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Bhuineem (Andrographispaniculata): A Review on its Pharmacological and Botanical Aspects

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Abstract: ***A common native medicinal herb grown across Malaysia is Andrographis paniculata. Water, ethanol, or methanol can be used to separate its many bioactive components. Andrographolide has been identified as the main component of these molecules, and it demonstrates a range of pharmacological activity, including anti-cancer capabilities, especially in the lipid-dependent cancer pathway.***

The adaptable tropical plant Andrographis paniculata is thought to possess numerous vital therapeutic qualities. The intended advantages of A. paniculata must be assessed, as it is used in traditional medical systems to treat a variety of ailments. As a herbal treatment, A. paniculata has been used to treat fever, herpes, diabetes, upper respiratory and gastrointestinal tract disorders, and other chronic illnesses.

Andrographis paniculata, also known as A. paniculata, is a herb that has long been used as a remedy for inflammation and bacteria. The primary active ingredient in A. paniculata, andrographolide, has a variety of pharmacological properties, such as anti-inflammatory, anti-cancer, anti-obesity, and anti-diabetic effects. The main source of therapeutic solutions for a variety of illnesses is medicinal plants.

Their active phytoconstituents are principally responsible for these possible therapeutic effects. The active phytochemicals in this plant are extracted from all parts, although the phytoconstituent compositions vary greatly according on the location, time of year, and harvest. Over 55 ent-labdane diterpenoids, 30 flavonoids, 8 quinic acids, 4 xanthones, and 5 uncommon noriridoids were found by our thorough data mining of the phytoconstituents. Extracts from A. paniculata and its main diterpene lactones have demonstrated remarkable anti-inflammatory, antidiabetic, antimalarial, anticancer, antifungal, antibacterial, antioxidant, and hypoglycemic properties, according to a World Health Organization (WHO) monograph on a few medicinal plants. The primary bioactive ingredient in A. paniculata is andrographolide, which is also the species' principal diterpene. Certain characteristics of diterpenes, such as their poor water solubility, slow dissolving rates, limited gastrointestinal absorption, high chemical and metabolic instability, and quick excretion, can restrict their oral bioavailability and impact their effectiveness.

Keywords: Andrographolide, Andrographis paniculata, noriridoids, diterpene lactones.

I. INTRODUCTION

Bhuineem, also known as Kalmegh, is a medicinal herb scientifically named Andrographis paniculata. Belonging to the Acanthaceae family, it is native to India and Sri Lanka and is widely recognized in traditional medicine systems like Ayurveda, Siddha, and tribal medicine. The name "Bhuineem" translates to "ground neem," reflecting its resemblance to the neem tree (Azadirachta indica) in appearance and bitter taste, though it is smaller in size.

In Ayurveda, in particular, the term "bhuineem" is frequently used in India to refer to the plant Andrographis paniculata, commonly called "Kalmegh" or "King of Bitters."

A. Taxonomical Classification

Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Eudicots
Order: Lamiales
Family: Acanthaceae
Genus: Andrographis
Species: Andrographis paniculata

B. Botanical Description

Plant Profile: Bhuineem (Andrographis paniculata

1. Botanical Name: Andrographis paniculata (Burm.f.) Wall. ex Nees
2. Family: Acanthaceae
3. Habitat and Distribution:
   a. Native Region: India and Sri Lanka
   b. Distribution: Widely distributed across Southeast Asia, China, and tropical parts of Africa. Now cultivated in various regions for medicinal purposes.
   c. Habitat: Grows in open spaces, along roadsides, fallow lands, and also cultivated in herbal gardens. Prefers tropical to subtropical climates with moderate rainfall and well-drained soil.

4. Morphological Description

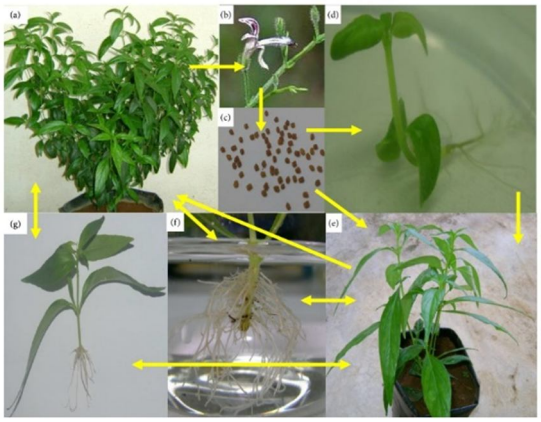

Figure 1 Images of Andrographis paniculata: (a) whole plants, (b) flowers, (c) leaves, and (d) seed. Bar = 1 cm.

