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Invitro Study of Anti-inflammatory, Anti-Oxidant & Anti-Microbial Activities of Turmeric

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Abstract: ***Turmeric, or Curcuma longa Linn, is a popular spice that is grown all throughout the Indian subcontinent. Turmeric has been used in traditional medicine to treat a variety of ailments, including cough, diabetes, and liver issues. Over the past few decades, numerous investigations have been carried out to ascertain the pharmacological effects of turmeric and its compounds. Curcumin, the main chemical component of turmeric, has been demonstrated to possess anti-inflammatory, antioxidant, antimutagenic, antidiabetic, antibacterial, hepatoprotective, expectorant, and anticancer qualities. This study mainly offers a safety evaluation and an update on the pharmacological characteristics of turmeric, its preparations, and its therapeutic applications.***

Interest in turmeric increased in the 1970s after researchers found that the herb may have anti-inflammatory and antioxidant properties. Safety evaluation tests have shown that both curcumin and turmeric are well tolerated at very high doses without any negative effects. Thus, turmeric and its constituents have potential for the development of modern medicine to treat a variety of ailments.

Turmeric extract decreased fungal aflatoxin production by 90% in addition to curcumin and turmeric's capacity to repair necrosis, lipid changes, and biliary hyperplasia. Diabetes, cancer, gastrointestinal problems, and neurological disorders have all been demonstrated to benefit from oral curcumin treatment. Curcumin can also be applied topically to lessen inflammation and irritation caused by inflammatory skin conditions and allergies. Curcumin can stop the three stages of carcinogenesis: angiogenesis, tumor development, and tumor promotion. This review focuses on the pharmacological and medicinal benefits of turmeric in treating and preventing illness.

Keywords: Turmeric, Anti-inflammatory, Anti-oxidant, Anti-microbial, Health beneifts.

I. INTRODUCTION

Turmeric is a herbaceous evergreen plant that is a member of the Zingiberaceae family. It is grown extensively in Asia, especially in China and India. In India, where it most likely originated, turmeric has been used for at least 2500 years. The turmeric plant grows in tropical and subtropical parts of the earth. The plant is said to have originated in Southeast Asia, most likely in India, however its precise origin is uncertain. The plant is cultivated across India.[1]Turmeric (Haridra) is one such medicinal herb that is well discussed in the Indian material medica (Dravyaguna Sastra). Hindu women rub this lucky beauty spot to their foreheads on a daily basis. An essential part of Hindu customs is applying a paste made of turmeric to the bride.[2] Curcumin's effects on specific cytokines, kinases, enzymes, transcription factors, growth factors, and receptors have been investigated due to its polyphenol structure.[3] Injecting curcumin into TNBC cell cultures decreased TNBC cell proliferation, according to a study examining curcumin's impact on triple negative breast cancer (TNBC), which is known to have a bad prognosis. This outcome was believed to be caused by the suppression of the EGFR (epidermal growth factor receptor) pathway. [4] Nutraceuticals can be used to treat conditions including diabetes, cancer, and neurological disorders that exhibit a shift in the redox state because most of them have antioxidant qualities.[5]

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II. BOTANICAL CLASSIFICATION

Kingdom :Plantae
Division: Angiosperm
Order: Zingiberales
Family: Zingiberaceae
Genus: Curcuma
Species: Longae



Fig.1 Rhizome

III. PLANT DESCRIPTION

plant without stems but with root stock. The leaves are either oblong or broadly lanceolate, with a deep ferruginous purple color. The blade is the same length as the sheath and petiole, a spike that emerges before to the leaves. The blossoming bract is green with a tinge of ferrugin, and the bloom is pale yellow with a reddish border. [6]

