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Antimicrobial Effect of Manilkara Zapota Plant : Traditional and Medicinal Uses

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Abstract: *Background-The research aims to provide a detailed description of the antimicrobial activity and phytochemical composition of Manilkara zapota.Sapodilla, another name for Manilkara zapota, is widely available throughout the Indian subcontinent. Due to its widespread use in traditional medicine, it is a highly valued member of the Sapotaceae family.*

Objective-The objective of the review is to investigate the antimicrobial activity of Manilkara Zapota plant and to identify the bioactive compounds that responsible for antimicrobial activity in Manilkara Zapota plant.

Methods-The methods used in this area in vivo, in vitro methods. Microbial strain, extraction method also used in this research. Phytochemical analysis of manilkara zapota plant is carried out in this research.

Conclusion -Many phytoconstituents, including tannins, alkaloids, flavonoids, and saponins from the plant, have been reported by various authors to have a variety of biological effects, including anti-inflammatory, anti-arthritic, anti-bacterial, anti-fungal, anti-oxidant, anti-tumor, and anti-diabetic properties.

Result-This page presents a systematic, in-depth assessment of the research on this plant species, covering taxonomy, pharmacology, and phytochemistry. This review study will undoubtedly be a valuable resource for any upcoming scientific studies pertaining to this plant.

Keywords: Antimicrobial, Phytoconstituents, Manilkara zapota, Medicinal use

I. INTRODUCTION

The world's microbial infections have suddenly increased because of harmful microorganisms. Finding potential antibacterial drugs is, therefore, of the highest priority[1]. Studies have also shown that the lifespan of antimicrobial drugs, particularly those from recently discovered families, will be limited[2]. These days, researchers are focusing more on using natural sources as antimicrobial agents, which fight harmful bacteria instead of synthetic ones[3]. Given these facts, the purpose of this study was to determine the antimicrobial activities of M. zapota L. to investigate the plant's potential as a natural source of antimicrobial agents.Sapota plants are often grown in tropical climates, though they can also be grown in greenhouses in semi-tropical climates[4]. Growing it up to 1200 meters above sea level is possible.The Sapotaceae family consists of approximately 800 species of evergreen trees and shrubs across 65 genera[5]. This tropical plant family includes the sapodilla, scientifically referred to as Manilkara zapota[6]. This tropical fruit plant is indigenous to Mexico and Central America[7], but it is currently grown extensively in many other tropical regions of the world, including Thailand, India, and the Philippines Additionally[8], sapota has been used for its medicinal properties in traditional medicine,with claims that it can aid digestion, boost immunity, and even act as an aphrodisiac[9]. The plant species M. zapota holds great significance in terms of its medicinal value[10], as it is used to treat a wide range of illnesses owing to the presence of numerous phytochemicals[11]. The main components present in the leaves of sapodilla are lupeol acetate, oleanolic acid, apigenin-7-O-α-L-rhamnoside, myricetin-3-O-α-L-rhamnoside and caffeic acid[12].Bioassay guided isolation of crude methanolic extracts of the leaves and seedsof M. zapota yielded a total of three known compounds[13], myricetin-3-O-α-L-rhamnoside, D-quercitol and saccharose[14]. It has been demonstrated that M. zapota possesses diuretic, antibacterial, anthelminthic, anticancer, analgesic, antioxidant, anti-hyperglycemic, hypocholesterolemic, and hypoglycemic properties[15]. In continuation to investigate the medicinal properties of these plants, we are reporting the antimicrobial activities of leaf and bark extracts prepared from Manilkara zapota[16]. M. zapota leaf acetone extract has demonstrated strong antioxidant activity. It has been found that M. zapota leaf extracts in petroleum ether and ethanolic form have analgesic properties[17]. M. zapota's ethanolic

