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A Comprehensive Study of the Coleus Forskohlii Plants Morphology, Phytochemistry, and Pharmacological Qualities

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Abstract: ***In traditional Indian medicine, the herb Coleus forskohlii is used a lot. Forskolin, a diterpenoid used to treat a wide range of illnesses in ancient Ayurvedic medicine, was taken from this plant. Forskolin is used to treat a wide range of medical conditions, such as eczema, asthma, psoriasis, heart disease, and high blood pressure. It is thought that the loss of cAMP inside of cells is a key factor in the development of a number of diseases. In light of a number of important new findings, this report gives a full description of the plant's shape, location, medicinal uses, phytochemistry, pharmacological activities, analytical methods, cultivation considerations, and biotechnological approaches for forskolin production. This paper talks about everything from the chemical makeup of plants to how they work in the body to how they can be used as medicine.***
Keywords: Coleus forskohlii, forskolin, morphology, phytochemistry, pharmacological activities

I. INTRODUCTION

People have used plants as medicine for thousands of years, and now, in countries all over the world, hundreds of plant species are grown just for their possible medical value. Even though modern pharmaceuticals have come a long way, medicinal plants are still an important part of treating illness. In some places, the only way to treat certain conditions is with traditional medicines made from local plants, because they are easy to get and not too expensive. In 2003, the World Health Organization said that more than 80% of the world's people used traditional medicine. Herbal treatments have been used for hundreds of years, but in some developed countries, they are becoming more popular again.

Most traditional forms of medicine are based mainly on the wide variety of plants and the knowledge of how certain plants can help people. India is known as one of the world's twelve "mega diversity hotspots" because one out of every five plants found there can be used in some way to help people. India's rural people rely on traditional medicine, which includes the use of about 25,000 different effective remedies made from plants. Traditional knowledge and plant species are very important to both the herbal medicine and pharmaceutical industries. Raw materials come from plants, and traditional practices teach how to gather them.

Traditional medicine, which includes both beliefs and practices to improve and maintain health, is the source of many types of complementary and alternative medicine, as well as new drugs and other health products. In conventional medicine, preventive care and healing therapies are also very important parts.

The parts of medicinal plants can be used as therapeutic agents, but they can also be used as raw materials in drug production or as models for pharmacologically active compounds. Because of this, they are important for both studying the pharmacology of medicinal plants and making new medicines. The annual global market for chemicals made from plants, like medicines, perfumes, flavors, and colorants, is expected to reach several billion dollars. Taxol, vincristine, vinblastine, and colchicine are some of the best-known phytochemicals in biology and medicine. Two more are artemisinin, which is used to treat malaria, and forskolin, which is used in Ayurvedic medicine.

Due to the plant's main diterpene, forskolin, C. forskohlii has recently come to people's attention as a possible useful medicine. In the 1970s, it was found that forskolin could be used as a medicine. Forskolin is used to treat a wide range of medical conditions, such as eczema, asthma, psoriasis, heart disease, and high blood pressure. It is thought that the loss of cAMP inside of cells is a key factor in the development of a number of diseases. The cytoplasmic vesicles in the cork cells of C. forskohlii tubers range in color from yellow to reddish brown, which makes this plant easy to spot. Forskolin and other secondary metabolites are stored for a long time in these vesicles.

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II. THE HISTORY AND WORLD-WIDE SPATIAL DISTRIBUTION

Most people agree that India is where C. forskohlii was first seen in the wild. It grows in the wild in the subtropical and temperate zones of India, Nepal, Burma, Sri Lanka, and Thailand. Brazil, Egypt, Arabia, and the tropical countries in East Africa all seem to be buyers. This bush can only be found on the lonely, dry mountains of India.

The species can be found between 80 and 310 degrees north and 600 to 800 meters above sea level. It has the same length both across and up.

