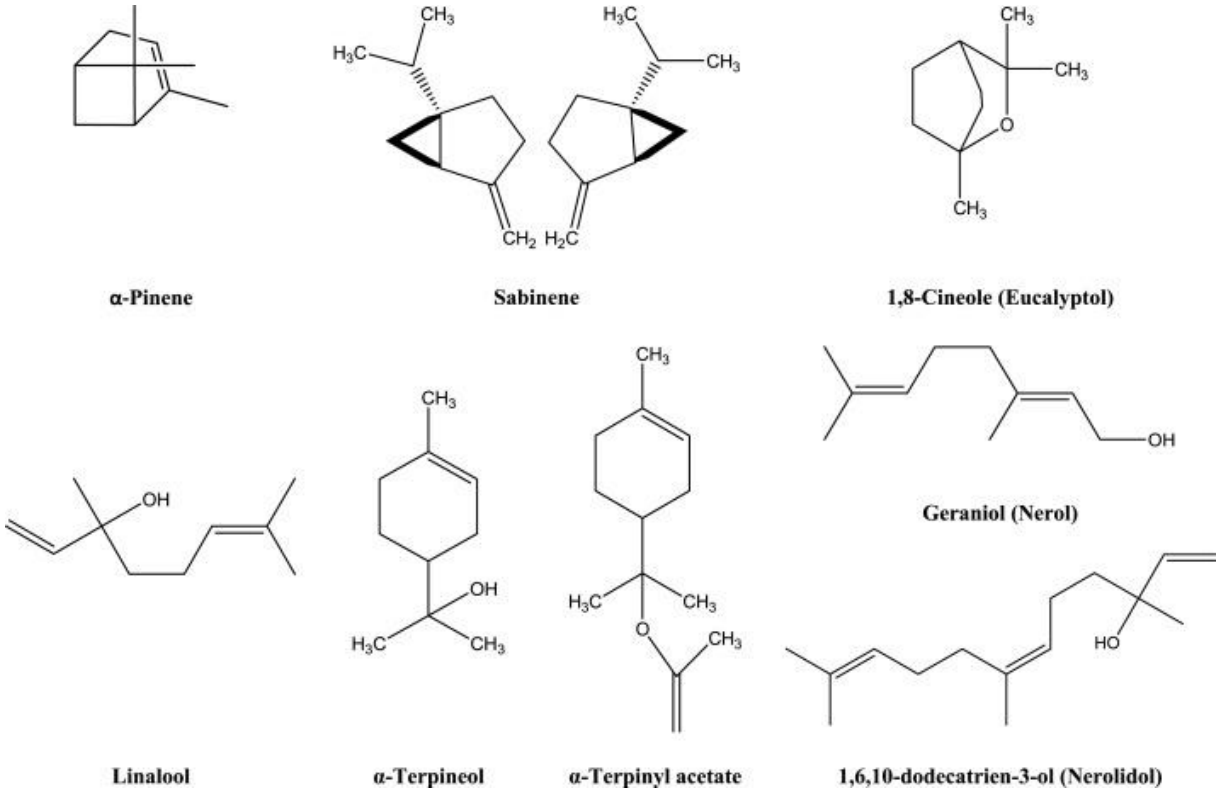


Figure 8 Diagram 2.2.5 Molecular structure of the major essential oil constituents in *Elettaria cardamomum* [62]

[2.2.6] Pharmacological Profile of *Elettaria cardamomum*:

[1] Anti-Oxidant activity:

Numerous chronic and degenerative diseases, including diabetes, cancer, immune system failure, and Parkinson's, are primarily brought on by oxidative stress. Antioxidants are substances, either natural or artificial, that can be employed to scavenge free radicals and reduce degenerative and chronic illnesses [67].Due to the presence of phenol constituents including quercetin, kaempferol, and luteolins, *cardamom* flowers and seeds are excellent sources of antioxidants that neutralize free radicals by limiting the oxidation of other components and possessing inherent antioxidant qualities. It is believed that natural antioxidants are safer than synthetic ones [68].

[2] Anti-Microbial and Anti-Bacterial activity:

Strong antibacterial properties of *cardamom* essential oil are demonstrated against a range of food-borne microbes. CEO (10 mg/ml) exhibited antibacterial action against Candida albicans, Bacillus pulmilus, Listeria monocytogenes, Escherichia coli, Streptococcus typhi, and Streptococcus mutans. CEO may be used to stop food-borne infections and food spoiling organisms from causing harm because of its potential broad-spectrum antibacterial and antifungal properties. Most research on the antibacterial properties of CEO and *cardamom* extracts has been done with the disc diffusion method [69].