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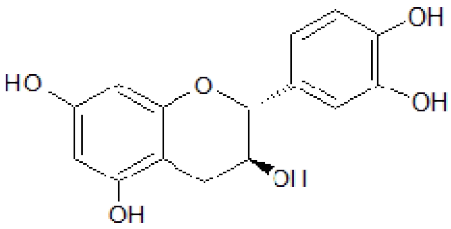
extract has strong anti-arthritic properties. The seeds are aperients, diuretic tonic and febrifuge. Bark is antibiotic, astringent and febrifuge. Chicle from bark is used in dental surgery. Fruits are edible, sweet with rich fine flavour[18]. Antimicrobial and antioxidant activities are also reported from the leaves. Crushed seeds are said to be beneficial in treating rheumatism, have a diuretic effect, and eliminate kidney and bladder stones. Apply tallow or oil-soaked leaves as a compress to the temples for neuralgia[19].To find new biomolecules, it is essential to examine plants that are employed in traditional medicine. Its fruits are utilized in food that has been shown to have therapeutic benefits. This paper examined the composition, direct antibacterial propertiesof the Manilkara zapota[20].

Fig 1. Manilkara zapota plant

II. PHYTOCHEMICAL CONSTITUENTS

Periodically, a number of researchers reported finding phytochemicals in Sapodilla leaf and seed extracts[21]. The extraction of several phytochemicals from M. zapota utilizing acetone, chloroform, and methanol extracts was proven by Mohanapriya et al. The maximum amount of phytoconstituents, including tannins, flavonoids, alkaloids, phenols, steroids, glycosides, and saponins[22], were found in the medium polar acetone extract. These workers also observed the presence of steroids, glycosides, and saponins in the low polar chloroform extract; and steroids, phenols, glycosides, and saponins in the high polar methanol extract[23]. Previous publications have noted the presence of a secondary metabolite in acetone extracts of M. zapota seeds. The pharmacological uses and antioxidant properties of sapodilla stem from these phytoconstituents, which are found in the seeds and other plant sections of the plant[24].

Aside from minerals like iron, copper, zinc, calcium, and potassium, it also includes proteins, amino acids, ascorbic acid, phenols, and carotenoids. Additionally, Chickoo contains a significant amount of vitamins, which makes it a beneficial cosmetic. Polyphenols are the main components that have been extracted from M. zapota fruits[25].

Chemical constituents	Structure	Pharmacological activities	Reference
Catechin		Antioxidant, Anti-inflammatory, Antimicrobial, Anticancer.	A systemic review on traditional use and phytochemistry of sapodilla.

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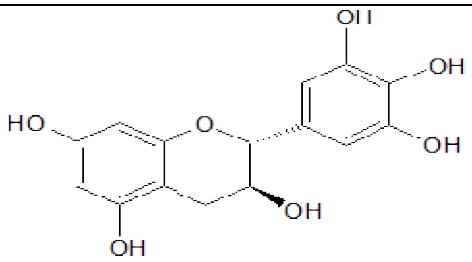
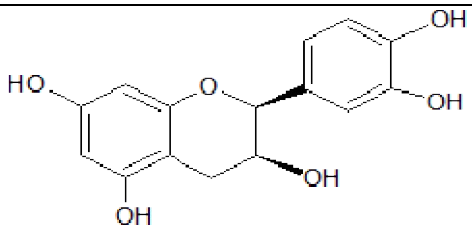
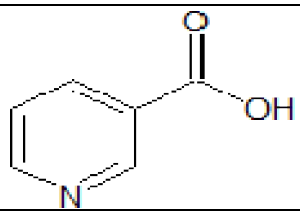
Gallocatechin		Anti-diabetic, Neuroprotective, Immuno-modulatory.	Pharmacological Potential of Manilkara Zapota(L.) P.Royen.
Epicatechin		Antimicrobial, Antifungal, Antiviral, Antibacterial.	Manilkara Zapota : Medicinal properties and Applications.
Niacin		Vasodilation, Lipid metabolism, Antioxidant.	Manilkara Zapota : An overview

Table 1. Phytochemical constituents of Manilkara Zapota

III. TRADITIONAL USES

Sapodilla fruits and crushed seeds are utilized for their diuretic properties, which help to prevent oedema. Additionally, they stop bladder and kidney stones from forming[26].

Cavity filling material is made from the latex found in sapodilla fruit[27].

In cases of gastritis, reflux oesophagitis, and bowel issues, the chickoo fruit relieves discomfort and inflammation. Sapodilla seed paste is used to reduce pain and swelling from bites and stings[28].

Chickoo's high vitamin C content fortifies the intestines, increases immunity, and shields against numerous bacterial illnesses[29].

