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# Aloe Vera-Review on Industrial Processing and Cultivation

Aarthi Pughazhendhi[1], D. Sathish Sekar[2]
[1]*Research Scholar, Periyar University, Salem, Tamil Nadu, India*
[2]*Associate Professor, Department of Biotechnology, PEE GEE College of Arts & Science, Dharmapuri, Tamil Nadu*

***Abstract: Aloe Vera farming business profit has tremendously increased with the growing demand of herbal and cosmetic product and pharmaceutical benefits. The main advantage of this farming is that it requires less water and maintenance. It possess various nutrients, minerals, antibiotic and antifungal properties with loads of vitamins which makes Aloe Vera a super food. Apart from this, Aloe also plays with healing effect on skin naturally and helps in the glowing of skin. Though, people are aware with the advantages of Aloe vera, people are not forwarding to cultivate Aloe vera and process the juice and gel widely since they are not sure with the agriculture practice of Aloe vera. This review article is focused on the industrial processing of aloe vera along with the history of aloe vera and its vital importance which helps in creating awareness in order to develop more ideas on Aloe farming.***

***Keywords*: Aloe vera, Benefits, Farming, Industrial processing, Juice, Gel**

## I. INTRODUCTION

### *A. Aloe Vera*

The botanical name of Aloe vera is *Aloe barbadensis.* However, the Egyptians call Aloe as “the plant of immortality”. Aloe vera plant is local to northern parts of Africa, still it has quickly spread all over the world in recent years as their cultivation and maintenance is simple. Aloe vera, being a succulent plant with thick, plump, serrated, lanceolate-formed leaves of green-greyish shading, its inward gel is acquired from the lower leaves of the plant by cutting the leaf open. Aloe vera plant is known for its gel which is clear, unscented, and bland. Aloe vera contains two major liquid sources, yellow latex (exudates) and the clear gel (mucilage).Yellow latex is mainly composed of aloin, aloe-emodin and phenols. The mucilaginous jelly from the parenchymal cells of the plant is the aloe vera gel. Gel contains 97–98% of water and more than 60% of dry matter made up of polysaccharides. The gel is a colourless, odourless, hydrocolloid with several natural beneficial substances.

### *B. Taxonomy*

Kingdom : Plantae
Order : Asparagales
Division : Spermatophyta
Subdivision: Angiospermae
Class : Monocotyledoneae
Family : Liliaceae

1) *Why Aloe vera?* The term 'Aloe' used in medicine stands for the dried juice, which flows from the transversely cut bases of the leaves. Aloe Vera contains over 20 minerals, all of which are essential to the human body. The human body requires 22 amino acids for good health - eight of which are called "essential" because the body cannot fabricate them. Aloe Vera contains all of these eight essential amino acids, and 11 of the 14 "secondary" amino acids. Aloe Vera has Vitamins A, B1, B2, B6, B12, C and E.

### *C. Aloe – Worldwide Traditional Medicine*

*Aloe vera*, being a traditional plant, has a long history of traditional use. It is used in India as a medicine for constipation, colic, skin diseases, worm infestation, and infections. In Trinidad and Tobago, aloe is used for hypertension and followed by Mexican Americans for the treatment of type 2 Diabetes Mellitus. It is often recommended in the treatment of fungal diseases as Chinese medicine. In Western society, *Aloe vera* is widespread and known for its use in the cosmetic, pharmaceutical, and food industries. In order to extend its applications, the clinical trials of *Aloe vera* have been conducted include skin conditions, management of burn and wound healing, constipation, Diabetes, and gastrointestinal disorders. However, the plant has been utilized by Egyptians,

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Assyrians, and Mediterranean human advancements, and additionally in Biblical times. Congo people apparently rub their bodies' using free adhesive aloe gel to diminish sweat; some African tribes apply the aloe gel for constant conjunctivitis. In India, the gel is utilized for the treatment of asthma.