IV. HISTORY

Turmeric (Curcumalonga) and several other Curcumagenus species are found in the rainforests of Southern Asia, which includes India, Indonesia, Indochina, adjacent Asian countries, and several Pacific islands like Hawaii. All of these areas have been utilized for traditional culinary and therapeutic purposes since prehistoric times.In Indian Ayurvedic medicine, turmeric is said to strengthen and warm the entire body.Among the traditional uses in India are improving digestion, eliminating worms, relieving gas, cleaning and strengthening the liver and gallbladder, normalizing menstruation, relieving arthritis and swelling, acting as a blood purifier, warming and promoting proper metabolism, correcting excesses and deficiencies, acting locally on sprains, burns, cuts, bruises, insect bites, and itches, acting as an antibacterial and antifungus, and treating any weakness or debility. As a remedy "The ancient Hawaiians used this herb for many things, including the prevention and treatment of sinus infections (it is very astringent and appears to pull mucus out), ear infections (swimmers ear), and gastrointestinal ulcers," said Moriarty.Turmeric is eaten both raw and cooked throughout Asia. Traditionally, it is crushed or ground in a mortar to make a paste that may be used with other spices to flavor curries. Nowadays, the most used ingredient in curries in India and other nearby nations is dried root powder. (Direct observation) Turmeric has long been used as a fabric dye and culinary colorant, and it is less costly than saffron. In religious rites and presents, it is commonly utilized as a sign of life, prosperity, and purity. The ancient European herbals make very little, if any, reference of turmeric. Marco Polo refers to turmeric, which is used to dye textiles, as Indian saffron. In 1991, Michael Castleman said, "The ancient Greeks were well aware of turmeric, but unlike its close botanical relative, ginger, it never caught on in the West as a culinary or medicinal herb." However, it was used to produce orange-yellow colors.[7]

V. CULTIVATION

Red soil was gathered at the same depth in the Nago Agricultural Experiment Station, Okinawa, while dark-red and gray dirt were obtained from the 50-cm deep layer of the fields of the Subtropical Field Science Center, University of the Ryukyus, Japan. A Kĕhn Type Soil Sedimentation Apparatus was used to assess the soil's physical characteristics, an Inductively Coupled Plasma Spectrometer was used to identify the soil's mineral contents, and a TOA pH meter HM-20S (Toa Electronic Ltd., Japan) was used to measure the soil's pH in water. Between April 20, 1999, and January 28, 2000, the glasshouse experiment was carried out. Each Wagner pot (0.05 m2) was filled with ten kg of air-dried soil. Each pot had one seed-rhizome (30 g) sown at a depth of 6 cm. Ten pots were used for each soil, and the pots were distributed at random. We did not use any chemical or organic fertilizers in order to determine the actual impact of the physical and chemical properties of soil on turmeric growth, yield, and quality indices.Enough water was provided each day to keep the soil at the proper moisture levels for seedling emergence and good plant growth. The plant's height and the number of tillers were measured 205 days after planting, when the main stem had completed producing leaves. The plants were harvested after each sprout turned scarlet. After the leaves, shoots, roots, and rhizomes were gathered and oven-dried for 48 hours at 80 degrees Celsius, the plant parts were weighed. After being sliced, the rhizomes were dried at 40 degrees Celsius for 48 hours before being finely pulverized. Ten plant powders were mixed for each soil treatment, and all quality metrics were computed using three samples of each soil.

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Turmeric powder's mineral content was assessed using a Shimadzu AA-660, and the protein content was ascertained by measuring the nitrogen concentration. Total fat was extracted using a Soxhlet apparatus with diethylether, and the Kjeldahl method was used to quantify it. The protein factor 6.25 was used.[8]