III. SPECIES STATUS

C. forskohlii Briq. is a popular herbal medicine that comes from the plant family Lamiaceae. In the Ayurvedic medical book, it is called both "Makandi" and "Mayani." These two names come from the Sanskrit language. Here's a quick summary of where C. forskohlii stands in terms of classification:

Kingdom	- Plantae
Division	- Magnolophyta
Class	- Magnoliopsida
Order	- Lamiales
Family	- Lamiaceae
Genus	- *Coleus*
Species	- *forskohlii*

The Greek word "COLEOS," which means "sheath," is where the name "Coleus" comes from. Loureiro used it to describe the plant in 1790. Loureiro was the first person to write down a formal description of the Coleus plant family. All Coleus species have the same structure, with four didynamous and dedinate stamens whose filaments join at their bases to make a sheath around the style. The plant's species name, forskohlii, was chosen to honor a Finnish naturalist named Forskel. The genus Coleus includes nearly 150 species, but only C. amboinicus, C. forskohlii, C. spicatus, and C. malabaricus can be found growing in the wild.

IV. COMPRISING CHROMOSOME PLOIDY AND VARIABILITY, GENETIC BASE

Based on what we know, C. forskohlii is a species with n = 14 diploid cells. On the other hand, research on the chromosomes of South African dicotyledons suggests that C. forskohlii is a diploid species with only 16 copies of each gene. Bir and Saggoo say that the main number of South Indian collections is n = 15. . It thought that the different base numbers they saw among members of the same family might be caused by aneuploidy at the generic level, which in turn causes differences in the way things look. Note: [Needs references] Researchers found striking differences in the way groups from different ecoregions looked.

Chromatographic studies of C. forskohlii extracts from Brazil, Africa, and India showed that each region's plants made a different mix of chemicals. It was found that these differences were unique to each country, so they were put down to either genes or the environment. A study in Tamil Nadu that compared the effectiveness of two different types of C. forskohlii found that the 'Maimul' variety had much more tubers per plant and a higher percentage of plants with strong roots. Similar to how there was a wide range of differences in how C. forskohlii looked and how much it produced.

V. BOTANICAL DESCRIPTION

C. forskohlii is a perennial plant that stays green all year and can grow up to 60 centimeters tall. It has four stems that are at different angles and go in different directions. Most common nodes are bushy. The leaves are between 7.5 and 12.5 centimeters long and 3 to 5 centimeters wide. They are usually hairy and have thin petioles that don't have hair. The flowers may grow in a raceme that is 15–30 cm long. Most of the time, the flowers are perfect and strong, and they are between 2 and 2.5 mm in diameter. There are hairs inside the calyx. The calyx's upper lip is shaped like an ovate. The bilabiate flower's corolla can look either blue or violet.

The bottom lobes are bigger and have a concave shape so that the vital organs can fit inside. The ovary of the flower has four lobes, and the stigma has two lobes that stick out. The flower can be pollinated by the wind or by insects. Most of the time, the root is thick and fibrous, and it grows in a radial pattern. The roots are tuberous, branched, cone-shaped, fusiform, upright, orange on the inside, and have a strong smell. There are 20 of them, and their diameters range from 1/2 centimeter to 2 1/2 centimeters. C. forskohlii is the only other plant in the genus that has roots that are fasciculated, or grouped together. The smell spreads through the whole plant. The smell of the leaves is very different from the smell of the tubers. C. forskohlii, on the other hand, grows in many different ways and can either stand up or lie down. The shape of the roots is also very different between populations. Some groups have tuberous roots, others have semi-tuberous roots, and still others have fibrous roots.

