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A Review: Preparation and Evaluation of Herbal Foot Cream by using Tridax Procumbens Extract

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Abstract: ***The growing demand for natural and sustainable skincare solutions has led to increased interest in herbal formulations for foot care. Foot creams enriched with plant extracts offer therapeutic benefits while minimizing the side effects associated with synthetic ingredients. Tridax procumbens, a medicinal plant with well-documented antimicrobial, anti-inflammatory, and wound-healing properties, presents a promising candidate for developing an effective herbal foot cream. This review explores the preparation methods, formulation strategies, and pharmacological evaluation of Tridax procumbens-based foot creams. The study highlights the plant's bioactive compounds, including flavonoids, alkaloids, and tannins, which contribute to its efficacy in treating dry, cracked feet and preventing infections. Additionally, the article discusses the evolution of herbal foot creams, focusing on advancements such as nanoemulsion-based delivery systems and synergistic combinations with other botanicals like aloe vera and neem. Stability testing, safety assessments, and comparative studies with conventional foot creams are also examined to validate the therapeutic potential of Tridax procumbens in dermatological applications. The findings suggest that herbal foot creams incorporating Tridax procumbens extract can serve as a natural, cost-effective, and sustainable alternative for foot care, with prospects for further optimization and commercialization.***

Keywords: Herbal foot cream, Tridax procumbens, Natural skincare, Anti-microbial activity, Wound healing, Phytochemicals, Emollient formulation, Plant-based cosmetics, Stability testing, Dermatological applications

I. INTRODUCTION

The skin on the feet is subjected to constant mechanical stress, environmental exposure, and microbial attacks, making it prone to dryness, cracks, calluses, and infections. Unlike other parts of the body, the feet have fewer sebaceous glands, leading to reduced natural moisture retention and increased susceptibility to damage. Conventional foot care products often rely on synthetic moisturizers, antimicrobial agents, and chemical exfoliants, which, while effective, may cause adverse effects such as skin irritation, allergic reactions, or microbial resistance with prolonged use. This has spurred a shift toward natural and herbal alternatives that offer therapeutic benefits with minimal side effects.

Among the various medicinal plants explored for dermatological applications, Tridax procumbens (commonly known as coat buttons or "Ghamra") has gained attention due to its well-documented pharmacological properties. Traditionally used in Ayurveda and folk medicine, Tridax procumbens exhibits potent antimicrobial, anti-inflammatory, and wound-healing activities, attributed to its rich phytochemical composition. Flavonoids, alkaloids, tannins, and terpenoids present in the plant contribute to its ability to promote skin repair, combat infections, and enhance tissue regeneration. These properties make it an ideal candidate for incorporation into herbal foot creams aimed at addressing common foot ailments such as cracked heels, fungal infections, and excessive dryness.The development of herbal foot creams using Tridax procumbens extract aligns with the growing consumer preference for sustainable, plant-based skincare solutions. Recent advancements in formulation technology, such as nanoemulsions and natural preservative systems, have further improved the stability and efficacy of such products.

Additionally, combining Tridax procumbens with complementary botanicals like aloe vera, coconut oil, or tea tree oil can enhance moisturization, antimicrobial action, and overall skin barrier function. This review comprehensively examines the preparation methods, therapeutic benefits, and future prospects of Tridax procumbens-based foot creams, providing insights into their potential as a safer and more holistic alternative to conventional foot care products.[1-5]

II. PHYTOCHEMICAL COMPOSITION AND THERAPEUTIC PROPERTIES OF TRIDAXPROCUMBENS

Tridax procumbens, commonly known as the "coat buttons" plant, is a rich source of bioactive compounds that contribute to its diverse medicinal properties.

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Phytochemical analyses have revealed the presence of flavonoids, alkaloids, tannins, saponins, terpenoids, and phenolic compounds, which collectively enhance its therapeutic potential. Flavonoids, such as quercetin and luteolin, exhibit strong antioxidant and anti-inflammatory effects, helping to protect the skin from oxidative stress and reduce irritation. Alkaloids contribute to the plant's analgesic and antimicrobial properties, making it effective against bacterial and fungal infections that commonly affect the feet. Tannins, known for their astringent qualities, promote wound healing by contracting skin tissues and reducing excess exudation. Saponins, with their natural foaming and cleansing abilities, enhance the penetration of active ingredients while providing mild antimicrobial benefits. Additionally, terpenoids play a crucial role in combating inflammation and fungal growth, further supporting the plant's use in dermatological formulations.

