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Traditional Galactagogue Herbs of Tamilnadu

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Abstract: ***Breastfeeding helps the newborn or infant to get optimal nutrients for growth and immunity. Human breast milk contains oligosaccharides, proteins, milk exosomes, growth factors, fatty acids, and microorganisms where the concentrations greatly vary based on maternal diet. But poor production of breast milk (hypogalactias) is the primary reason to give up lactation in most women. Galactagogues are synthetic or plant-derived substances that induce milk production in humans. Even though the action mechanism of herbal galactagogues is not very clear, due to the side effects of pharmaceutical galactagogues, the use of the herbal galactagogues increased in the last decade in most the countries. This article is to summarize the studies and their outcomes of the herbal galactagogues (cumin, fennel, fenugreek, ginger, and garlic) mainly used in southern regions of India specifically in Tamilnadu.***

Keywords: Hypogalactias, galactagogues, herbs, pharmaceutical, human breast milk

I. INTRODUCTION

Human Breast Milk (HBM) is primary source of nutrients for infants. As per the World Health Organization's recommendation, the American Academy of Paediatrics (AAP), Hepatology and Nutrition (ESPGHAN), and the European Society for Paediatric Gastroenterology guidelines, it is necessary to breastfeed infants for the first six months exclusively. Later for two more years, they could receive complementary nutritional substances in addition [1,2]. Breast-feeding largely decreases mortality and morbidity in infants. HBM contains not only the nutrients for the growth and development of an infant. It also regulates the health of the mother. It is explained by the “mother-breast milk-infant” triad [3].

Figure 1: Mother-breast milk-infant triad

It also contains immunological compounds which are anti-infectious and unique microbiome which helps in the development of gut colonization of infants [4]. The difference in the metabolome of HBM between the mothers of normal and prenatal babies helps to understand the biological function of HBM in an infant’s health [5]. Infants born from January 2008 to December 2009 were followed up for 10 years in Korea. Low risk of fragile X syndrome and autism is observed in infants fed with HMB for the first 6 months exclusively [6]. It also helps in the development of the IQ of the child. Blood pressure, serum cholesterol level, and body mass are maintained during adulthood. Non-communicable diseases like diabetes, cardiovascular disease, and obesity occurrence also reduced in later life of breastfed infants. Infections in-ear, pneumonia, acute bronchiolitis, and asthma are also reduced in breastfed infants [7]. HBM is the richest source of all nutrients required for the growth of infants. HBM majorly contains milk fat globule membrane, proteins, oligosaccharides, growth factors, milk exosomes, or microorganisms [8]. The composition of nutrients in HBM is majorly influenced by the mother's dietary intake during lactation. Lactose is an important energy source. Usually, maternal diet is not influencing the concentration of lactose [9]. On the other hand, Human Milk Oligosaccharides (HMOs) concentration depends on the enzyme activity which decides the fucosylation of HMOs [10]. Moreover, the other factors like genetic, and environmental are not clear yet. HMOs influence the gut microbiota development and neurological development of infants mainly which is not completely studied [11, 12]. HBM contains lots of proteins which helps in the weight gain of infants.

