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"Ethnomedicinal Applications, Phytochemistry, and Pharmacological Properties of *Ficus Benghalensis L.* (Moraceae): A Comprehensive Review"

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Abstract: ***There are diverse varieties of plants and trees with humongous medicinal properties. Indian and other ancient civilizations were leveraging these plants for curing and treating various diseases and ailments. One such tree with remarkable medicinal properties is the Ficus benghalensis, also known as the Indian Banyan Tree. Ficus benghalensis L. (Moraceae) is used as traditional medicine in South Asian countries for the treatment of various ailments. The main aim of this review was to collect and analyze the traditional uses and scientific information on the phytochemistry and pharmacological activities of different plant parts of F. benghalensis. Information on its ethnomedicinal uses was collected from published books, book chapters, and research papers on ethnobotanical surveys. Scientific information about phytochemistry and pharmacology was retrieved from online bibliographic databases such as PubMed, Sci Finder, Web of Science, and Google Scholar. Regarding traditional uses, various plant parts of F. benghalensis were found to be used in Ayurveda, Siddha and other traditional medicine systems in South Asia. Ficus benghalensis is an important medicinal plant that has several bioactive compounds. The stem bark was used mostly for the treatment of diabetes, diarrhoea, and dysentery. The latex is used for the treatment of wounds, burns, and rheumatism. Fruits are edible and are used as a tonic. Regarding phytochemistry, leucoanthocyanidin derivatives, and triterpenes were reported from the stem bark, and triterpene derivatives and phenolic compounds including flavonoids were reported from the leaves. The present review is, therefore, an initiative to give a broad survey of the literature on its phytochemistry, pharmacognosy, traditional and pharmacological uses.***

Keywords: ***ficus benghalensis, Moraceae, tree, phytochemistry, antidiabetic, anti- microbial anti- tumor, pharmacological properties, medicinal plants etc.***

I. INTRODUCTION

Since the beginning of human history, people have used a variety of plants for a variety of purposes, including food, medicine, and other sources of income. Worldwide, plants have played a major role in the evolution of human societies. Numerous plant and tree species possess immense therapeutic benefits.[1] These herbs were used by the Indians and other ancient civilizations to treat and cure a wide range of illnesses. Because they are abundant sources of therapeutic value that can be utilized in drug development, medicinal plants form the foundation of traditional medicine. [2] India is referred to as the world's medical garden. Its diverse range of environments supports a large diversity of plant species. Both tribal populations and traditional medical systems in India employ these medicinal plants in their healing rituals. The advancement of knowledge to cure diseases has resulted in the development of novel plant-derived medications. [1,2,3]

India has the greatest traditional and local knowledge base of medicinal plants in the world, and the Himalayas is one of the world's megabiological zones. [4] Since ancient times, plants have been used in phytomedicine due to their robust biochemistry, which allows man to extract an amazing variety of industrial compounds from them. Ancient scholarly works, such as the Atharva-Veda (an Indian religious text), Ayurveda (an Indian traditional medical system), and others, provided a wealth of knowledge on preventive and therapeutic medications. [5] Among the world's 17 largest countries with the highest biodiversity is India. There are 40,000–20,000 plants with therapeutic properties among the 40,000 plant species. [6]

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The majority of poor nations employ traditional medicines and medicinal plants to maintain good health, according to a 1996 report by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO). The traditional medical systems of Ayurveda, Siddha, Unani, homeopathy, yoga, and naturopathy are widely acknowledged in India. [7]

Ficus benghalensis, a huge evergreen tree, is part of the Moraceae family. It's also known as the "Indian Banyan Tree". It is one of four sacred trees known as "Nalpamara" (Ksirivarkas) that are intended to be planted around homes and temples. Their ever-expanding branch represents eternal life; hence it is regarded as sacred. Plants produce the bulk of chemical substances that perform essential biological processes. [8] The banyan tree, one of history's most revered trees, possesses qualities that can cure some of the most terrible diseases [8,9].