The therapeutic properties of Tridax procumbens extend beyond its chemical constituents. Studies have demonstrated its efficacy in accelerating wound healing, reducing skin inflammation, and preventing microbial infections—key attributes for an effective foot cream. Its antimicrobial activity is particularly effective against Staphylococcus aureus and Candida albicans, common pathogens responsible for foot odor and infections. Furthermore, its moisturizing and emollient properties help alleviate dryness, cracks, and calluses, making it an ideal natural ingredient for foot care. Given its broad-spectrum benefits, Tridax procumbens extract serves as a multifunctional agent in herbal foot creams, offering both preventive and reparative skincare solutions. Future research could further explore its synergistic effects with other medicinal plants to enhance its dermatological applications.[6-10]

III. PREPARATION OF HERBAL FOOT CREAM WITH TRIDAX PROCUMBENS EXTRACT

The preparation of an herbal foot cream using Tridax procumbens extract involves a systematic process that ensures the retention of its bioactive compounds while achieving a stable, effective, and skin-friendly formulation. The first step involves the collection and preparation of Tridax procumbens leaves, which are thoroughly washed, shade-dried, and ground into a fine powder. This powder is then subjected to solvent extraction, typically using ethanol or water, to obtain a concentrated extract rich in flavonoids, alkaloids, tannins, and other therapeutic compounds. The choice of solvent depends on the desired phytochemical profile, with ethanol being more effective for extracting non-polar compounds and water for polar constituents. The extract is then filtered, concentrated under reduced pressure, and stored in a cool, dark place to preserve its potency.

The formulation of the foot cream requires a balanced combination of emollients, emulsifiers, and stabilizing agents to ensure optimal texture, spreadability, and absorption. A typical oil phase consists of natural ingredients such as beeswax, coconut oil, and shea butter, which provide moisturizing and barrier-repairing properties. These ingredients are gently melted together at a controlled temperature (around 60–70°C) to avoid degradation of their beneficial components. Simultaneously, the aqueous phase is prepared by mixing distilled water with emulsifying agents like cetyl alcohol or stearic acid, which help in forming a stable emulsion. Once both phases reach a similar temperature (approximately 65°C), the aqueous phase is slowly incorporated into the oil phase under continuous stirring to ensure uniform mixing and prevent phase separation.

After achieving a homogenous mixture, the Tridax procumbens extract is added at a concentration of 5–10%, depending on the desired therapeutic strength. Additional ingredients such as natural preservatives (e.g., vitamin E or tea tree oil) and essential oils (e.g., lavender or peppermint for fragrance and antimicrobial effects) may also be introduced at this stage. The mixture is then allowed to cool gradually while stirring continuously to prevent graininess and ensure a smooth, creamy consistency. Once the temperature drops below 40°C, the cream is transferred to sterile containers and stored at room temperature for further evaluation.

Quality control tests, including pH assessment, viscosity measurement, microbial testing, and stability studies under different storage conditions, are conducted to ensure the safety and efficacy of the final product. The resulting herbal foot cream is expected to exhibit excellent moisturizing properties, antimicrobial activity against common foot pathogens, and enhanced wound-healing capabilities, making it a viable natural alternative to conventional foot care products. Future refinements may include encapsulation techniques for sustained release or combination with other medicinal herbs to enhance therapeutic outcomes.[11-15]

IV. EXTRACTION PROCESS OF TRIDAX PROCUMBENS FOR HERBAL FOOT CREAM FORMULATION

The extraction of bioactive compounds from Tridax procumbens is a crucial step in ensuring the efficacy of the herbal foot cream. The process begins with the collection of fresh, healthy leaves, which are thoroughly washed to remove dirt and impurities. The cleaned leaves are then shade-dried at room temperature to preserve their phytochemical constituents, as excessive heat may degrade thermolabile compounds. Once completely dried, the leaves are finely powdered using a mechanical grinder to increase the surface area for efficient solvent extraction.

For optimal extraction, solvents such as ethanol, methanol, or water are commonly used due to their ability to dissolve a wide range of bioactive molecules.

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Ethanol is particularly preferred for its effectiveness in extracting flavonoids, alkaloids, and terpenoids while being relatively safe for topical applications. The powdered leaves are subjected to maceration or Soxhlet extraction, where they are soaked in the chosen solvent for a specified period (typically 48–72 hours for maceration or 6–8 hours in a Soxhlet apparatus). The mixture is then filtered to separate the crude extract from the plant residue.