[3] Anticancer activity:

In vitro research using *cardamom* capsule essential oil demonstrated anticarcinogenic properties by preventing aflatoxin B1 from damaging adult DNA through a microsomal enzyme-mediated reaction[70]. The oxidation and detoxification of xenobiotics are arbitrated by *cardamom* oil, which also increased the activities of glutathione transferase and acid-soluble sulfhydryl. It has also been reported that the phytochemical constituents of CEOs, such as 1, 8-cineole and limonene, have a protective effect against the development of cancer. Additionally, they claimed that aqueous

cardamom extract could lessen lipid peroxidation and enhance the activity of the detoxifying enzyme glutathione S-transferase.[71]

[4] Cytotoxic activity:-
Cardamom capsule extracts showed promise as an anticancer agent and significantly increased the cytotoxic effects of natural killer cells. CEO increased the number of CD4+ and CD8+ lymphocytes in rats treated with doxorubicin in a dose-dependent manner. These scientists also shown the role of CEO as an immune-stimulating drug in chemotherapy. The pharmacological significance of this result is limited by the use of cell lines based solely on in vitro experiments, despite the indications of the safety of CEO and *cardamom* extracts.[72]

[5] Anti-ulcerogenic activity:
Rats were used to test the petroleum ether soluble extract of *Elettaria cardamomum* seeds for aspirin-induced anti-ulcerogenic action. At 12.5 mg/kg, the petroleum ether soluble extract virtually 100% suppressed lesions.[73]

[2.3] *Cassia occidentalis L*

Figure 9 *Cassia occidentalis L*

[2.3.1] Taxonomical Classification:[74]

Kingdom	Plantae
Division	Spermatophyta
Class	Dicotyledonae
Order	Fabales
Family	Fabaceae
Genus	Cassia
Species	Cassia occidentalis L
Binomial Name	Cassia occidentalis

[2.3.2] Vernicules name of *Cassia occidentalis L* [75]:
- Sanskrit: Kasmard
- Hindi: Kasondi
- English: Coffee Senna

- Gujarati: Kasundi

[2.3.3] Geograpical Distributions:
This plant has very different habits in India. It grows as an annual in North and West India, including Haryana, but as a perennial in South India. The earlier findings motivated us to carry out more in-depth research on the antibacterial characteristics of *Cassia occidentalis* leaves by utilizing the agar disk diffusion method to assess the inhibition zone. The goal of the current study was to examine the antibacterial activity and precursor phytochemicals found in *Cassia occidentalis* leaves that were obtained from the Indian state of Haryana.[76] Small trees, *Cassia occidentalis*, grow 5–8 cm across South America, including the Amazon. It belongs to the same genus as Senna and is also known as coffee senna at times. Sometimes, lengthy seed pods are roasted and used to make a beverage similar to coffee[77].

[2.3.4] Botanical Description:
Root: Tap roots are cylindrical and tapering at the top extremities, yielding a few lateral branches and many rootless branches. They are 15–25 cm long and 1–15 cm in diameter. Numerous transversely running lenticels and a few root scars from falling roots contribute to the rough surface. It has a creamy inside and an exterior of dark brown color. A fracture is fibrous and rigid. The root has an unpleasant flavor and distinct smell.

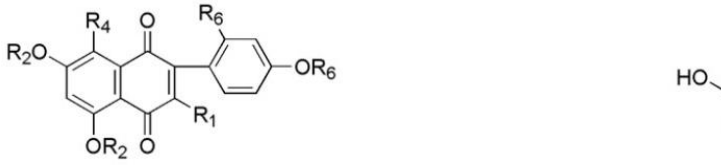
Stem: Straight, 0.5–1.5 cm, 1-2 meters in length. thickness at the base, with spiral branching at nodes. Mature stems range in color from light brown to dark brown, while young stems are green and tangled. Numerous, smooth, flexuose, climbing branches with a dark purple green surface color. The internode has a length of 2-4 cm. Compound, pinnate leaves measure 9–13–20 cm. Long, petiolate, pulvinate petiole (rachis), glabrous, grooved or almost spherical, 5–12 cm long, with a dark purplish color in the grooved area and a greenish tint on the other side.