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VI. CULTIVATION PRACTICES

C. forskohlii grows best in soil with a pH between 5.5 and 7 and a red, sandy loam texture. This plant does best when the humidity is between 83 and 95% and the temperature is between 10 and 250 degrees Celsius. Every year, it must rain between 100 and 160 centimeters between June and September. Both vegetative propagation from the plant's end stems and vegetative propagation from seeds are possible. It takes a lot of work and time to grow plants from seeds, but stem cuttings can be done quickly, cheaply, and effectively. Small pieces of the plant's tip with three to four leaves are cut off and planted in nursery soil to help the plant grow new roots. If the cuttings have strong roots after a month, they can be planted in the main field. The best times to plant are in June, July, September, and October, and each rooted cutting should be at least 60 cm away from the next. It is important to water, weed, and care for the plants on a regular basis. Different types of fertilizers, both natural and man-made, have worked well with the crop. Put on a total of 140 kg of organic fertilizer at 30-day and 45-day intervals after planting. Applying 40 kilos of nitrogen, 60 kilograms of phosphorus oxide, and 50 kilograms of potassium oxide per hectare will help you get the most fresh tubers (120 t/ha) and dried tubers (3,982 t/ha). As a "base dose," you can use the full amount of nitrogen, phosphorus, and potassium. Then, 30 days later, you can use the other half of the nitrogen dose as a "top dressing."

The arbuscular mycorrhizal fungus Glomus bagyarajii made coleus plants grow faster and have more forskolin when it was present during growth. The most damaging pests to this crop are root knot nematodes, mealybugs, and caterpillars that eat the leaves. Fusarium chlamydosporum is a very dangerous soil-borne disease that can be stopped from spreading by inoculating plants with Trichoderma viride and Glomus mosseae. Macrophomina phaseolina can cause root rot, which could cut tuber production by as much as 100%. Using a bioformulation with Trichoderma harzianum and zinc sulfate is the best way to stop root rot. The crop is ready to be picked four and a half to five months after it was planted. After the plants are pulled up, the tubers are dug up, washed, and left in the sun to dry.

One acre of land can produce between 800 and 1000 kg of dried tubers. Instead, if farmers use the right methods, they could get 2,000 to 2,200 kg of dried tubers per hectare.

Most of the time, contract farming is used to grow C. forskohlii in India. A study found that the most important things that lead to better performance in coleus contract farming are the removal of price risk, the removal of middlemen, the availability of guaranteed income and financial support, technical guidance from the company, timely availability of inputs, knowledge of the right technology, and the guarantee that financial support will be given.

VII. MEDICINAL USES

In India, the most valuable healing type of Coleus forskohlii is the kind that grows in tubes. Clostridium amboinicus, Clostridium blumei, Clostridium malabaricus, and Clostridium scutellaroides are also often used to treat digestive problems like dysentery. In many cultures, C. forskohlii is often used to treat a wide range of health problems. Because of its expectorant, emmenagogue, and diuretic properties, the leaf is used as a medicine in Egypt and other African countries. In Brazil, it is used as a digestive aid and medicine. In Indian cooking, the tubers are pickled and used as a side dish. Also, it is often used as a seasoning. In traditional Ayurvedic medicine, C. forskohlii has been used for a long time to treat heart disease, abdominal colic, breathing problems, insomnia, convulsions, seizures, asthma, bronchitis, intestinal problems, burning sensations, constipation, epilepsy, and angina. The roots can also be used to get rid of worms and make painful boils less painful. When the root extract is mixed with mustard oil, it can be used as a topical treatment for eczema and other skin conditions. The herb can also be used to treat animals. Forskolin is also used to make drugs and treatments that can turn white hair back to its natural color or stop it from graying. The essential oil in the tubers of the plant is used as a medicine, but it also has a pleasant, light scent with a hint of spice that makes it a nice addition to any home. Essential oil is a good ingredient for the food business because it can kill bacteria and could taste good.