To concentrate the extract, the solvent is evaporated using a rotary evaporator under reduced pressure, leaving behind a viscous, dark-green to brownish residue. This concentrated extract is further subjected to phytochemical screening to identify and quantify key active compounds such as flavonoids, tannins, saponins, and alkaloids. Standardization of the extract ensures consistent potency in the final formulation. The resulting Tridax procumbens extract is then incorporated into the foot cream base at an optimized concentration (typically 5–10%) to maximize therapeutic benefits while maintaining stability and safety. Advanced techniques like ultrasound-assisted extraction or supercritical fluid extraction may also be employed to enhance yield and purity for commercial-scale production.

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V. FORMULATION INGREDIENTS

The herbal foot cream formulated with Tridax procumbens extract consists of a carefully selected blend of natural and semi-synthetic ingredients to ensure optimal texture, stability, and therapeutic efficacy. The base materials form the foundation of the cream, providing emollient and occlusive properties to lock in moisture and prevent transepidermal water loss. Commonly used natural emollients include beeswax, which imparts a thick, protective barrier, along with shea butter and coconut oil, both renowned for their deep moisturizing and skin-softening effects. These lipids help repair the skin barrier, making them particularly beneficial for dry, cracked heels.

To achieve a stable emulsion, emulsifying agents such as cetyl alcohol and stearic acid are incorporated. These compounds facilitate the blending of oil and water phases, ensuring a uniform consistency while enhancing the cream's spreadability and absorption. Additionally, natural humectants like glycerin or aloe vera gel may be included to attract and retain moisture in the skin, further improving hydration.

Since microbial contamination is a concern in herbal formulations, natural preservatives such as vitamin E (tocopherol) or tea tree oil are preferred over synthetic parabens due to their antioxidant and antimicrobial properties. The active ingredient, Tridax procumbens extract, is typically incorporated at a concentration of 5–10%, ensuring sufficient bioactive compounds (flavonoids, alkaloids, and tannins) are present to exert antimicrobial, anti-inflammatory, and wound-healing effects.

For enhanced therapeutic benefits, complementary botanical extracts like neem oil (antifungal), turmeric extract (anti-inflammatory), or lavender essential oil (soothing and fragrant) may also be added. The final formulation is designed to be non-greasy, quick-absorbing, and pH-balanced (5.5–6.5) to maintain skin compatibility while delivering measurable dermatological benefits.[21-25]

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VI. EVALUATION OF HERBAL FOOT CREAM

The evaluation of herbal foot cream formulated with Tridax procumbens extract involves a series of tests to ensure its safety, efficacy, and stability for dermatological use. Physical evaluation is the first step, where parameters such as color, odor, texture, and spreadability are assessed to determine consumer acceptability. A smooth, homogeneous consistency with a pleasant herbal aroma is desirable, while the cream should spread easily without leaving a greasy residue.

Next, pH testing is conducted to confirm compatibility with the skin's natural pH (5.5–6.5). A pH outside this range may cause irritation or disrupt the skin barrier. The viscosity and rheological properties are also examined to ensure proper consistency for easy application and adherence to the skin.

Microbiological testing is crucial to validate the antimicrobial efficacy of the foot cream, particularly against common foot pathogens like Staphylococcus aureus, Escherichia coli, and Candida albicans. Since Tridax procumbens possesses natural antimicrobial compounds, the cream's ability to inhibit microbial growth is compared with standard antifungal and antibacterial agents.

Stability studies are performed under varying temperature and humidity conditions (e.g., 25°C, 40°C, and freeze-thaw cycles) to assess shelf life. Changes in texture, phase separation, and degradation of active compounds are monitored over weeks or months. Additionally, skin irritation and sensitization tests (such as the patch test on human volunteers or animal models) ensure that the formulation is non-irritating and hypoallergenic.

Finally, moisturizing efficacy is evaluated using techniques like corneometry (to measure skin hydration) and transepidermal water loss (TEWL) assessments. Comparative studies with commercial foot creams help establish the herbal formulation's superiority in terms of hydration, healing cracked skin, and reducing microbial load. These comprehensive evaluations ensure that the Tridax procumbens-based foot cream is effective, stable, and safe for long-term use.[26-30]

VII. EVOLUTION AND ADVANCEMENTS IN HERBAL FOOT CREAMS

The evolution of herbal foot creams has been driven by increasing consumer demand for natural, sustainable, and side-effect-free skincare solutions. Initially, traditional foot care relied on simple formulations using plant-based oils and waxes for moisturization. However, with advancements in phytopharmaceutical research and cosmetic science, modern herbal foot creams now incorporate scientifically validated plant extracts, such as Tridax procumbens, for enhanced therapeutic effects.