Figure 1: Ficus benghalensis tree

II. TAXONOMICAL CLASSIFICATION

Kingdom: Planate –Plants
Subkingdom: Tracheobionta
Superdivision: Spermatophta
Division: Magnolipophyta
Class: Magnoliopsida
Subclass: Hamamelididac
Order: Urticales
Family: Moraceae
Genus*: Ficus*
Species*: bengalensis* (L)

A. Species

1) *Ficus Benghalensis* (Indian banyan or the wish fulfilling tree)
2) *Ficus Religiosa* (Bodhi tree or Sacred tree)
3) *Ficus Racemosa* (Cluster fig or Goolar fig)
4) *Ficus Carica* (Common fig or Fig) [10]

B. Religious Background

The banyan is considered sacred by Hindu deities such as Vishnu, Brahma, Kali, Lakshmi, and Kubera, and it symbolizes Lord Shiva. The Trimurti—Vishnu, Brahma, and Shiva—is represented by the tree. Shiva is thought to be the branches, Brahma the roots, and Vishnu the bark. In many Indian communities, the banyan tree is revered by childless people because it symbolizes life and fertility, and it is never chopped down [11].

C. Distribution

It grows well in rainforests, monsoon areas, tropical and semi-tropical climates, and areas with moderate to abundant rainfall. Its development is ideally suited to humid air, moist soil, hardiness, tolerance to drought, and moderate cold. Native to South Asia, the banyan tree is primarily found in Pakistan, India, and Sri Lanka. It is frequently planted in the vicinity of temples and other sites of religious significance. [10,11] Both Hindus and Buddhists regard it as a sacred tree. The banyan tree is commonly grown across the tropics of both the New and Old Worlds in municipal parks and botanical gardens [11].

Approximately 750 plant species in the genus Ficus can be found in most tropical and subtropical forests worldwide. The wide range of behaviors among the species in this genus is noteworthy [12,13,14].

D. Morphology

The banyan tree is enormous, reaching a height of approximately 100 feet and spreading its branches over several acres as its giant limbs are supported by prop roots. When young, the smooth green bark turns greyish white as it ages, and when it is cut, it turns pink. The wood is porous and soft, and the latex is milky and sticky. [14]

Figure 2. Parts of Ficus benghalensis.

When fully grown, leaves are glossy, leathery, glabrous, oval, largely obtuse, rounded, and heavily coriaceous. The midrib has 4-6 pairs of secondary nerves, the blade is 10–20 cm long, and the petiole is 2–5 cm long. Leaves are beneficial for ulcers. [15]

It features tiny, distinct male and female blooms. Male flowers were clustered close to the receptacle's opening, whereas female flowers had longer styles and shorter perianths. Fruits are globose, sessile in axillary pairs, with a meaty pericarp and a dark red color that ripens to a dark purple hue. The seeds are microscopic. The fruits have a diameter of 1.5 to 2.0 cm. Monkeys and birds consume fruit, but humans cannot eat it. [15,16]

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Figure 3. Photographs of F. *benghalensis*, a: leaves with fruits, b: fruits, c,d: tree with aerial roots both young and mature aerial roots and e: the mature aerial roots

III. TRADITIONAL APPLICATIONS

Different components of the tree have been found to have medicinal effects; the leaves are beneficial for ulcers, the aerial roots are good for gonorrhea, and the seeds and fruits are cooling and nourishing. Ficus bengalensis roots are used to treat intractable vomiting, and an infusion of its bark is considered a tonic and astringent. It is also used to treat diarrhea, dysentery, and diabetes. In India, Ayurvedic practitioners use the milky liquid (latex) of Ficus bengalensis stem bark to cure rheumatism and other inflammatory conditions. The plant's bark is utilized in Ayurvedic medicine to cure Diabetes [17].