*D. Aloe Active Ingredients*

The aloe gel predominantly comprises of water (99.1%) and mesophyll cells (0.9%), which can be isolated into 3 particular portions: cell divider, micro particles, and fluid gel which accounts for 16.2%, 0.7%, and 83.1% of dry mass, respectively. The transcendent sugar part present is mannose which includes 20.4% in cell divider, 32.2% in micro particles, and 62.9% in the fluid gel. Muco polysaccharides are mostly present as acemannan which refers to a exceedingly acetylated, β-1-4-connected polysaccharide made for the most part of mannose with different side chain glycosylation patterns. The plant also incorporates different amino acids, proteins, and vitamins. The IASC has a standard in which "entire aloe vera leaf gel" needs to stick to the solids (0.46%–1.31%); pH (3.5–4.7); calcium(98.2–448 mg/L); magnesium (23.4–118 mg/L; malic corrosive (817.8–3,427.8 mg/L); acemannan with crude materials (≥ 5% by dry weight); isocitrate; crude materials powder content (≤ 40%); aloin.



Fig.1 Aloe gel

*E. Aloe Functional Components*

*1) Active components with its properties:* Aloe vera contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids.

| PLANT PART | NUTRIENT | FUNCTION |
|---|---|---|
| LEAF | VITAMINS | Gives energy |
| | A | Strengthens immune system |
| | B1 | |
| | B2 | |
| | B3 | |
| | B6 | |
| | B12 | |
| | C | Antioxidant – neutralizes free radicals |
| | E | Antioxidant– neutralizes free radicals |
| | MINERALS | |
| | Calcium | |
| | Iron | |
| | Potassium | Helps in human metabolism |
| | Magnesium | Growth of bones and teeth |
| | Manganese | Blood flow; proper functioning of enzyme |
| | Sodium | systems, antioxidant |
| | Zinc | |
| | Chromium | |

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| | | |
|---|---|---|
| | Copper<br>Selenium | |
| | AMINOACIDS<br>Lysine<br>Threonin<br>Valine | Repair tissues<br>Carry oxygen throughout the body<br>Form antibodies |
| | ENZYMES<br>Oxidase<br>Catalase<br>Aliase<br>Alkaline phosphatase<br>Amylase<br>Cellulase<br>Lipids<br>Bradykinase | <br><br>Regulates Intestinal activity<br>Aids in breaking up of food elements, sugars and fats<br><br><br><br><br>Reduce excessive inflammation |
| | SUGARS<br>Monosaccharides<br>Polysaccharides<br>Glycoproteins | Non-allergic, anti-inflammatory |
| | ANTHRAQUINONES | Laxative, Antibacterial; Antiviral |
| | FATTY ACIDS | Anti-inflammatory, Antiseptic, Analgesic properties |
| | HORMONES<br>Auxins<br>Gibberellins | Wound healing and anti-inflammatory |

*F. Action Mechanism*

1) *Topical Treatment:* After the oral intake of aloe vera, Glucomannan, a mannose-rich polysaccharide along with the growth hormone gibberellin interacts with growth factor receptors on the fibroblast, by stimulating its activity and proliferation, which significantly increases collagen synthesis. Aloe gel also changes the collagen composition and increases the degree of collagen cross linking which accelerates the wound contraction and increase the breaking strength of scar tissue. It was also reported that the oral intake led to the increase in the synthesis of hyaluronic acid and dermatan sulfate in the healing wound.
2) *Skin exposure:* Aloe vera gel extracted reported to have a protective effect against the radiations which causes damage to the skin. This is all because of an antioxidant protein, metallothionein, which is generated in the skin scavenges hydroxyl radicals and prevents suppression of superoxide dismutase and glutathione peroxidase in the skin. It reduces the production and release of skin keratinocyte-derived immunosuppressive cytokines such as interleukin-10 (IL-10) preventing the UV-induced suppression of delayed type hypersensitivity.
3) *Anti-Inflammatory Action:* Recent studies revealed that the novel anti-inflammatory compound called C-Glucosyl chromone which inhibits the cyclooxygenase pathway and reduces prostaglandin E2 production from arachidonic acid.
4) *Activation Of Immune System:* Alprogen released after the oral intake of aloe vera, inhibit calcium influx into mast cells, thereby inhibiting the antigen-antibody-mediated release from mast cells. Acemannan in the gel stimulates the synthesis and release of interleukin-1 (IL-1) and tumor necrosis factor, which initiated an immune attack that resulted in necrosis and regression of the cancerous cells.
5) *Laxatives:* Anthraquinones present in latex part is the potential laxative. It increases intestinal water content, stimulates mucus secretion and increases intestinal peristalsis.[17]
6) *Antiviral And Antitumor Activity:* These actions may be due to indirect or direct effects. Indirect effect is due to stimulation of the immune system and direct effect is due to anthraquinones. The anthraquinone aloin inactivates various enveloped viruses such as herpes simplex, varicella zoster and influenza. In recent studies, a polysaccharide fraction has shown to inhibit the binding of benzopyrene to primary rat hepatocytes, thereby preventing the formation of potentially cancer-initiating