Its high nutritional content makes it helpful throughout pregnancy. In addition to preventing anemia, it lessens weakness, nausea, and dizziness[30].

Fever and diarrhea are treated using a decoction made from the fruit and bark. Bark tea is also used to cure dysentery. Additionally, it helps with piles and constipation[31].

The Vitamin A and fibre content of sapodilla fruit.

prevents lung cancer, colon cancer, and oral cavity[32].

Relieves and prevents respiratory diseases when a paste made from sapodilla flowers and fruits is applied.

Sapodilla fruit is good anti-spasmodic agent[33].

The nutrient-rich plant sapota is a natural treatment for skin problems and is very useful for enhancing one's appearance.

The fruit Manilkara zapota contains vitamins E, A, and C, which have a moisturizing effecton the skin[34].

Antioxidants including as flavonoids, polyphenols, and ascorbic acid are present and aid in the reduction of wrinkles.

The creamy sap of the sapota plant removes warts and fungi from the skin[35].

The seed oil softens hair and moisturizes the scalp. It produces positive outcomes when it comes to curly hair management[36].

The sapota seed oil helps to treat hair-fall due to seborrheic dermatitis.

The sapota tree has numerous other uses that increase its usefulness in addition to its medicinal, nutritional, and culinary applications[37].

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In India, chickle, or sapota tree latex, is used as an adhesive for mending items and as a foundation material for chewing gum[38].

IV. PHARMACOLOGICAL ACTIVITIES

4.1.ANTIOXIDANT ACTIVITY

Chanda & Nagani used a series of extraction techniques with various solvents to observe the antioxidant activity in the M. zapota leaf extracts[39]. Standard techniques for evaluating the antioxidant potential of plant extracts, such as DPPH (2, 2-diphenyl1picrylhydrazyl), superoxide, and hydroxyl radical scavenging activity[40], revealed that acetone extracts outperform standard ascorbic acid and gallic acid in terms of DPPH radical and superoxide anion scavenging activity[41]. The significant level of antioxidants found in sapodilla acetone extracts suggests that this plant can be added to diet as a supplement to provide protection from oxidative damage[42]].

4.2 ANTIDIEBETIC ACTIVITY

Extracts from M. zapota's seeds, leaves, and roots have been shown to have hypoglycemic action because they contain a variety of phytochemicals[43]. Saradha et al. used ethanol and aqueous extracts of sapodilla seeds to investigate the hypoglycemic activity[44]; however, they discovered that the ethanolic extract had a greater hypoglycemic effect than the aqueous extract[45]. Saponins, one of the several phytochemicals made by sapodilla plants, have been shown in streptozotocin-induced diabetic rats to exhibit anti-diabetic action and to have significant hypoglycemic effects[46].

4.3 ANTIMICROBIAL ACTIVITY

The antimicrobial activities of M. zapota were tested by Osman et al. using ethyl acetate extracts of both stem bark and leaves against a variety of pathogenic bacteria and fungi[47]. The results showed that the extract of stem bark had antimicrobial activity against all of the pathogenic bacteria tested, including Salmonella typhi[48], Escherichia coli, Bacillus subtilis, and Bacillus megaterium, with inhibition zones ranging from 08 to 16 mm, while the extracts of leaves had only mildly active against these bacterial strains[49].

4.4 ANTITUMORACTIVITY

Many natural compounds that have been extracted from herbs have been tested for their ability to prevent cancer in animal models and cancer cell lines during the last few decades[50]. These days, research is being done on the cytotoxic properties of sapodilla fruit for potential anti-cancer effects[51]. In their description of the anticancer potential of sapodilla fruits, Ma et al. looked at the cytotoxic effects of methyl 4-O-galloylchlorogenic acid and 4-Ogalloylchlorogenic acid on colon cancer cell lines[52].

4.5 ANTI-ARTHRITIC ACTIVITY

Using an in-vitro model of protein denaturation inhibition, Singh et al. investigated the anti-arthritic properties of an ethanolic extract of Manilkara zapota[53]. They discovered a considerable protective effect against protein denaturation, indicating the potential application of Manilkara as an anti-arthritic agent[54].