Figure 2 Morphology of Andrographis paniculata. (a) Mature A. paniculata in polybag stage, (b) flowering stage, (c) harvested seeds, (d) in vitro seedling, (e) young A. paniculata in polybag, (f) adventitious roots of A. paniculata, and (g) vegetative seedlings. Single direction of arrow indicates the developmental stages and both directions of arrow denote vegetative propagation of plant (Photographs are taken from M.S. Hossain's research work, except (b)).

1) Growth Habit: An erect, branched annual herb that typically grows up to 30–110 cm in height.

2) Stem: Slender, dark green to purplish, quadrangular (four-sided), and hairless.

3) Leaves:
   a. Arrangement: Opposite
   b. Shape: Lanceolate (lance-shaped)
   c. Size: 2–12 cm long and 1–3 cm wide
   d. Surface: Smooth with entire margins
   e. Color: Bright green

4) Flowers:

a. Inflorescence: Terminal panicles
b. Color: Pale violet to bluish-purple with dark markings
c. Size: Small, tubular, about 1 cm long
d. Calyx: 5-lobed, green
e. Corolla: Bilabiate (2-lipped), with the lower lip longer and marked with purple streaks
f. Blooming season: Rainy and post-rainy season

5) Fruits and Seeds:

a. Fruit: Linear-oblong capsule, about 1.5–2.5 cm long
b. Seeds: Numerous, small, yellowish-brown, winged for wind dispersal

Andrographis paniculata has several synonyms in various traditional and botanical contexts. Here are some of them:

Botanical Synonyms:

1. Justicia paniculata Burm.f. – An older classification
2. Andrographis subspathulata C.B.Clarke – considered a synonym by some taxonomists

Ayurvedic/Traditional Synonyms (Sanskrit & regional names):

1. Kalmegh – widely used in Hindi and Ayurveda
2. Bhunimba – Sanskrit name; literally means "Neem of the earth
3. Yavatikta – Sanskrit, meaning "entirely bitter"
4. Mahatita – Sanskrit, meaning "great remedy"
5. Kirata-tikta – sometimes used interchangeably, though it may also refer to Swertia chirata
6. Green chiretta – English common name
7. Nilavembu – Tamil
8. Nelabevu – Kannada

II. PHYTOCONSTITUENTS

Sr.no.	Category	Phytoconstituents	Activity
1	Diterpenoids	Andrographolide, Neoandrographolide, Deoxyandrographolide	Main bioactive compounds; responsible for bitter taste
2	Flavonoids	Apigenin, Luteolin, Quercetin	Antioxidant and anti-inflammatory properties
3	Xanthones	Norwogonin, 7-O-methylwogonin	Contribute to antimicrobial activity
4	Polyphenols	Caffeic acid, Chlorogenic acid	Antioxidant and hepatoprotective effects
5	Alkaloids	Trace amounts (not predominant)	Minor contribution to pharmacological activity
6	Sterols	Stigmasterol, β-sitosterol	Anti-inflammatory and cholesterol-lowering potential
7	Other constituents	Volatile oils, Resins, Glycosides	Supportive in overall pharmacological effects

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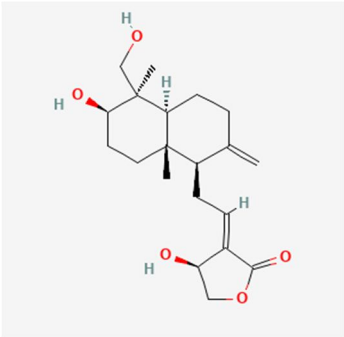
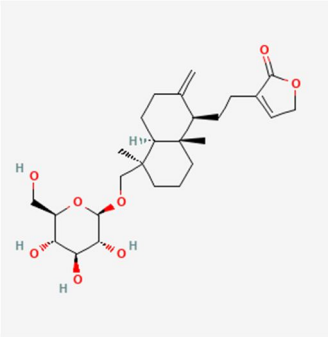
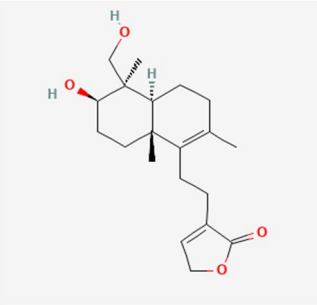
A. Diterpinoids Structure