Leaflets: 3–5 pairs, oblique, uneven; the superior ones are longer, 2.5–8 cm, while the lowermost ones are shortest and oval. Broad, very short stalk, lanceolate, acute or acuminate, oblong to ovate, rounded and somewhat oblique at base, hairy below and glabrous above. The leaves smell quite foul.

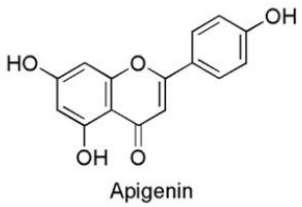
Flower: The bloom is yellow and has a diameter of 1 to 2 cm. The inflorescence racemes are few-flowered, axillary, and form terminal panicles with caduceus bracts.
Fruit: 10–12 cm long, flat pods containing 10–30 seeds. Areolate seeds have two ends: a tip and a blunt [78–79].

[2.3.5] Phytochemical Profile:- [80]
Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek phyto, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.

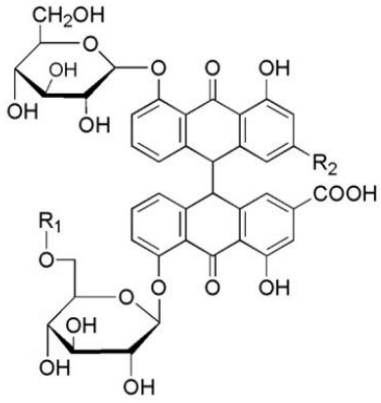
Plant Parts	Chemical Constituents
Roots	six anthraquinones: Islandicine, Chrysophanol, Physcion, Emodin, Questin and 7-methyl-physcion, Bianthraquinones — Chrysophanol 10,10-bianthrone Three tetrahydroanthracenes — Germichrysone, Methylgermitorosone and 7-Methyltorosachrysone
Seeds	D-Resin, tannins, carbohydrates,fatty acids, 1,8-dihydroxy-2-methyl anthraquinone, physcion, rhein, aloe-emodin, chrysophanol and steroidal glucosides
Flower	Anthraquinones, Emodin, Physcion and Physcion-1-O-β-D-glucoside,Sterol β-sitosterol
Fruits	Methylmorpholine, Galactomannan, Cassiollin, Xanthorin, Helminthosporin, Apigenin, Dianthrone heteroside, 1,8-dihydroxy-2-methyl anthraquinone; 1,4,5-trihydroxy-7-methoxy-3-methyl anthraquinone, Physcion, Rhein, Aloe-emodin, Chrysophanol and steroidal glycosides
Leaves	Alkaloids, Flavonoids, Tannins, Phlobatannins, Chrysophanol, Emodin, Physcion, Tetrahydroanthracene derivatives, Germichrysone



3,2'-dihydroxy-7,8,4'-trimethoxyflavon-5-O-{-b-D-allopyranoside 2
1 R1 = R5 = OH, R3 =CH3, R4 = OCH3
R2 = D-glucose-D-galactose sugar
2 R1 = R2 = R4 = R5 = R6 = H, R3 = D-allose sugar



Apigenin



Sennosides

Figure 10 Phytochemical Constituent isolated from *cassia occidentalis*

[2.3.6] Pharmacological Profile of *Cassia occidentalis L*

[1] Antimicrobial, antifungal, antiparasitic and insecticidal effects:

Strong antibacterial action against Vibrio cholerae, Bacillus subtilis, Bacillus protens, and Staphylococcus aureus was demonstrated by *Cassia occidentalis*. Ethanol and water were utilized to extract the leaves of *Cassia occidentalis*. Antimicrobial screening was performed in vitro using the extracts on Pseudomonas aeruginosa, Shigella sonnei, Salmonella typhi, Escherichia coli, and Staphylococcus aureus [81]. The antifungal properties of crude extracts derived from the leaf, seed, and pod of *Cassia occidentalis* were tested against three types of fungi: Aspergillus clavatus, Aspergillus niger, and Candida albicans [82]. Using mature earthworms (Pheritima posthuma), the ethanolic extract of *Cassia occidentalis* was tested for its anthelmintic activity. [99]. Numerous

investigations have proven the antimalerial properties of *Cassia occidentalis* [83-85]. The ability of an ethanolic leaf extract from *Cassia occidentalis* to prevent termite workers from destroying wood (Isoptera: Rhinotermitidoe) was assessed [86].