4.6 ANTI-INFLAMATORY AND ANTIPYRETIC ACTIVITY

Histamine or serotonin release in the first phase and prostaglandin production and release in the second phase are linked to inflammation[55]. The cyclooxygenase pathway's inhibition of prostaglandin formation may also have anti-inflammatory and antipyretic effects[56]. The active constituents found in Manilkara zapota leaves, such as lupeol acetate, oleanolic acid, apigenin-7-O-α-Lrhamnoside[57], and myricetin-3-O-α-Lrhamnoside, may be responsible for the plant's anti-inflammatory and antipyretic properties[58].

4.7 ANTIBACTERIAL ACTIVITY

According to research by Vijay Kothari and colleagues, Manilkara zapota acetone extract had high antibacterial activity when compared to common medications like ofloxacin and streptomycin[59].

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4.8 ANTIFUNGAL ACTIVITY

According to Osman et al. (2011), antifungal activity was tested using five fungus strains: Aspergillus flavus, Aspergillus fumigatus, Candida albicans, Vietnamese factum, and Fusarium[60]. The stem bark extract exhibited antifungal properties against Vasian factum, Fusarium[61], and Aspergillus flavus. Terpenoids, flavonoids, and glycosides are likely responsible for the antifungal action[62].

4.9 ANALGESIC ACTIVITY

The sapota plant's chemical contents, which include flavonoids, polyphenols, and alkaloids, are responsible for its strong analgesic effects[63]. The way that analgesics work. Seems to be connected to non-selective inhibition of the cyclooxygenase pathway and desensitization of nociceptors[64]. Both cerebral and peripheral analgesic effects are possible with it[65].

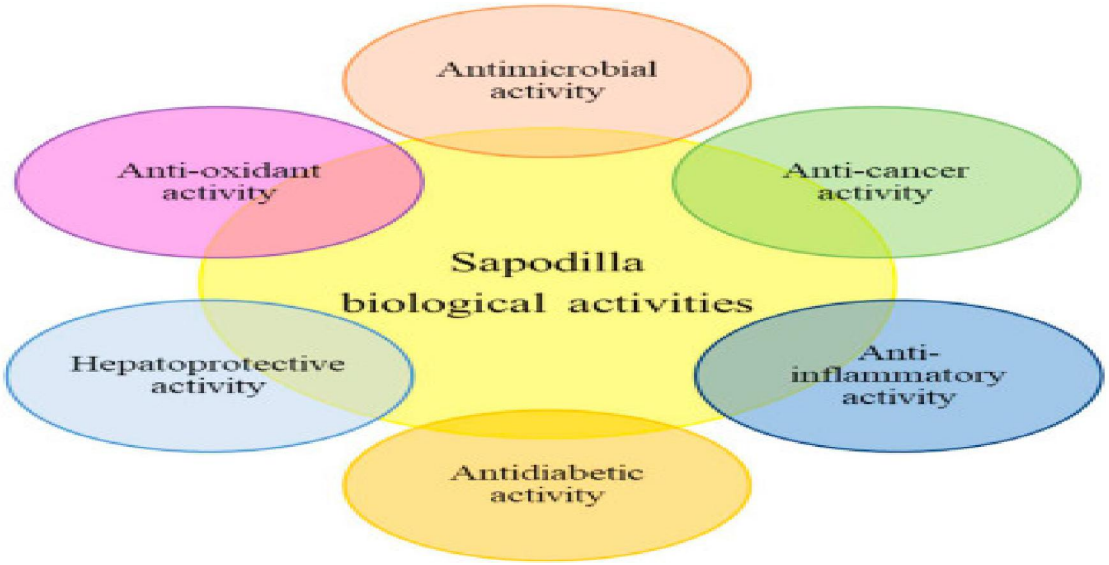

Fig2. Pharmacological activities of Manilkara Zapota Linn

V. CLINICAL STUDIES

Clinical research on Manilkara zapota's antibacterial properties has produced encouraging findings [66]. The ethanolic fruit extract of Manilkara zapota was shown to have strong antibacterial action against a number of harmful bacteria, such as Escherichia coli, Staphylococcus aureus, and Bacillus subtilis [67]. Additionally, the study found that the extract exhibited antifungal efficacy against Aspergillus flavus, Aspergillus niger, and Candida albicans [68].