IV. BIOACTIVE SUBSTANCES AND PHYTOCHEMISTRY

Plants contain phytochemicals in the form of secondary metabolites, which can be used to treat a variety of human illnesses. Many phytochemical elements responsible for F. benghalensis' different medicinal and pharmacognostic characteristics have been discovered in various areas of the plant during preliminary phytochemical investigations. They are rich in terpenes, flavonols, flavonoids, triterpenoids, methyl esters, sterols, coumarins, carbohydrates, amino acids, saponins, and tannins [18].

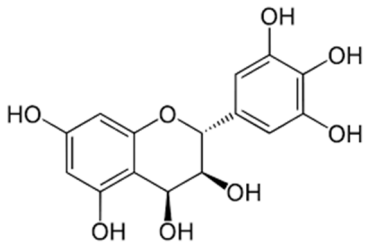
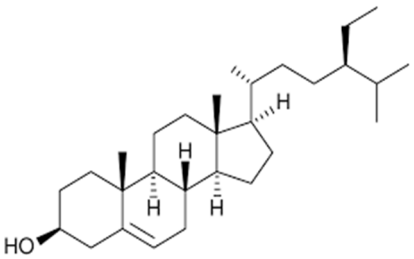
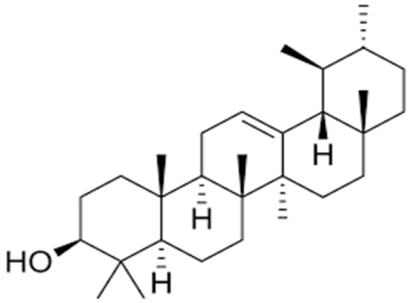
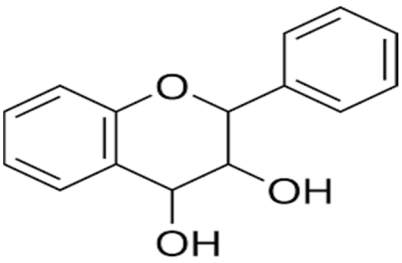
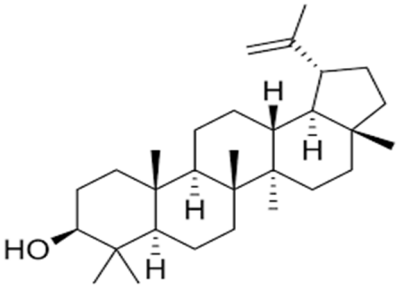
Stem bark contains a number of anthocyanidin derivatives (methyl ethers of leucodelphinidin-3-O-L-rhamnoside, lecocyanidin-3-O-D-galactosylcellobioside) as well as aliphatic long chain ketones (pentatriacontan-5-one). The leaves include 9.63% crude protein, 26.84% crude fibre, 2.53% calcium oxalate, and 0.4% phosphorus. The numerous qualitative chemical tests of ethanol and aqueous leaf extracts reveal a high concentration of sterols, flavanoids, phenol, tannins, and saponins [18,19].