VIII. PHYTOCHEMISTRY

Forskolin, which used to be called coleonol, was first found in 1974. After similar coleonols and diterpenoids were found, this chemical was given the name "forskolin." The other six Coleus species (C. amboinicus, C. blumei, C. canisus, C. malabaricus, C. parviflorus, and C. spicatus) and the six Plectranthus species did not have forskolin (P. coesta, P. incanus, P. mollis, P. parviflorus, and P. spicatus). In Japan, 100 samples of Coleus, Orthosiphon, and Plectranthus species from the Ocimoideae subfamily were tested, but no forskolin was found. All of the studies used the same group of plants. Drugs like 5-(3-dimethylamino)-propionyl forskolin hydrochloride (NKH 477) and 5-(6-deoxy- 7-deacetyl-7) amino carbon forskolin (HIL 568), which can be used to treat glaucoma and cardiovascular disease, are examples of second-generation forskolin derivatives.

Extracts of the coleus forskohlii plant's root are giving scientists important clues about how to make new chemical compounds. Roots of C. forskohlii were used to get six compounds, including 14-deoxycoleon U, demethylcryptojaponol, alpha-amyrin, betulic acid, alpha-cedrol, and beta-sitosterol. First time alpha-amyrin and betulic acid have been taken from C. forskohlii. Forskolin I and Forskolin J are two new diterpenoids that were found in C. forskohlii plants in India. These chemicals are called 1-alpha, 6-betadiacetoxy-7 beta, 9-alpha-dihydroxy-8, 13-epoxylabd-14-en-11-one and 1-alpha, 9-alpha-dihydroxy-6beta,7betadiacetoxy-8,13-epoxylabd-14-en-11-one.

The ethanol extract of the plant has recently been used to find two more labdane diterpene glycosides. Forskoditerpenosides A and B are two names that you might hear for these chemicals.

In vitro tests on isolated guinea pig tracheal spirals showed that the glycosides calmed them down. This is the first time that glycosides made from labdane diterpene have been found in nature. Forskoditerpene A, a new labdane diterpene, was later found in an ethanol extract of the whole C. forskohlii plant. Forskoditerpenoside C, D, and E were then found to be three new minor labdane diterpene glycosides. Forskoditerpenosides C, D, and E showed a new 8,13-epoxy-labd- 14-en-11-one glycoside pattern and made isolated guinea pig tracheal spirals relax in the lab. The fact that the glycosides are forskoditerpenosides made it possible to find these results. Labdane is the base of forskoditerpene A, which was first found to have a spiro group. Forskolin is in high demand in Europe and Japan because it is used in many medical treatments and more and more people are interested in studying it.

IX. MECHANISM OF ACTION

Since forskolin is the main chemical in the tuber, herbal preparations of it work on a wide range of pharmacological processes. The Central Drug Research Institute in Lucknow, India, did a thorough search for biological activity in Indian plants in order to find out what the roots could do to lower blood pressure. In tests on animals, the methanol that was taken from the tuber root was shown to lower blood pressure and make the heart beat faster. Singh and his colleagues found that coleonol and forskolin are stereoisomers by comparing their physical and chemical properties to those of their derivatives. This shows that the main difference between forskolin and colenol was how the acetate (-OAc) group was set up at carbon 7. In different studies, it was found that forskolin and coleonol have the same effects on the body.

Forskolin's ability to turn on adenylate cyclase and raise levels of the second messenger cyclic AMP inside cells is a big part of why it can lower blood pressure. This is the main way that forskolin works to lower blood pressure (cAMP). Forskolin has been shown to directly turn on almost all hormone-sensitive adenylate cyclases, both in whole cells and tissues and in a solubilized adenylate cyclase preparation.

The catalytic subunit of the enzyme or a protein that is very close to it is where forskolin acts to turn on the enzyme. Forskolin may stimulate all types of adenylate cyclase in humans except type IX, which is only found in spermatozoa. Adenylate cyclase is thought to be what makes forskolin work to relax many types of smooth muscles. Note: [Needs references] Forskolin's effect on cyclic adenosine monophosphate (cAMP) signaling shows that the molecule could be used to treat a number of diseases, such as cardiac insufficiency, high blood pressure, glaucoma, thrombosis, asthma, and even metastatic disease. The effect of forskolin on cyclic AMP signaling showed that the molecule could be used as a research tool.