Antimicrobial Activity of Manilkara Zapota Extracts:

Ethanolic Extract: Demonstrated strong antibacterial activity against Escherichia coli, Staphylococcus aureus, and Bacillus subtilis, with an inhibitory zone of 17–30 mm [69].

Ethyl Acetate Extract: Exhibited a zone of inhibition of 11–15 mm and moderate antibacterial activity against Escherichia coli, Staphylococcus aureus, and Bacillus subtilis [70].

Petroleum Ether Extract: Showed modest antibacterial activity with inhibition zones between 11 and 16 mm against Staphylococcus aureus, Proteus vulgaris, and Klebsiella pneumoniae [71, 72].

Chloroform Extract: Showed modest antifungal activity toward Candida albicans and Aspergillus flavus, with inhibition zones between 10 and 13 mm [73].

According to these results, extracts from Manilkara zapota may possess antibacterial qualities that could aid in the creation of natural antimicrobial agents [74]. However, additional research is required to validate these findings and investigate the therapeutic uses of extracts from Manilkara zapota [75].

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VI. TOXICOLOGICAL STUDIES

Toxicological studies for Manilkara zapota plant:

Acute Toxicity Studies:

1. LD50 (Lethal Dose 50): 2000-5000 mg/kg (oral) in rats and mice.
2. Single-dose oral toxicity: No mortality or toxicity observed up to 5g/kg[76].

Sub-Chronic Toxicity Studies:

1. 28-day repeated-dose oral toxicity: No significant changes in hematological, biochemical, or histopathological parameters.
2. 90-day sub-chronic toxicity: No adverse effects on liver, kidney, or hematological parameters[77].

Chronic Toxicity Studies:

1. 6-month chronic toxicity: No carcinogenic effects or significant changes in hematological, biochemical, or histopathological parameters.
2. 12-month chronic toxicity: No adverse effects on reproductive or developmental parameters[78].

Genotoxicity Studies:

1. Ames test: Negative for mutagenicity.
2. Micronucleus test: No clastogenic effects.
3. Comet assay: No DNA damage observed[79].

Reproductive Toxicity Studies:

1. Teratogenicity study: No fetal abnormalities or developmental toxicity.
2. Reproductive toxicity study: No adverse effects on fertility or reproductive parameters[80].

Safety Pharmacology Studies:

1. Cardiovascular system: No significant changes in blood pressure, heart rate, or ECG.
2. Central nervous system: No sedative or stimulant effects.
3. Respiratory system: No adverse effects on respiratory rate or function[81].

Clinical Toxicology:

1. Human studies: No reported adverse effects or toxicity.
2. Case reports: No documented cases of toxicity or poisoning[82].

Toxic Compounds:

1. Saponins: Potential gastrointestinal irritants.
2. Tannins: May cause liver or kidney damage at high doses.
3. Flavonoids: Generally considered safe[83].

Safe Dosage:

1. Recommended daily dose: 500-2000 mg.
2. Maximum tolerated dose: 5000 mg[84].

VII. CONCLUSION

Manilkara zapota revealed the presence of some bioactive components like tannins, glycosides, alkaloids, saponins, carboxylic acids[85]. These compounds have potentially significant application against human pathogens[86], including those that cause enteric infections[87]. The presence of alkaloids is interesting[88], as significant quantities are used as antimalarials, analgesics and stimulants[89]. The presence of glycosides moieties like saponins, are known to inhibit tumor growth[90] and serve also to protect against gastrointestinal infections[91]. Herbs that have tannins as their components are astringent in nature and are used for treating intestinal disorders[92] such as diarrhea and dysentery thus exhibiting antibacterial activity[93]. Tannins are widely used in traditional medicine in treating wounds and to arrest bleeding[94].

Indeed, many of these compounds have been used in the form of whole plants or plant extracts for food or medical applications in human[95] because plants are the natural reservoir of many antimicrobial, antifungal, insecticidal, anticancer, analgesics, anti-diarrheal agents[96], as well as various therapeutic activities[97]. Acceptance of medicines from such plant origin as an alternative form of healthcare is increasing because they are serving as promising sources

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of novel antibiotic prototypes[[98]. Some of the phytochemical compounds e.g. alkaloids, saponins, tannins, flavonoids, terpenoids[99] and glycosides have variously been reported to have antimicrobial activity[100].

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