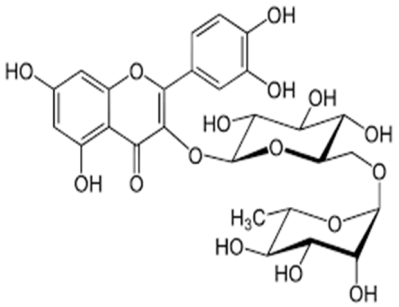
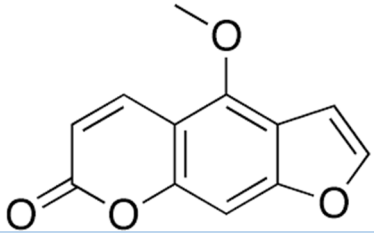
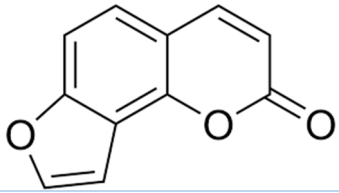
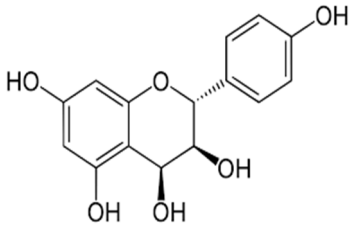
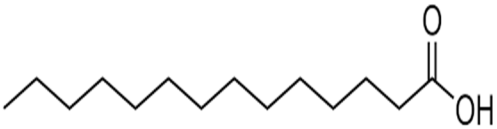
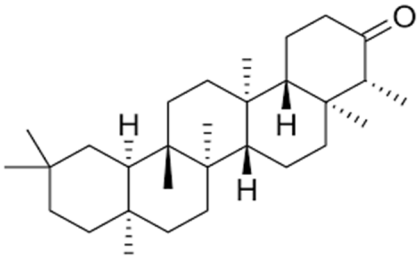
Table 1 covers F. benghalensis' phytoconstituents and ethanomedical uses.

Plant part used	Phytochemical class	Phytochemical constituents	Ethnomedicinal application
Leaf	phenols, flavonols & flavonoids, Leucoanthocyanidin Terpenoids	Gallic acid, theaflavins, catechin, bergapten, rutin, leucodelphinidin, Beta-sitosterol, lupeol, beta-amyrin,2 traxasten-3-ol, Friedelin	Treats chronic diarrhea, vomiting, nausea, vaginal infections dysentery, wounds, abscesses, pimples, and other skin disorders
Stem bark	Anthocyanin derivatives, Phenolics,Terpenes/terpenoids Esters	Tannin, Lupeol, beta-sitosterol and saponin, leucoanthocyanin, leucoanthocyanidin.	Infusion of stem used in treating nervous disorders, diarrhea, asthma, nervous disorders, urinary problems, The milky sap is used to treat snake bites, gonorrhea, diarrhea, joint pain, dermatitis diabetes. Als it increases memory power and acts as a natural immunity booster.
Aerial roots	Terpenes/terpenoids	Amyrin acetate, lupeol, lanosterol, azelaic acid cyanuric acid, synephrin Myristic acid, palmitic acid,sitosterol,ergosterol acetate.	Treat jaundice, body and joint pain, leucorrhoea, diarrhea, vomiting, and excessive hair fall. Reduce excessive blood flow during mensturation.
Buds, seeds and fruits	Proteins, Amino acids	Methionine, arginine, cysteine, glutathione, glutamine, tryptophan, hydroxyproline Hexadecanoic acid, D-glucose, D-fructose, D-arabinose.	Diarrhoea, dysentery, biliary complications.

Table 1 lists of phytoconstituents of *F. benghalensis* with its ethanomedical applications. [18]

Structure of a Few *ficus benghalensis* phytochemical constituents

Sr. no	Compound Name	Structure
1.	leucodelphinidin	
2.	Beta-sitosterol	
3.	beta-amyrin	
4.	Leucoanthocyanin	
5.	Lupeol	

6.	Rutin	
7.	Bergapten	
8.	Furanocoumarin	
9.	Leucopelargonidin	
10.	Azelaic acid	
11.	Myristic acid	
12.	freidelin	

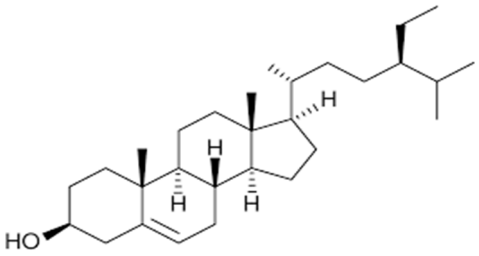
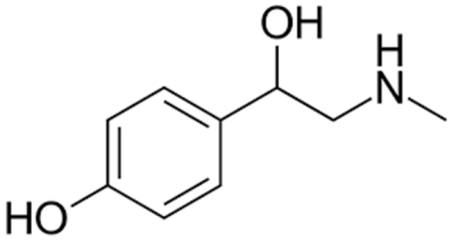
13.	Sitosterol	
14.	Synephrin	