a) Andrographolide

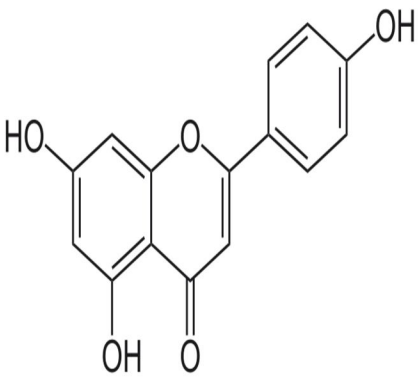


b) Neoandrographolide

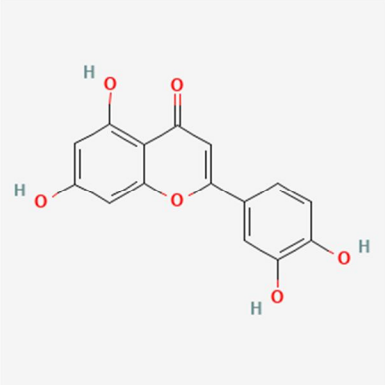


c) Deoxyandrographolide

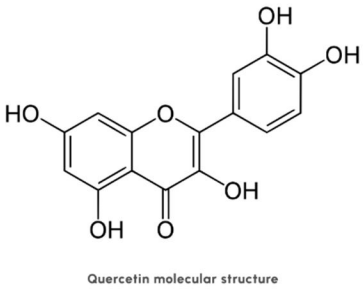
B. Flavonoids Structure



a) Apigenin

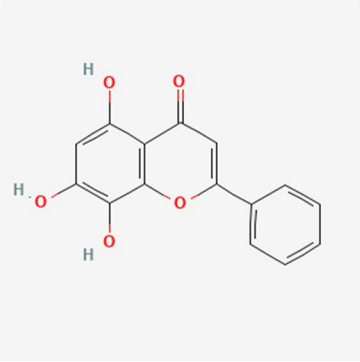


b) Luteolin

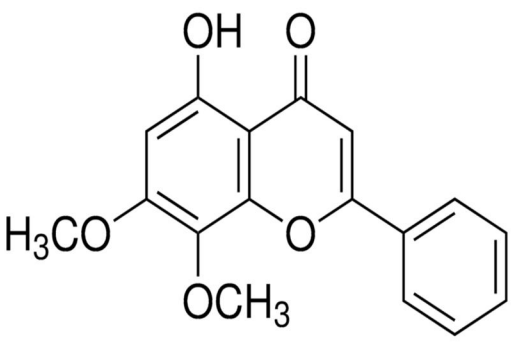


c)Quercetin

C. Xanthones Structure

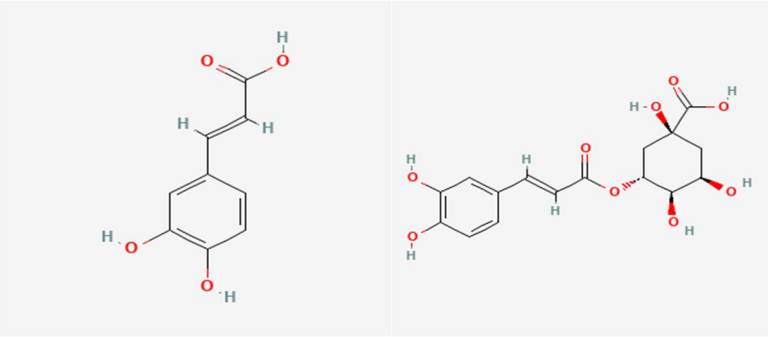


a) Norwogonin



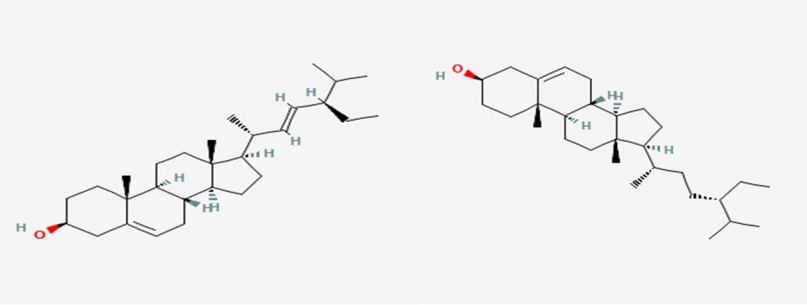
b) 7-O-methylwogonin

D. Polyphenols Structure



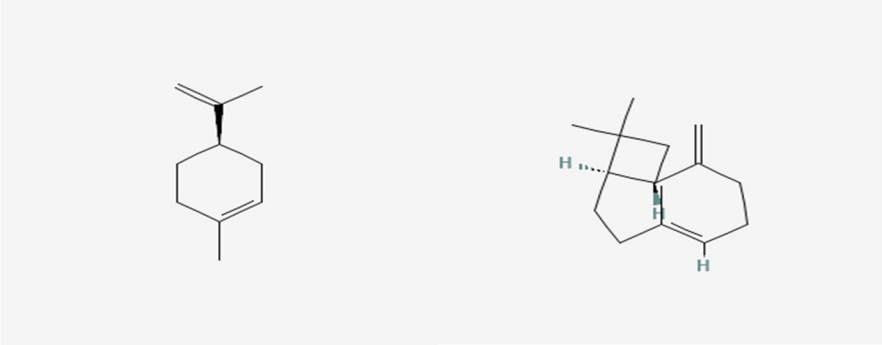
a) Caffeic acid b) Chlorogenic acid

E. Sterols Structure

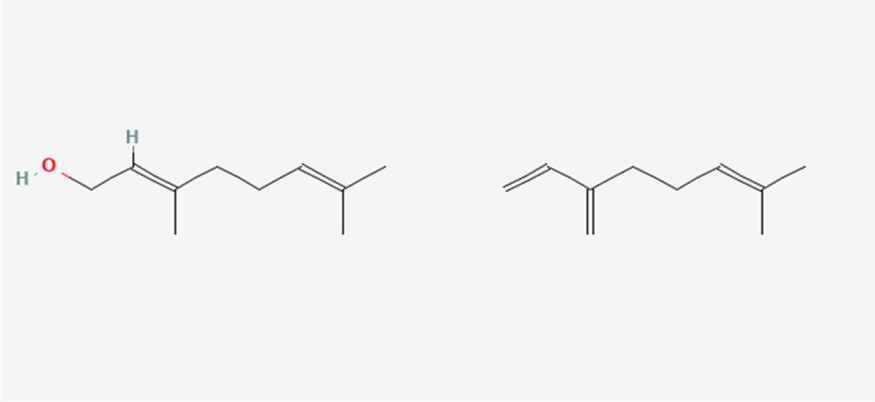


a) Stigmasterol b) β-sitosterol

F. Other Constituents



a) Limonene b) Caryophyllene



c) Geraniol d) Myrcene

III. THERAPEUTIC USES

Sr.no.	Therapeutic Activity	Description	Major Active Compounds
1.	Hepatoprotective	Protects liver cells from toxins, improves liver function	Andrographolide, Neoandrographolide
2.	Anti-inflammatory	Reduces inflammation by inhibiting inflammatory mediators like TNF-□, IL-6	Andrographolide, Flavonoids (Apigenin, Luteolin)
3.	Antioxidant	Scavenges free radicals, prevents oxidative stress	Flavonoids, Polyphenols (Caffeic acid, Chlorogenic acid)