Forskolin stops basophil and mast cells from releasing granules and stops histamine from being made. It also lowers blood pressure and pressure inside the eye. This is done by making cAMP go up, which in turn makes cAMP go up.

A. Heart Disorder

Forskolin has an inotropic effect on heart tissue because it can raise the level of cAMP. Extensive pharmacological research on a wide range of animal species has shown that forskolin has both a good inotropic effect on heart muscle and a vasodilatory effect. The blood pressure went down from whatever level it had been at before.

B. Glaucoma

Capriole and Sears were the first to write about how forskolin changed the way aqueous humor worked. When applied topically to rabbits, monkeys, and people, forskolin lowered the pressure inside their eyes. Forskolin showed promise as a treatment for glaucoma because it decreased the amount of fluid going into the eye without affecting how much fluid could flow out. Forskolin was tested on both humans and rabbits and monkeys.

Forskolin had no effect on the intraocular pressure of glaucomatous monkeys, which were watched over time. When it was put on the eye of a person, it did not stop the flow of tears.

C. Asthma

Researchers have looked into whether or not forskolin could be used as a bronchodilator to treat asthma. In guinea pigs, histamine and leukotriene C-4 cause bronchospasm, which is the most noticeable sign of asthma and bronchitis. Both of these chemicals were taken away. Forskolin has been shown to stop human basophils and mast cells from making histamine and leukotriene C-4. Results from a test with human volunteers suggest that asthma patients who inhale forskolin powder may have their bronchi open up.
Forskolin could help people with heart failure, glaucoma, and asthma if they took the right amount.

D. Antithrombotic Effect

It is possible that forskolin's ability to stimulate adenylate cyclase, which in turn makes prostaglandins work better, is one reason why the compound can stop platelets from sticking together. As shown in rabbits, cerebral vasodilation may make people less likely to get blood clots. In this study, rabies was used. The vasodilation did not change because of adenosine. It has been suggested that a crude extract of Forskohlii could be used as an anticoagulant in phytotherapy.

E. Anti-obesity

C. forskohlii, on the other hand, may help overweight women keep from gaining weight and hasn't been linked to any serious side effects. C. forskohlii doesn't seem to have any side effects that are clinically important, but this is still the case. The effects of C. forskohlii on weight loss were tested on rats whose ovaries had been surgically removed. C. forskohlii extracts caused rats to gain less weight, eat less, and store less fat. This suggests that C. forskohlii could be used to treat obesity.

F. Other uses

Forskolin not only makes more cAMP, but it also stops platelet-activating factor (PAF) from binding in a way that doesn't depend on making more cAMP. Forskolin stops glucose from moving through erythrocytes, fatty tissue, and platelets, among other places. If what it does to these membrane-bound transport proteins is any indication, forskolin may affect more membrane-bound transport proteins. There is evidence that the effects of forskolin happen without cyclic AMP. Desensitization, changing voltage-dependent potassium channels, reversing multidrug resistance, and controlling nicotinic acetylcholine receptor channels are some examples. We still don't know if C. forskohlii or forskolin are safe for people to eat. People with ulcers should stay away from it because it could make their stomach acid rise.

X. CONCLUSION

In this study, we tried to find out as much as we could about C. forskohlii, including how it looks, where it grows, how it is used as medicine, its chemical makeup, and how to analyze it. Forskolin can only be found in nature in Coleus forskohlii, according to the research that has been done. Using pharmacological and biochemical methods, it was shown that forskolin has a wide range of biological roles. Most research, though, used a concentrated extract of forskolin given in a way other than by mouth to treat different diseases in animal models. The effectiveness of forskolin given by mouth to humans has not been shown. Also, besides forskolin, there isn't enough evidence to support how other bioactive plant parts are said to work. Forskolin and other bioactive chemicals need to be studied more to find out if they are safe and effective ways to treat illness.