Table 2 :- Chemical constituent of *ficus benghalensis* [18,19]

V. PHARMACOLOGICAL ACTIVITY

A. Anti-inflammatory Activity

In experimental animals, the anti-inflammatory properties of ethanolic and petroleum ether bark extracts were assessed through oral administration of dosages of 300 and 600 mg/kg/day of body weight. Rats with hind paw edoema caused by carrageenan were given extracts to study for their anti-inflammatory properties, and three hours after injection, the volume of the paw was measured plethysmometrically. The carrageenan-induced paw edoema in rats was considerably decreased by the ethanolic and petroleum ether extracts of FB. Animal models were used to assess the analgesic and anti-inflammatory properties of FB's methanolic extract (MEFB) and aqueous extract (AEFB). According to preliminary findings, MEFB therapy has a significantly higher potential for reducing inflammation than AEFB.It was discovered that MEFB's anti-inflammatory effectiveness in both acute and sub-chronic models of inflammation was significant. [20,21]

B. Anthelmintic Activity

The methanolic, aqueous, chloroform, and petroleum ether extracts of FB were investigated for their ability to cause earthworm paralysis and death. It was discovered that every extract killed the earthworms (Vermicidal) in addition to paralysing them (Vermifuge). It was discovered that the earthworm could be executed more successfully with the aqueous and methnolic extract. [22,23]

C. Anti-diarrhoeal Activity

Ficus bengalensis (bark) ethanol extract was tested for antidiarrheal properties against many rat experimental types of diarrhoea. Plant extract significantly inhibited the castor oil-induced diarrhoea that rats developed. In rat testing using charcoal meals, these extracts also significantly decreased the motility of the gastrointestinal system. [23,24]

D. Anti-stress & Anti- Allergic

Various preparations of Ficus bengalensis bark were tested for their anti-allergic and anti-stress properties in asthma using milk-induced leucocytosis and eosinophilia. In the order listed, aqueous, ethanol, and ethyl acetate extracts significantly reduced leucocytes and eosinophils, although petroleum ether and chloroform extracts did not. This demonstrates the use of polar components from F. bengalensis bark as anti-stress and antiallergic agents in asthma. [25,26]

E. Anti- oxidant Activity

The extract's antioxidant activity was assessed using DPPH radical scavenging activity, hydroxyl radical scavenging activity, reducing capacity, hydrogen peroxide activity, and total phenolic content using Folin-Ciocalteu's phenolic reagent. The extract significantly reduced DPPH radical (96.07%) at 250 µg mL-1 concentration and hydrogen peroxide (69.23%) at 1000 µg mL-1 concentration. When compared to other chemicals, the extract outperforms them. This demonstrates the extract's scavenging action. [27,28]

F. Anti-tumor Activity

The chloroform extract of the fruit of Ficus benghalensis showed toxicity in the brine shrimp (Artemiasalina) bioassay (LC50 < 1000µg/ml). It also demonstrated anti-tumor efficacy in the potato disc bioassay (% tumour inhibition > 20%). The other examined extracts revealed no significant suppression of calcium absorption in rat pituitary cells GH4C1. The findings corroborate the traditional use of these plants in folk medicine to treat respiratory ailments and certain skin diseases. [29,30]

G. Anti- diabetic Activity

The aqueous extract of FB bark was shown in this study to have significant hypoglycemia and hypocholesterolemic effects on alloxan-induced, mild, and acute diabetes in rabbits. The dose of 300mg kg−1 resulted in a maximum decrease of 43.8 and 40.7% in BGL during FBG and glucose tolerance test (GTT) tests of normal rats, respectively.