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benzopyrene-DNA adducts. An induction of glutathione S-transferase and an inhibition of the tumor-promoting effects of phorbol myristic acetate has also been reported which suggest a possible benefit of using aloe gel in cancer chemoprevention.

7) *Moisturizing and Anti-Aging Effect:* Mucopolysaccharides help in binding moisture into the skin. Aloe stimulates fibroblast which produces the collagen and elastin fibers making the skin more elastic and less wrinkled. It also has cohesive effects on the superficial flaking epidermal cells by sticking them together, which softens the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects has also been studied in treatment of dry skin associated with occupational exposure where aloe vera gel gloves improved the skin integrity, decreases appearance of fine wrinkle and decreases erythema.[21] It also has anti-acne effect.
8) *Antiseptic Effect:* Aloe vera gel works as an antiseptic by the release of Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulfur which are involved in the inhibitory action on fungi, bacteria and viruses.

## II. CLINICAL USES

Aloe provides many interesting clinical uses and is essential to determine its effectiveness in all the following diseases.

1) *Scientific Based Evidence:* These uses have been tested in humans or animals. Safety and effectiveness have not always been proven.
2) *Traditional /Theory Based:* The below uses are based on tradition or scientific theories. They often have not been thoroughly tested in humans, and safety and effectiveness have not always been proven.

### *A. After -Effect*

In some cases, it may cause redness, burning, stinging and leading to generalized dermatitis in sensitive individuals rarely. This sensation of Allergic reactions is mostly due to anthraquinones, such as aloin and barbaloin.

Oral treatment leads to abdominal cramps, diarrhea, red urine, hepatitis, dependency or worsening of constipation. Prolonged use of oral source of aloe even after the symptoms has increased risk of colorectal cancer. Laxative effect may cause electrolyte imbalances due to the low potassium levels.

It is important to note that Oral aloe is not recommended during pregnancy due to the theoretical stimulation of uterine contractions, and in breastfeeding mothers, it may sometime causes gastrointestinal distress in the nursing infant.

Application on the skin may increase the absorption of steroid and reduces the effectiveness and may increases the adverse effects of potassium lowering drugs such as digoxin and digitoxin. There is a possibility of blood sugar lowering levels interacting with oral hypoglycemic drugs and insulin. There are a few case study in which the improvement of extreme touchiness response and contact dermatitis in light connected aloe gel.

However, Aloe vera still has a wide range of spectrum consisting of several clinical uses, properties. Some of them turn to be myths and some of them work as a magic in treatment. In future, controlled studies will be an evidence in order to prove the effectiveness of Aloe vera under various conditions.

## III. CULTIVATION PROCESS

1) *Land Preparation:* Roots of Aloe vera do not penetrate below 20-30 cm, depending upon soil type and agro-climatic conditions, 1-2 ploughing followed by leveling are recommended. The field shall be divided into suitable plot sizes (10-15mx3m) for easiness. The ground is to be carefully prepared to keep free from weeds and the soil should be slightly acidic. The plants are set spaced out by 24 inches in rows. At that rate, about 9000 plants are set per acre. According to the farmers, 8-12 inches aloe pulp would take about 18 months to get fully mature



Fig.2 Aloe cultivation

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*A. Specifications*

*1) Climate*

*a)* Warm tropical areas and cannot survive at freezing temperatures.
*b)* Good in warm and humid climate.
*c)* Plant flourishes well on dry sandy soils
*d)* Lower annual rainfall of 50 to 300 mm is preferred.
*e)* Needs protection against Frost.