4.	Immunomodulatory	Enhances or suppresses immune responses as needed	Andrographolide
5.	Antipyretic	Reduces fever	Andrographolide
6.	Antimicrobial (Bacterial/Fungal/Viral)	Inhibits growth of various pathogens including Staphylococcus, E. coli, and viruses like influenza	Andrographolide, Xanthones (Norwogonin)
7.	Antimalarial	Inhibits growth of Plasmodium falciparum	Andrographolide, Flavonoids
8.	Anticancer/Antitumor	Induces apoptosis in cancer cells, inhibits tumor growth	Andrographolide
9.	Antidiabetic	Lowers blood glucose by enhancing insulin secretion and glucose uptake	Andrographolide, Flavonoids
10.	Cardioprotective	Improves heart function, reduces blood pressure and cholesterol	Andrographolide, □-sitosterol
11.	Gastroprotective	Reduces gastric ulcers, protects gastrointestinal lining	Andrographolide, Flavonoids
12.	Anti-HIV	Shows inhibitory activity against HIV replication (experimental)	Andrographolide (in vitro evidence)
13.	Anti-allergic	Inhibits histamine release, helpful in asthma and allergic rhinitis	Andrographolide, Flavonoids
14.	Anti-viral	Inhibits replication of viruses including hepatitis and herpes viruses	Andrographolide, Xanthones
15.	Analgesic (Pain reliever)	Reduces pain by modulating pain receptors	Andrographolide