The hypoglycemic impact in normoglycemic and antidiabetic effects in sub- and mild-diabetic animals of aqueous extract of aerial roots of Ficus bengalensis are attributed to the presence of these glycemic ingredients in high concentrations relative to other elements. [31,32,33]

H. Analgesic and anti-pyretic Activity

Ficus benghalensis bark was found to have antipyretic action against Brewer's yeast-induced pyrexia in rats. The extract and Aspirin significantly reduced analgesic efficacy for hot plate and tail immersion methods, as well as antipyretic activity for Brewer's yeast-induced pyrexia in rats. The presence of flavonoids and phenolic chemicals may explain the increased analgesic effects of the studied extracts. The bark extracts of Ficus benghalensis have analgesic and antipyretic properties, possibly due to bioactive components. [34]

I. Wound Healing Property

Although several plants have been experimentally evaluated for wound healing activities in various pharmacological models and patients, their full potential remains unknown. Occasionally, active chemical components were found. Ficus bengalensis has been used in Ayurvedic medicine for wound healing and has been evaluated in several models. [35]

J. Immunomodulatory Activity

The aerial roots of Ficus benghalensis were tested for immunodulatory activity utilising an in vitro polymorpho nuclear leukocyte (human neutrophile) function test. In vivo tests with rats were conducted to assess the immunological modulatory activities of the methanol extract. The extracts were examined for hypersensitivity and hem agglutination reactions with sheep red blood cells (SRBC) as an antigen. In vivo investigations showed that methanol extracts at doses of 100 and 200 mg/kg increased hypersensitivity to the SRBC antigen. In animal tests, dosages of 100 and 200 mg/kg resulted in significantly higher antibody titers to SRBC. [36]

K. Hypolipidemic Activity

Three groups of rabbits were provided cholesterol suspension in ground nut oil (100mg/kg/day), while another group was fed Ficus benghalensis bark extract (50mg/kg/day).

Bark extract treatment significantly lowered serum cholesterol (59%), triacylglycerol (54%), and lipid peroxidation. After cholesterol feeding, antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase showed significant increases, which were previously suppressed in other groups. This study found that a water extract of Ficus benghalensis bark has significant hypolipidemic properties. [37]

L. Anti-microbial Activity

Ficus benghalensis fruit extract (0.5 mg/disc) inhibited the bacterium Micrococcus luleus (18-26 mm inhibition zone), while kanamycin (100 µ.g/disc), streptomycin (100 µg/disc), and penicillin (5 µg/disc) did not. The fruit extract inhibited Streptococcus faecalis and Streptococcus faecium with an inhibition zone of 17-20 mm. Bacillus cereus, B. megaterium, Staphylococcus aureus, Streptococcus epidermis, Streptococcus lactis, Escherichia coli, Klebsiella pneumonia, Proteus vulgaris, and Pseudomonas aeruginosa were all inhibited to varying degrees (16-19 mm inhibition zone). [38]

VI. CONCLUSION

This review contains useful information regarding the morphology, phytochemistry, phytochemical analysis, and pharmacological properties of Ficus benghalensis. The review identifies 5,7-Dimethyl ether of leucocyanidin 3-O-α -D-galactosylcellobioside, Quercetin 3-O-galactoside, α-Amyrin acetate, Lupeol, β -Sitosterol-β-D-glucoside, and Myristic acid as the primary constituents of these species, which were analysed using different methodologies. These are commonly employed as antioxidants, antitumors, analgesics and antipyretics, anthelmintics, immunomodulators, antimicrobials, anti-inflammatory agents, and anti-diabetics. However, a methodical and scientific approach is required to fully realise the potential of these species. Only a few pharmacological investigations on animals have demonstrated that extracts and isolated substances have promising antidiabetic properties, but the underlying processes have not been thoroughly investigated. Future studies should also focus on the study of potential toxicity and pharmacokinetic parameters, and clinical studies.