*2) Soil*

*a)* Grown in marginal to sub marginal soils having low fertility.
*b)* Plants have tendency to tolerate high soil PH
*c)* Growth is faster under medium fertile heavier soils such as black cotton soils of Central India.
*d)* Can be cultivated on any soil for 'dry land management';
*e)* Sandy loamy soil is best suited for it.

*3) Planting Time*

*a)* Suckers should be planted in July- August for better field survival.
*b)* Planting can be done round the year except in Winter months (November- February)

*4) Spacing*

*a)* Spacing of 2'X2' is followed which accommodates about 9000 plants per acre.

*5) Planting Material*

*1)* Nearly 3-4 months old suckers, having 4-5 leaves and about 20-25 cm in length be used as planting material.



Fig.3 Aloe Planting

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## IV. ALOE VERA PROCESSING

Selection of Full Matured Aloe vera Leaves

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Aloe vera leaf Pre Washing & Cleaning Process

↓

Aloe vera Leaf Cutting Process

↓

Washing Process

↓

Aloe vera Leaf Pulp Separation Process

↓

Homegenization of Aloe vera Pulp

↓

Sterilization and Storage Process

↓

Stirring Process

↓

Finished Product (Before packing)

↓

Bottle Cleaning & Filling Process

↓

Labelling Process

↓

Packing

Processing consists of three basic steps viz., preliminary, intermediate and final processing. Preliminary processing begins with sanitizing the outer surface of the freshly harvested leaf and proceeds through removal of the outer rind which ends the intermediate processing followed by expression of the gel fillet either manually or by machine to produce the gel completes the final stage of processing. Ideally, leaves should be harvested and washed within two to four hours. However, this requires small batches (less than a ton) and quick transport from the field to either the field processing station or the integrated processing plant. For processing of "Aloe", the juice should be allowed to drain from the cut leaves into vessels and then concentrated by evaporation, spontaneously or by frequent boiling. The fresh juice of aloe vera can be colorless or yellow but changes to dark brown due to evaporation/boiling.

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Fig.4 Aloe processing unit

*A. Drying*

Sun dried or concentrated "Aloe" juice over a fire gives an amorphous, opaque, waxy extract called 'hepatic' or 'livery' aloe. When the juice is concentrated rapidly over a strong fire, the product obtained on cooling is amorphous and semitransparent and is called 'glossy' or 'vitreous' aloe.

*B. Aloe Gel*

*1)* Besides the dried juice, the gel is also a very important product.
*2)* The mucilaginous pulp from the leaf, which is mainly polysaccharides in nature, is used in cosmetic industries and in treatment of many human diseases.
*3)* The leaves left over after the removal of their exudates can be cut open and mucilage is scraped out with a blunt edged knife for isolation of gel.
*4)* Extracted mucilage is stirred vigorously in a blender to make it homogeneous mixture (solution).
*5)* This mixture is strained through a muslin cloth and filtered. The gel is precipitated from the extract and is isolated by centrifugation.
*6)* This gel is re-dissolved in slightly warm water and transferred to a tube of known weight and dried at a high temperature (<100 °C)

*C. Composition Of Aloe Gel*

*1)* Aloevera Pulp/Fillet is the leaf pulp or mucilage, a thin clear jelly-like substance obtained from the parenchymal tissue that makes up the inner portion of the leaves.
*2)* The gel contains carbohydrate polymers, such as glucomannans or pectic acid, plus various other organic and inorganic compounds.
*3)* We separate pulp from freshly harvested mature aloe Vera plants, under strict hygienic conditions, this pulp can be used to make aloe Vera juice and other products.