One significant development is the shift from crude herbal pastes to refined emulsions, where bioactive compounds are efficiently extracted and stabilized in cream bases using natural emulsifiers like beeswax and lecithin. Additionally, the integration of nanotechnology, particularly nanoemulsions and liposomal encapsulation, has improved the penetration and bioavailability of herbal actives, ensuring deeper skin hydration and prolonged antimicrobial action.

Another major advancement is the synergistic blending of multiple herbal extracts to enhance efficacy. For instance, combining Tridax procumbens with Aloe vera (for soothing inflammation), Neem (for antifungal properties), and Turmeric (for antibacterial benefits) creates a multifunctional foot cream that addresses dryness, infections, and cracks more effectively than single-herb formulations. Furthermore, modern preservation techniques using natural antimicrobial agents like tea tree oil and grapefruit seed extract have extended shelf life without synthetic parabens, aligning with clean beauty trends.

Sustainability has also influenced the evolution of herbal foot creams, with brands adopting eco-friendly packaging, biodegradable ingredients, and cold-process manufacturing to reduce carbon footprints. Clinical validation through dermatological testing and in-vivo studies has further strengthened consumer trust, proving that herbal foot creams can rival synthetic alternatives in efficacy.

Future innovations may include smart delivery systems, probiotic-infused formulations for microbiome balance, and AI-driven customization for personalized foot care. Overall, the progression from rudimentary herbal applications to scientifically optimized, eco-conscious formulations mark a significant leap in natural foot care, positioning herbal foot creams as a dominant choice in the global skincare market.[31-35]

VIII. FUTURE PERSPECTIVES

The development of Tridax procumbens-based herbal foot creams holds significant potential, but further research and innovation are needed to enhance their efficacy, safety, and commercial viability. One key area for future exploration is clinical trials to validate the therapeutic claims of these formulations. While preliminary studies demonstrate antimicrobial and wound-healing properties, controlled human trials will provide robust evidence of their effectiveness in treating conditions like cracked heels, fungal infections, and dermatitis.

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Another promising direction is the standardization of extraction techniques to ensure consistent bioactive compound concentrations. Advanced methods such as supercritical fluid extraction (SFE) or ultrasound-assisted extraction (UAE) could improve yield and purity while maintaining the plant's therapeutic properties. Additionally, quality control protocols must be established to monitor batch-to-batch variations in herbal formulations.Innovations in drug delivery systems, such as nanoemulsions, liposomes, or microencapsulation, could enhance the penetration and sustained release of active compounds in Tridax procumbens extracts. These technologies may improve moisturization and antimicrobial effects while reducing the need for frequent application.Furthermore, synergistic formulations combining Tridax procumbens with other medicinal plants (e.g., Aloe vera, Azadirachta indica, or Curcuma longa) could amplify therapeutic benefits. Research into such combinations may lead to multifunctional foot creams that address dryness, infection, and inflammation simultaneously.

Finally, sustainability and eco-friendly packaging should be prioritized to align with global trends in green cosmetics. Biodegradable containers and natural preservatives can enhance the environmental appeal of herbal foot creams, making them more attractive to eco-conscious consumers.By addressing these aspects, Tridax procumbens-based foot creams can evolve from traditional remedies to scientifically validated, commercially successful dermatological products with global market potential.[36-40]

IX. CONCLUSION

The increasing consumer preference for natural and sustainable skincare products has driven significant research into herbal alternatives for foot care. Among various medicinal plants, Tridax procumbens stands out due to its well-documented pharmacological properties, including antimicrobial, anti-inflammatory, and wound-healing effects. The preparation of herbal foot creams using Tridax procumbens extract leverages its bioactive compounds—such as flavonoids, alkaloids, and tannins—to provide a safe and effective solution for common foot ailments like dryness, cracks, and infections. The formulation process, which integrates natural emollients like shea butter and coconut oil, ensures optimal moisturization while avoiding the harsh chemicals found in conventional foot creams.

Evaluation studies have demonstrated that Tridax procumbens-based foot creams exhibit excellent spreadability, skin-friendly pH, and long-term stability, making them suitable for regular use. Furthermore, microbiological tests confirm their efficacy against common foot pathogens, reinforcing their role in preventing infections. The evolution of herbal foot creams has seen advancements such as nanoemulsion technology for enhanced bioactive delivery and synergistic combinations with other medicinal plants like aloe vera and neem, further improving therapeutic outcomes.