Fig.2 Cultivation & collection of turmeric

VI. EXTRACTION PROCESS

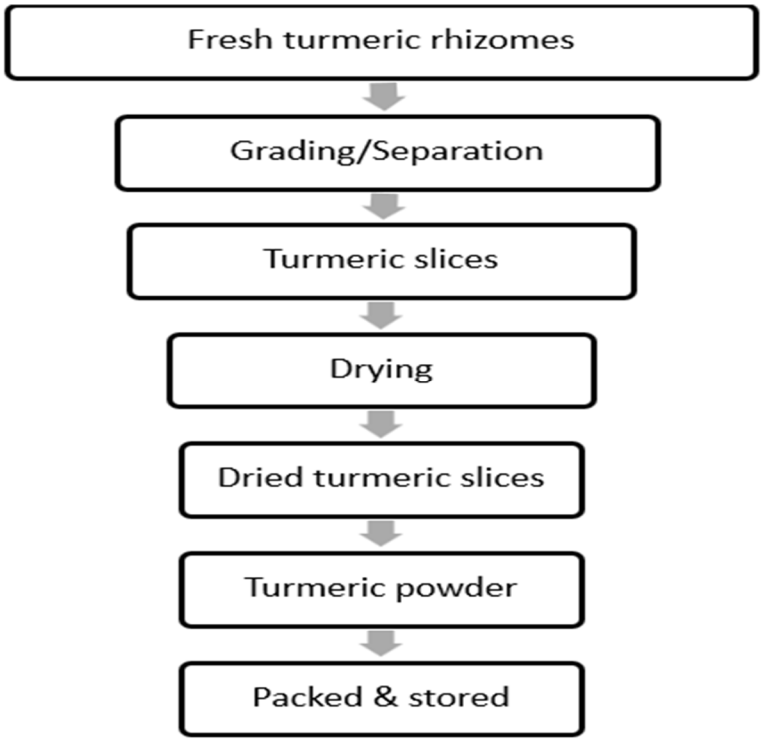


Fig.3 Extraction of turmeric

VII. CHEMICAL CONSTITUENTS

Phytochemistry is a branch of chemistry that studies the compounds present in plants. The phytochemical contents are influenced by a variety of factors, including geographic variance, soil conditions, ambient conditions, growing techniques, collection, preparation, and storage. The two main substances found in turmeric are curcuminoids and curcumin. Demethoxycurcumin and bismethoxycurcumin are the two primary curcuminoids present in the rhizome of turmeric. Curcumin is an orange-yellow crystalline molecule that is insoluble in water but soluble in inorganic solvents such ethanol, acetone, ketone, and chloroform. Because of the phytochemicals mentioned above, these rhizomes appear yellow [9]

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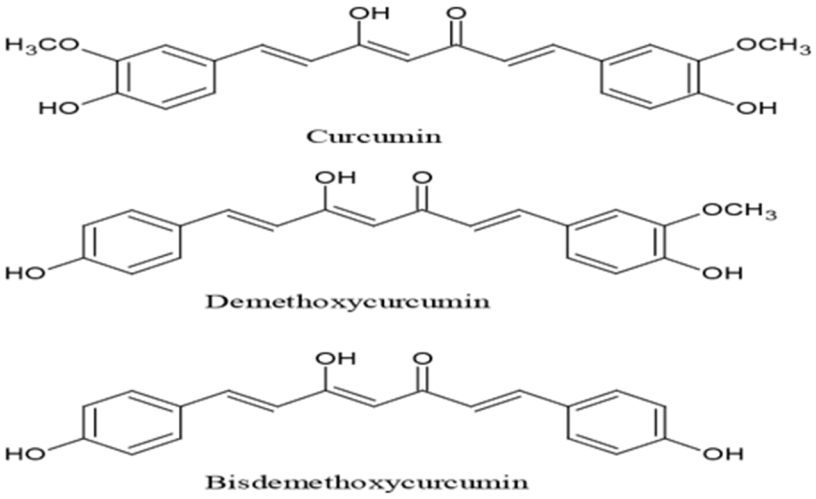


Fig.4 chemical structures

A range of essential oils (EO) may be made by steam-distilling turmeric. Zingiberene and Ar-cucumene are found in most maresquiterpines (53%). Monoterpenes include 1,8-cineole, sabinene, and alpha-phellandrene.



Fig.5,6 chemical structures

VIII. PHARMACOLOGICAL ACTIVITIES

1) *Anti- Oxiditant Activity:* Curcumin has been shown to be an efficient scavenger of oxygen free radicals. Its antioxidant activity is comparable to that of vitamins C and E. It can stop hemoglobin or lipids from oxidizing. It can significantly reduce the production of reactive oxygen species (ROS), including nitrite radicals, superoxide anions, and H2O2, by activated macrophages. Its derivatives, bisdemethoxycurcumin and demethoxycurcumin, also have antioxidant qualities.[10] Curcumin pretreatment has been shown to lessen the effects of ischemia and oxidative stress on the heart.[11] An in vitro study evaluating curcumin's effect on an inducible stress protein revealed increased cellular resilience to oxidative damage.[12]
2) *Anti- Microbial Activity:* Turmeric has been shown to prevent the growth of certain bacteria, dangerous fungus, and parasites. According to a study, providing meals laced with 1% turmeric to chicks infected with Eimera maxima enhanced weight gain and decreased intestinal lesions.[13] In a second animal study, topical administration of turmeric oil inhibited dermatophytes and pathogenic fungus in guinea pigs seven days after therapy.[14] Curcumin has also been demonstrated to be marginally effective against Plasmodium falciparum and Leishmania major.[15]
3) *Anti-Inflammatory Activity:* Curcumin is a potent anti-inflammatory that suppresses lipoxygenase and COX-2. It lowers both acute and chronic inflammation, according to both in vitro and in vivo studies. Curcumin has decreased edema in mice at doses between 50 and 200 mg/kg. Curcumin was nearly as effective as cortisone and phenylbutazone at similar dosages, and it reduced edema by 50% at 48 mg/kg body weight. Furthermore, curcumin inhibited formaldehyde-induced arthritis in rats at a dose of 40 mg/kg and showed no acute toxicity at levels up to 2 g/kg/day.[16] In an animal study of rheumatoid arthritis produced by streptococcal cell walls, intraperitoneal injection of turmeric extract containing 4 mg total curcuminoids/kg/day for four days prior to arthritis induction decreased joint inflammation in both acute (75%) and chronic (68%) phases. Rats given a 30-fold higher dosage of the curcuminoid formulation demonstrated a 48% decrease in joint inflammation four days prior to arthritis induction, demonstrating the efficacy of an oral treatment. [17]
4) *Anti-Cancer Activity:* Through its impact on numerous biological processes linked to mutagenesis, oncogene expression, cell cycle regulation, apoptosis, tumorigenesis, and metastasis, curcumin has been shown to possess anticancer properties. In addition to inhibiting the transcription factor NF-B and downstream gene products (such as c-myc, Bcl-2, COX2, NOS, Cyclin