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Fig.5 Aloe Extraction

*D. Washing In Demineralised Water*

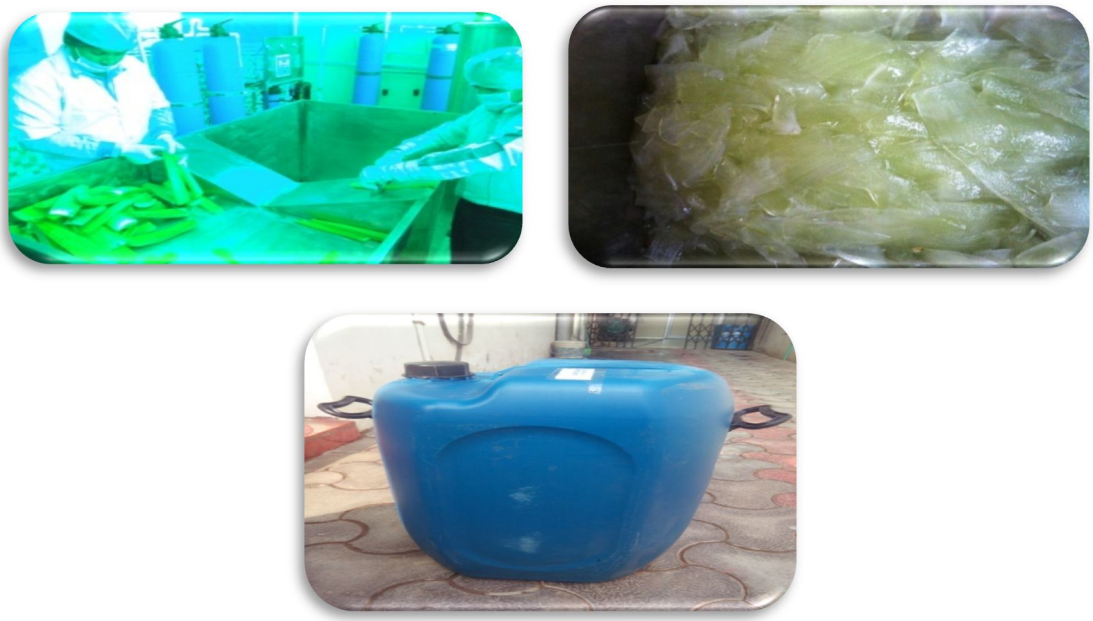


Fig.6 Industrial packing

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## V. INDUSTRIAL APPLICATIONS

The industrial applications of Aloe vera are well known. This is the reason why Aloe vera should be mass propagated and processed round the year. Basically, Aloe Vera has been used for topical treatment of wounds, minor burns, and skin irritations. Aloe Vera is used in skin-care products externally and to treat constipation, coughs sinus, wounds, ulcers, diabetes, cancer, headaches, arthritis, immune-system deficiencies, anti- inflammatory, minor vaginal irritations, to treat dandruff and sticky hair. In India, Aloe vera is believed to help in sustaining youth, due to its positive effects on the skin. Aloe Vera can be used in the form of gel externally, juice and can be taken internally.

### *A. Agriculture*

The unique blending nature in the Aloe vera as Biofertilizer consists of 80% Organic Aloe Vera providing the beneficial Natural Phytochemicals and Polysaccerides, acemannan that are important for the superior plant intelligence. Aloe Vera can suppress negative plant pathogens and as a raw material can be used in combination with the Aloe Biofertilizer as a foliar spray that acts as a plant growth promoter and also has been shown to reduce Bird, Flying Fox (bat) and Insect (pest) attacks on crops. Based on the historical studies, no Aloe Vera Plants are ever bothered by any type of pest because of its natural Aloin content. This is a natural environmental friendly way to deter the pest population.

### *B. Aloe Products*



Fig.7 Processed Aloe – As an industrial product

## VI. CONCLUSION

From the reviews and case studies, Aloe is undoubtedly a Miracle plant which acts as an agent in the improvement of health. Its unique properties creating awareness among people. Several studies prove the pharmacological attributes which sustained to be a medicine in Modern Sciences. It was a promising herb and Farmers friendly crop as it easy to cultivate; hardy nature of leaves show resistance against many insect pest and continues to be promising in the area of clinical studies and provide us the never ending gift in the field of medicine, cosmetics and various other fields.