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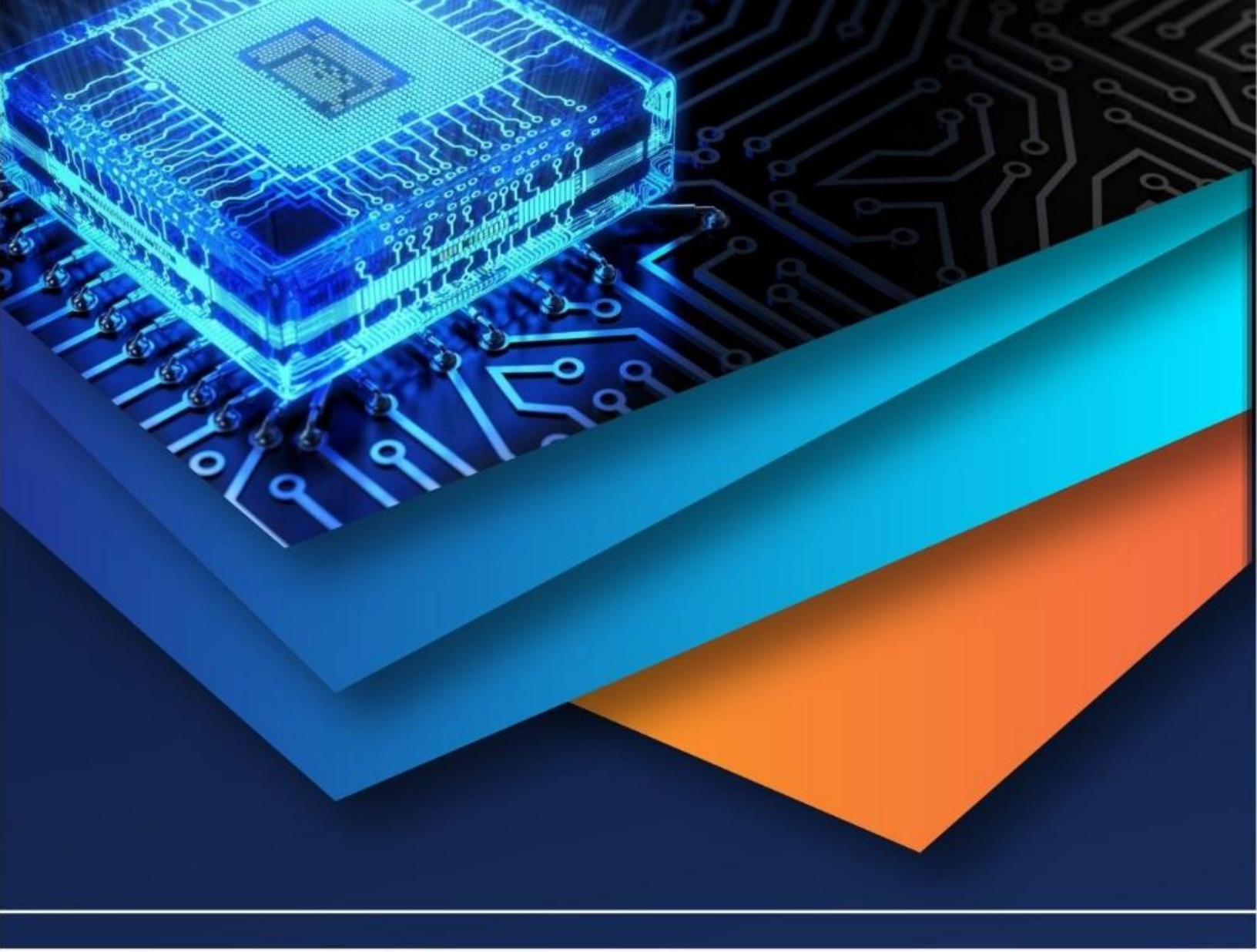

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