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D1, TNF-a, and cell adhesion molecules important in tumor growth, angiogenesis, and metastasis), curcumin has demonstrated anti-proliferative activities in a number of cancers.[18]

5) *Anti-Allergic Activity:* Curcumin prevented compound 48/80 from damaging the peritoneum. Histamine is created when RPMCs degranulate. Curcumin decreased both compound 48/80-induced systemic anaphylaxis in vitro and the anti-DNP immunoglobulin E (IgE)-mediated passive cutaneous anaphylactoid reaction in vivo. Curcumin has the ability to reduce both nonspecific and selective mast cell-dependent allergic reactions. [19]
6) *Hepatoprotective*: Turmeric is recognized to have hepatoprotective qualities, much as silymarin. Turmeric has been demonstrated to have hepatoprotective properties against hepatotoxic damage, including carbon tetrachloride (CCl4).[23]
7) *Anti-Diabetic Activity:* A hexane extract containing ar-turmerone, an ethanolic extract containing ar-turmerone, curcumin, demethoxycurcumin, and bisdemethoxycurcumin, and an ethanolic extract from the hexane extraction residue containing curcumin, demethoxycurcumin, and bisdemethoxycurcumin were found to stimulate adipocyte differentiation in a dose-dependent manner. The results show that the combination of curcuminoids and sesquiterpenoids in turmeric ethanolic extract has a more potent hypoglycemic impact than either one alone.[24]
8) *Cardiovascular Diseases:* Turmeric protects the cardiovascular system by lowering cholesterol and triglyceride levels, stopping platelet aggregation, and decreasing the susceptibility of low density lipoprotein (LDL) to lipid peroxidation.[25] It has been demonstrated that turmeric extract lowers triglycerides, plasma cholesterol, and the susceptibility of LDL to lipid peroxidation. Turmeric extract may affect cholesterol levels because the intestines absorb less cholesterol and the liver converts more cholesterol to bile acids. Parts of C. longa are thought to reduce platelet aggregation by boosting prostacyclin synthesis and blocking thromboxane generation.[26]
9) *Anti-Fungal Properties:* Antifungal qualities are seen in turmeric oil and extracts in ether and chloroform.[20] Crude ethanol extract also possesses antifungal properties. Turmeric oil can also affect Aspergillus flavus, A. Penicillium digitatum, Fusarium moniliforme, and parasiticus.[22]
10) Heart Disease: Preventing cardiovascular disease and other serious health concerns requires maintaining a healthy cholesterol level. Because high cholesterol may be very detrimental to one's health, people are always looking for ways to lower their cholesterol. Studies have shown that turmeric can significantly lower blood cholesterol. According to preliminary study, turmeric may help prevent atherosclerosis, the buildup of plaque that can obstruct arteries and result in a heart attack or stroke. In animal trials, turmeric extract lowered cholesterol levels and stopped LDL "bad" cholesterol from building up in blood vessels. Because turmeric inhibits platelets from clumping together, it may help prevent blood clots from developing along arterial walls. However, a double-blind, placebo-controlled study found that eating up to 4 g of curcumin, the active ingredient in turrmeric, daily did not reduce cholesterol. Curcumin dramatically reduces cholesterol in rats with elevated cholesterol.[28]