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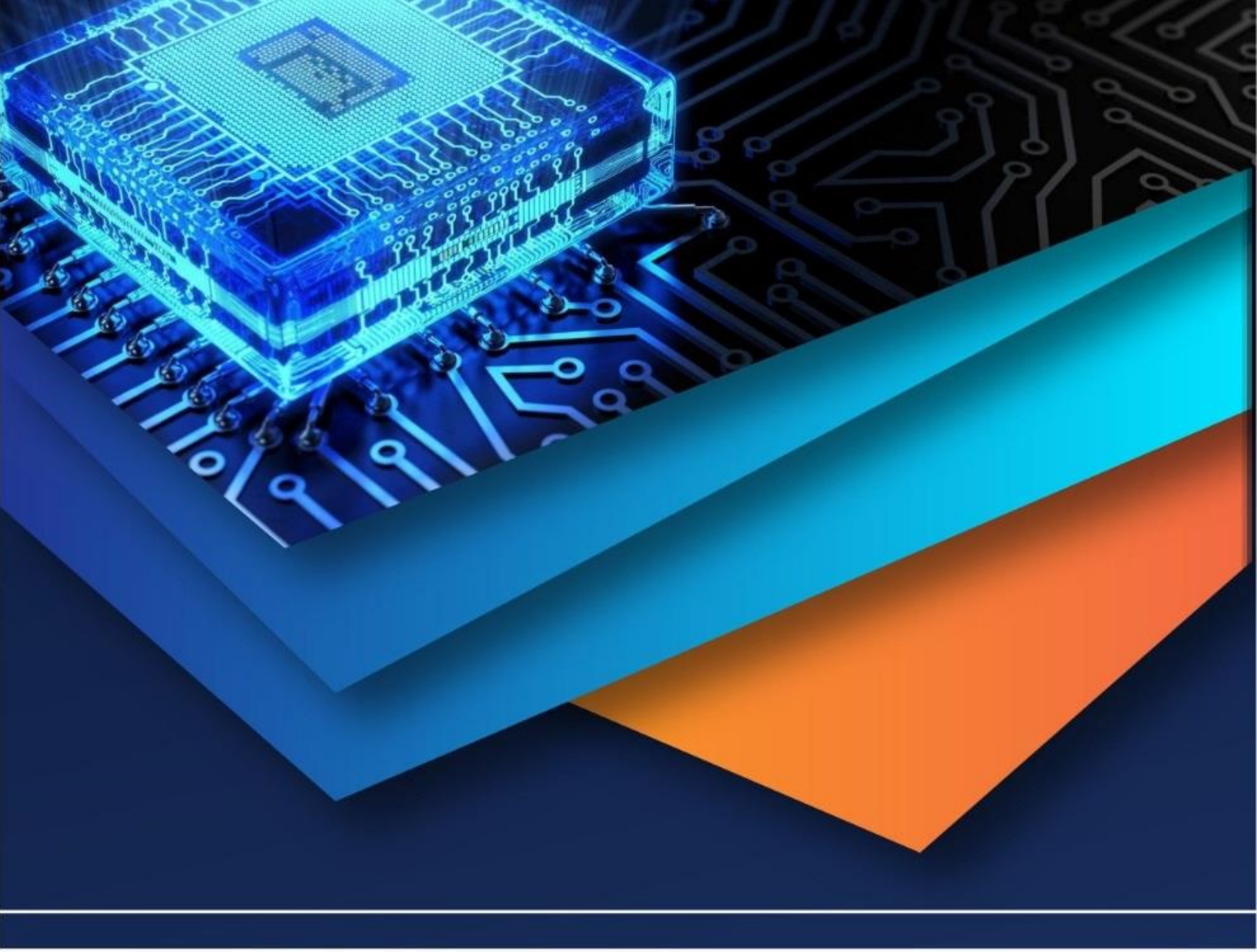
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