Given the rising demand for eco-friendly and non-toxic skincare, Tridax procumbens-enriched foot creams represent a promising alternative to synthetic products. Future research should focus on clinical trials to validate their efficacy, optimize extraction techniques for higher bioactive yield, and explore innovative delivery systems for better skin penetration. With further refinement and commercialization, these herbal formulations could revolutionize foot care by offering a natural, cost-effective, and sustainable solution for maintaining healthy skin.This shift toward plant-based dermatology not only aligns with global sustainability goals but also opens new avenues for integrating traditional herbal knowledge into modern skincare science.

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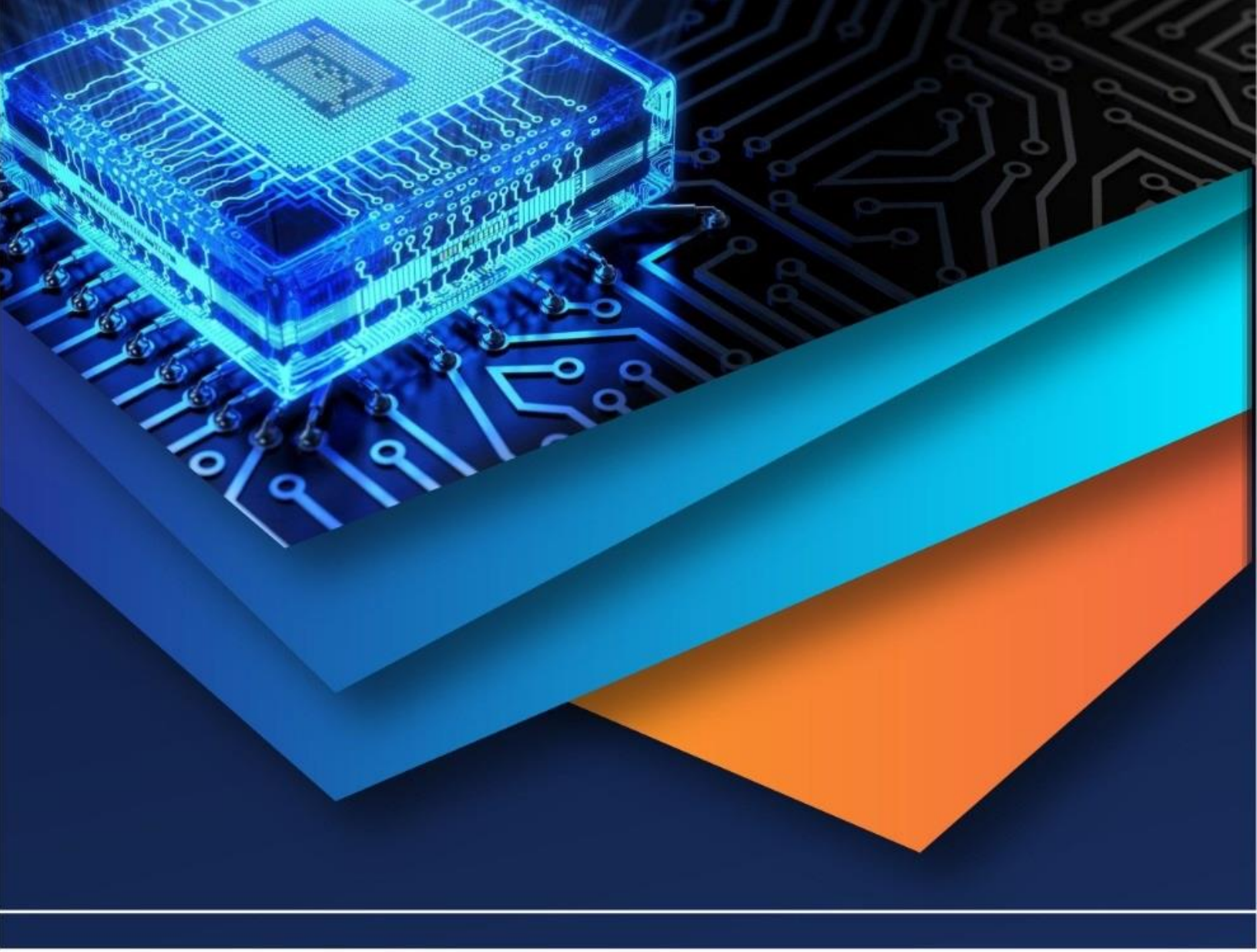
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