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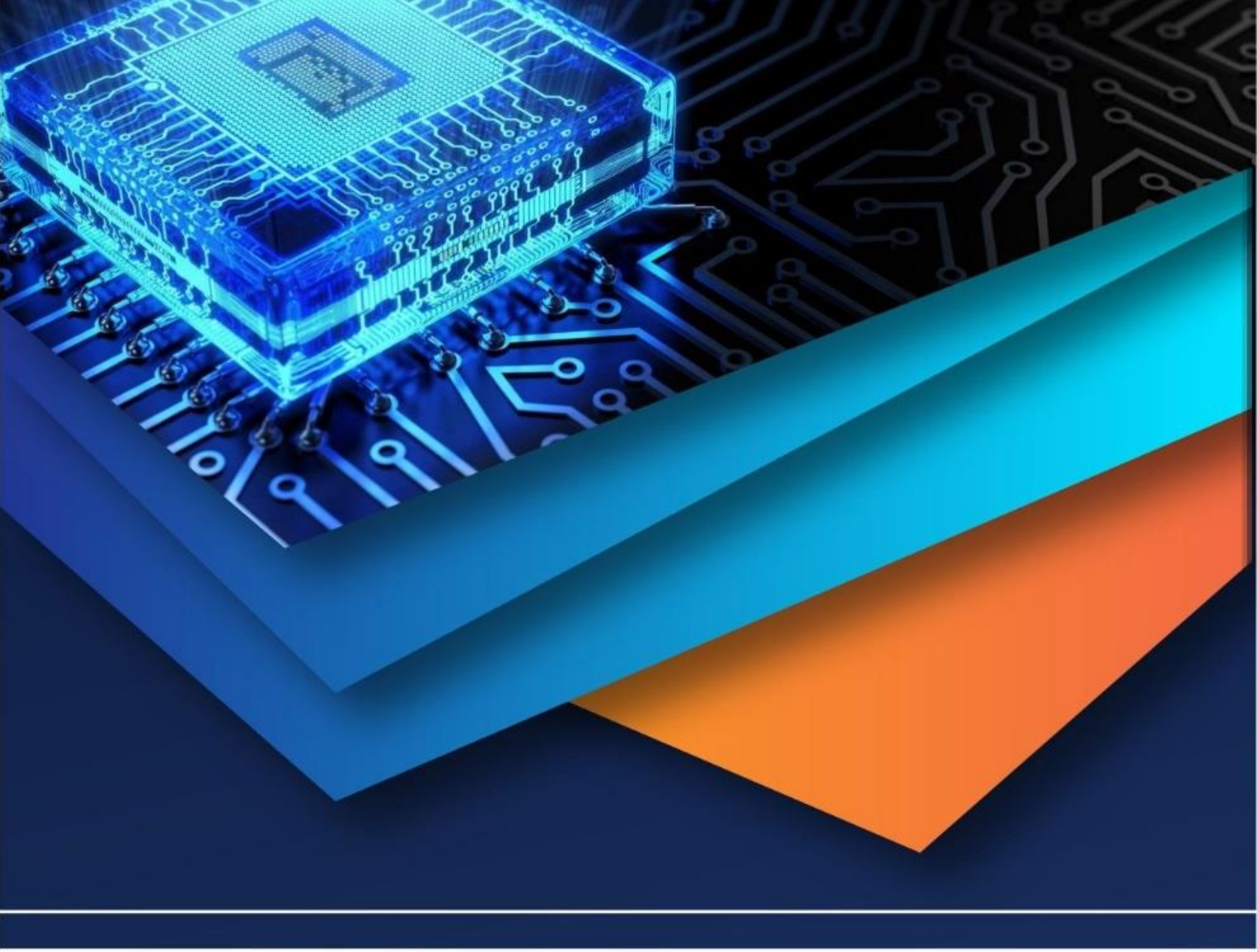

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