IX. HEALTH BENEFITS

1) Because it is a natural antiseptic and antibacterial agent, it effectively cleans burns and wounds.
2) When combined with cauliflowerIt has been shown to both stop the progression of pre-existing prostate cancer and prevent it.
3) Prevented the spread of breast cancer to the lungs of mice.
4) may eradicate melanoma cells already present as well as prevent melanoma.
5) Is a liver detoxifier that works naturally.
6) Prevent Alzheimer's disease and slow its progression by removing amyloid plaque buildup from the brain.
7) may stop a variety of cancer types from developing metastases.
8) It is a strong natural anti-inflammatory that has no negative side effects and functions just as well as many anti-inflammatory medications.
9) Has shown promise in slowing the progression of multiple sclerosis in mice.
10) Is a natural analgesic and cox-2 inhibitor.
11) Take one teaspoon of honey and turmeric juice daily if you have anemia.
12) .Boil one cup of milk with one teaspoon of powdered turmeric for asthma. Drink something warm.
13) Burns: Treat the injured area with a combination of one teaspoon aloe gel and one teaspoon turmeric.
14) Mix one tablespoon of raw, crushed turmeric with one-third cup of water to treat conjunctivitis. After boiling, sieve. Up to three times a day, you can apply two to three drops of this mixture to each eye.
15) Complexion: Apply a turmeric paste to your skin before bed and wash it off shortly after. Make a paste with oil and chickpea flour (besan) in the morning to get rid of any last traces of yellow.

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X. PRELIMINARY PHYTOCHEMICAL SCREENING

As part of the chemical examination, qualitative chemical testing has discovered a number of phytoconstituents included in the powdered crude drug.Using commonly used precipitation and coloring procedures, a number of studies performed initial phytochemical investigations of the aqueous, acetone, ethanolic, chloroform, and methanolic extracts of the Curcuma longa rhizome. Proteins, carbohydrates, alkaloids, glycosides, terpenes, steroids, flavonoids, tannins, and saponins were all detected by these assays.[29,30,31]

A. Test For Alkaloid

Three milliliters of mild hydrochloric acid were added to the extract before it was completely filtered. The filtrate was thoroughly assessed using the subsequent test.[31]

1) Mayer's Test: A few drops of Mayer's reagent are combined with one or two milliliters of filtrate at the test tube's side. Alkaloids were present because of the white or creamy precipitate.[29,32,30,33]
2) Wagners Test: Wagner's reagent was added to one or two milliliters of the filtrate extract; the appearance of a brown, reddish precipitate indicates the presence of alkaloids.[29,32,30]

B. Test For Glycosides

1) A positive glycoside result is obtained by adding equal volumes of Fehling's solutions A and B to a 2 ml test solution and boiling the mixture. A brick-red precipitate was present.[30]
2) Legal's Test: Pyridine and alkaline sodium nitroprusside were combined in a 2 ml or 1 ml test solution; a pink or blood red hue indicated the presence of glycoside.[29,30,31]
3) Keller-Killani Test: a drop of FeCl3 treated with extract in two milliliters of glacial acetic acid. Glycoside is present when a brown ring forms.[29,31]

C. Test for Flavonoids

1) Shinoda Test: Concentrated H2SO4 was added dropwise to two milliliters of test solution after a few pieces of magnesium ribbon were added. Either crimson red or pink scarlet is the result.[29,30]
2) Alkaline reagent Test: The addition of a sodium hydroxide solution gave the test solution a yellow or red hue.[29,30]

XI. CASE STUDY OF TURMERIC

Turmeric rhizomes' anticancer potential was evaluated in vivo in mice using Dalton's lymphoma cells cultured in ascites and in vitro using tissue culture methods. At 0.4 mg/ml, turmeric extract was cytotoxic to lymphocytes and Dalton's lymphoma cells and reduced the development of Chinese Hamster Ovary (CHO) cells. At room temperature (30°C), a cytotoxic impact was seen in 30 minutes. The active component, "curcumin," showed cytotoxicity to Dalton's lymphoma cells and lymphocytes at a dosage of 4 µg/ml.[27]