IV. PROPERTIES OF PLANT

Ras	Guna	Virya	Vipak	Dosh karma	Mukhya karma
Tikta	Laghu Ruksa	Sita	Katu	Kapha pitta hara	Dipana

Part	Medicinal Use
Leaf	Fever, colic pain, loss of appetite, irregular stool and diarrhoea, common cold, common fever hepatitis tuberculosis, mouth ulcer, bronchitis, gastrointestinal disorder and sores.
Whole plant	Snakebite and insect sting treatment, dyspepsia influenza, dysentery, malaria, and respiratory infections.
Root	Febrifuge, tonic, stomach ache.

A. Pharmacology

Scientists researched the pharmacological qualities of the A. paniculata plant to validate its use as a medicinal agent in the treatment of various disorders as a result of the popular usage of its numerous sections in traditional healthcare, notably in Asia. Multiple investigations indicated this plant was a range of biological qualities, including anti-microbial, cytotoxic, anti-protozoan, anti-inflammatory, anti-oxidant, immunostimulant, hepato-renal protective, sex hormone modulatory, anti-infective, anti-angiogenic, insecticidal, and toxicological actions.

B. Hepatoprotective Activity

Liver disorders of various types continue to pose significant health challenges and are a leading cause of death worldwide. Due to the lack of effective hepatoprotective drugs in conventional medicine, medicinal plants and herbs have become essential in the treatment and management of liver conditions. Extensive research on plant-derived compounds has revealed a wide range of molecules with strong liver-protective properties. In traditional Indian medicine, Andrographis paniculata has been widely used as both a liver stimulant and a protective agent against liver damage.

C. Antimicrobial Activity

To assess antimicrobial properties, researchers tested the aqueous extract, andrographolides, and arabinogalactan proteins derived from the dried herb of Andrographis paniculata. Results showed that while andrographolide exhibited antibacterial effects only against Bacillus subtilis, Escherichia coli, and Pseudomonas aeruginosa, both the aqueous extract and arabinogalactan proteins demonstrated broader antibacterial activity. Moreover, all three substances showed antifungal activity against Candida albicans.

In a separate study, five rare noriridoids andrographidoides A to E were evaluated for antibacterial effects against E. coli, Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, and B. subtilis. None of these compounds exhibited inhibitory activity at concentrations up to 100 µg/mL. Gentamycin, was used as a positive control in this assay.

D. Antioxidant Function

Male Wistar rats' liver, kidney, heart, lungs, and spleen were examined for anti-oxidant activity on nicotine-induced oxidative stress using andrographolide and an aqueous extract of A. paniculata herbs. The results indicated that intraperitoneal administration of andro (25 mg/kg) and Aphanamixis polystachya (25 mg/kg) for a period of 7 days significantly (P0.05) decreased levels of lipid peroxidation.viii Catalase and superoxide dismutase activities in erythrocytes were preserved after the rats were given an oral methanol extract of the dried leaves for 14 days, followed by a carbon tetrachloride (CCl4) challenge.

However, lipid peroxidation, alanine transaminase, aspartate transaminase, and plasma thiobarbituricix acid reactive substances were restored to values comparable with those. Following oral administration of a methanol extract (1 g/kg body weight) of the dried leaves, andrographolide, 14-deoxy-11, and 12 didehydroandrographolide were detectable in rat plasma, indicating that these diterpenes may be responsible for the observed anti-oxidant effect.

E. Immunomodulatory Activity

The innate immune response in mice was evaluated using several indicators, including the macrophage migration index, phagocytic activity against leucine-labeled Escherichia coli, and the proliferation of splenic lymphocytes stimulated by Andrographis paniculata extract. Similar immunostimulatory effects were also observed with the isolated compound andrographolide.