[2] Antianxiety and antidepressant effects:
Rats were used to test the antianxiety and antidepressant effects of ethanolic and aqueous extracts of *Cassia occidentalis* leaves (500 mg/kg, orally). Rats were exposed to unfamiliar aversion using a variety of techniques, including an actophotometer and an elevated plus maze model, to investigate the antianxiety action. In India, geriforte—a concoction of many plant compounds, including *Cassia occidentalis*—is used as a rejuvenating tonic for elderly people. Through the induction of diverse stressful circumstances in animals, the anti-stress (adaptogenic) activity of this preparation was assessed [87].

[3] Wound healing:
Excision, incision, and dead space wound models were used to assess the wound-healing capabilities of a methanolic crude extract of *Cassia occidentalis* leaves and a pure component called chrysophanol that was extracted from it. It was discovered that chrysophanol has more wound-healing properties than simple methanol extract. Reduced epithelialization period, increased rate of wound contraction, skin breaking strength, granulation tissue dry weight content, and granulation tissue breaking strength were all indicative of this effect. Comparing the granulation tissue histopathologically to the control group of animals revealed more collagenation [87].

[4] Anti-inflammatory, analgesic and antipyretic effects:
Male albino rats were used to test the anti-inflammatory properties of *Cassia occidentalis* leaf powder by inducing rat paw edema with carrageenan. A dose of 2000 mg/kg was the maximum amount of activity for *Cassia occidentalis*. *Cassia occidentalis* leaf powder inhibited the transudative, exudative, and proliferative aspects of chronic inflammation in the cotton pellet granuloma assay. Moreover, the exudate of cotton pellet granuloma showed reduced levels of lipid peroxide, gamma-glutamyl transpeptidase, and phospholipase A2 activity when *Cassia occidentalis* leaf powder was added.[116]. Mice were used to assess the antinociceptive effects of ethanol and water extracts of *Cassia occidentalis* leaves using the tail immersion, hot plate, and acetic acid-induced writhing tests. Rats were used to test the extract's antipyretic properties utilizing the yeast-induced pyrexia method [88].

[5] Antioxidant effects:-
The in vitro methods of nitric oxide scavenging activity, β-carotene-linoleic acid model system, hydroxyl radical scavenging activity, reducing power, metal chelating activity, and superoxide radical scavenging activity were used to examine the antioxidant potency of the methanolic extracts of *Cassia occidentalis* leaves, stems, and seeds. In comparison to the extracts of leaves and stems, the methanolic extract of seeds shown the highest potential to scavenge β-carotene-linoleic acid, superoxide radical, and hydroxyl radical. In contrast to the seed extract, methanolic extracts from leaves and stems were shown to have the maximum potential for chelating metals and scavenging nitric oxide radicals [89].

[6] Sun protective effects:-
A study was conducted on the sun protection factor (SPF) of *Cassia occidentalis* flowers. *Cassia occidentalis* was shown to have a high SPF rating along with antioxidant and antibacterial properties after comparison. According to the findings, *Cassia occidentalis* flowers are an effective antimeloncyte agent for UV radiation risks [90].

Conclusion

In conclusion, the review on the management of otitis media utilizing *Caryocar coriaceum*, *Elettaria cardamomum*, and *Cassia occidentalis* highlights the potential of these herbal remedies in providing symptomatic relief and promoting healing. The anti-inflammatory and antimicrobial properties of these plants suggest that they can complement conventional treatments effectively. However, further clinical studies are necessary to establish their efficacy and safety profiles. Incorporating these natural alternatives could enhance treatment strategies for otitis media, especially in regions where access to standard medical care is limited. Ultimately, a multidisciplinary approach that combines traditional knowledge with modern research may offer the best outcomes for patients suffering from this common condition.While the traditional uses of *Caryocar coriaceum*, *Elettaria cardamomum*, and *Cassia occidentalis* suggest potential benefits in managing otitis media due to their anti-inflammatory and antimicrobial properties, more research is necessary to substantiate these claims.

In conclusion, the exploration of eye drops formulated with *Caryocar coriaceum*, *Elettaria cardamomum*, and *Cassia occidentalis* for treating otitis media offers a novel approach to managing this condition. The potential anti-inflammatory and antimicrobial properties of these herbal ingredients may enhance therapeutic outcomes and reduce reliance on conventional antibiotics. While preliminary findings are encouraging, further research is crucial to validate their efficacy and safety in clinical settings. This innovative use of herbal formulations could pave the way for more holistic and accessible treatments for otitis media, particularly in areas with limited healthcare resources.

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