XII. CONCLUSION

Turmeric's health benefits are often obtained through long-term dietary use, even at low concentrations. Understanding the effective dosage, safety, and mechanism of action of turmeric is essential for its rational application in the treatment of human ailments.If turmeric is to be used to address human needs and enhance human welfare, more clinical research is necessary. The actions of turmeric include antibacterial, antiviral, anti-inflammatory, antitumor,anti- oxidant,anti-septic,hepatoprotective, nephroprotective, radioprotective, and digestive activities. Phytochemical research of turmeric has identified a vast number of chemicals, including curcumin, volatile oil, and curcuminoids, which have been discovered to have powerful pharmacological activities.[21]

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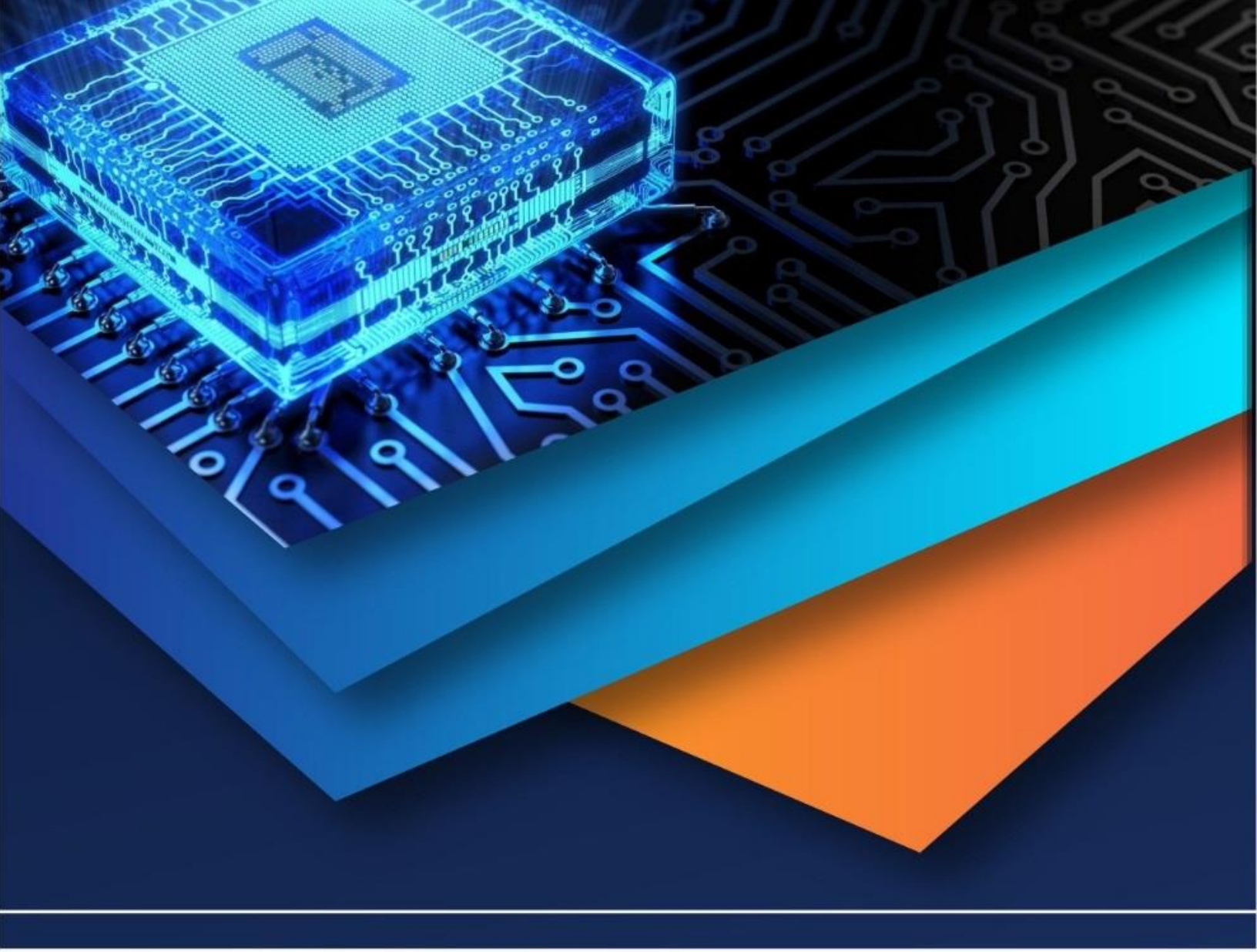
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