F. Antidiarrheal Effects

Traditionally, this compound has been used to support sluggish liver function and as a remedy for colic, dysentery, and indigestion. It has also been effectively employed during recovery from fever, in cases of general weakness, liver conditions, and in the later stages of dysentery. The fresh leaf juice of Andrographis paniculata, which naturally contains andrographolide, is commonly used at home to relieve colic pain, stimulate appetite, and address irregular bowel movements.

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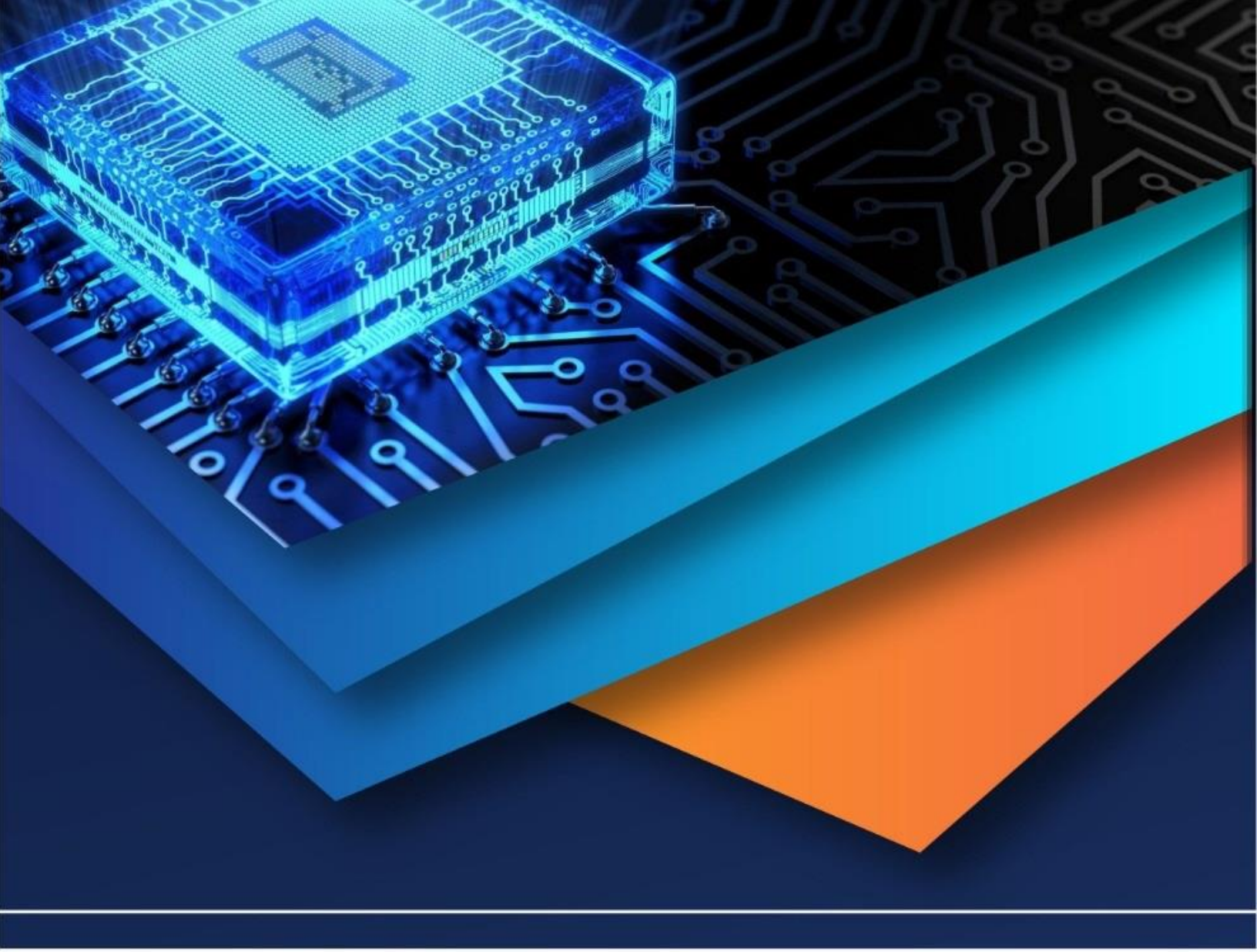

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