The well-known proteins are alpha-lactalbumin, lactoferrin, osteopontin, total casein, beta-casein, alphas-1 casein, and kappa-casein. It inferred that the concentration of these proteins depends on the maternal demographic and delivery facts [13, 14]. Lutein is a dietary carotenoid present in HBM and deposited in selective organs like the eyes and brain of infants. The bioavailability of lutein is depending on the number of fruits and vegetables consumed by the mother [15]. Polyamine in HBM is the first exogenous polyamine for the newborn. Putrescine, spermidine, and spermine are the three major polyamines present in HBM, where the concentrations of the same depend on different factors like the number of times of breastfeeding and duration of feeding [16]. Osteopontin (OPN) is a glycosylated phosphoprotein found in HBM which has a significant relationship with the growth and immune system function of infants. Also, the concentration of osteopontin depends on different maternal factors [17]. Sphingomyelins are polar sphingolipids present in HBM in high concentrations which neonatal neurological maturation, and in the intestinal development of newborns [18]. Linoleic acid (LA) and oleic acid (OA) are the predominant fatty acids in the HBM. Oleic-palmitic -linoleic (OPL) is the triacylglycerols mostly present followed by Oleic-Palmitic-Oleic (OPO). Fatty acid and triacylglycerol content are highly associated with maternal dietary intake [19]. The fatty acid composition of HBM depends on other factors like gestational age, and lactation stage [20]. The lipid storage of the mother is the main source of omega-6 [21]. Docosahexaenoic acid (DHA) and arachidonic (ARA) acid are the important omega-3-polyunsaturated in the HBM. In recent studies, lower levels of DHA were observed in the HBM of mothers with depression which affects the neurodevelopment of infants [22]. In a study, the DHA and EPA composition of human milk has shown the influence of diet, depression, and stress in omega-3 PUFAs in milk. It is also identified that the HBM contains mRNAs, miRNAs, and lncRNAs where most of the molecules are encapsulated by the milk-derived exosomes. Among them, exosomal circRNA modulates the VEGF signaling pathway by binding miRNAs and helps in the proliferation, repair, and migration of small intestine epithelial cells [23]. The reports are showing an increase in breastfeeding around the world. But still, the percentage is not reached the recommended level by WHO. One of the important reasons for termination of breastfeeding before six months is insufficient production of breast milk. Moreover, there was a rise in twin birth globally over the years. 35% of mothers of multiples reported that the interruption in breastfeeding before 6 months is due to insufficient milk production in Italy [24]. Non-infectious galactic and hypogalactias are the major issues in breastfeeding women. Sufficient mammary gland tissues, normal hormone levels, and regular effective removal of milk are the three major aspects in establishing adequate breastmilk [25]. Currently, hypogalactias are treated with galactagogues. Synthetic or plant-derived molecules which can induce, maintain and increase milk production are called galactagogues. Hormones like prolactin, leptin, estrogen, cortisol, somatotropin, progesterone, insulin, oxytocin, thyrotropin-releasing hormones (TRH), and medroxyprogesterone are also among the most important factors [26]. Usually, the galactagogues used to treat can regulate hormone production so that the milk secretion in mammary glands is increased. Domperidone [27] and metoclopramide [28] are the two important galactagogues used currently for which the efficacy and safety of the drugs were well studied. Other galactagogues including sulpiride, growth hormone, human recombinant prolactin, thyrotropin-releasing hormone, and metformin are also used in the treatment of lactation insufficiency [29]. But still, the usage of these galactagogues remains debatable. Serious cardiac side effects are observed in breastfeeding mother who takes domperidone in a concentration of more than 20 mg per day [27]. Same time depression, severe neuropsychiatric and cardiac side effects are observed in the usage of metoclopramide [30]. Moreover, the traceable amount of the drugs is also seen in breast milk which also affects the infant's development [31]. Due to the side effects of using pharmaceutical galactagogues, herbal galactagogues usage is currently increased in most countries including the USA, UK, Australia [31], Canada, India, etc in the last decade. The objective is to review the majorly used herbal galactagogues by breastfeeding women of Tamilnadu.

II. METHODOLOGY

This manuscript is prepared by screening articles from Scopus, web of science, Google Scholar, Research Gate, NCBI, etc. The key words/phrases used for screening the articles, are “herbal galactagogue”, “Indian herbs”, “galactagogue”. Research articles form last five years were consolidated. More over the other articles also concentrated equally.

III.RESULTS AND DISCUSSION

A. Cumin [32]

Cumin (*Cuminum cyminum*) seed is used as a galactagogue mostly in India and Turkey [33, 34]. Cumin seeds extract has cumin aldehyde and other aldehydes. It also contains flavonoids and terpenes. But still, the mode of action of these active compounds to increase lactation is not yet reported clearly. But a study on rats shows that mammary gland growth was stimulated due to cumin seeds consumption. When cumin was used in combinations with herbs like fennel, anise, cumin, black seed, and parsley (Shirafza Drop), no significant weight gain was reported in infants between 0 to 6 months of age.

When 30 grams of Lactancia, Corona Remedies Pvt. Ltd. (Combination of asparagus, cumin, licorice, and spinach) was taken twice a day, with amino acids, vitamins, minerals, and DHA, lactation, and weight of the infant was increased significantly [32]. There is no valid clinical data to support the safety and efficacy of the cumin seeds towards the mother and infants. Cumin occasionally develops phototoxic skin reactions after contact with oil. Otherwise, no further side-effects were reported so far. Those who have an allergy to cumin seeds can avoid the usage [35].

B. Fennel [36]

Studies showed that the fennel (*Foeniculum vulgare*) seeds consumption has increased the volume of milk production, fat content in milk, and body mass increase of infants [37]. Volatile oil composed of anethole (phytoestrogen) (Fig 2), fenchone, estragole, 1,8-cineole (eucalyptol) can be extracted from the fennel seeds. The presence of anethole in trace amounts has been seen in the HBM. The highest concentration (9.9 mcg/L human milk) of trans-method was detected after consumption of 100 mg of trans-anethole capsules for 3 days. The presence of anethole or metabolites of anethol was observed in the milk for 8 h after ingestion of the capsule [38]. Studies with delayed-release capsules (Soledum-Klosterfrau Vertriebs GmbH, Germany) which have 100 mg of 1,8 cineole (eucalyptol), the milk samples with eucalyptus odor had 1,8 cineole mostly in the range of 100 to 500 mcg/kg of milk. The odour negative samples had 0.98 to about 20.23 mcg/kg of milk [39]. In another woman, the peak concentration was 1,8-cineole, 71 mcg/kg at 1.5 h, and after 9.5 h after ingestion, the concentration was 15 mcg/kg [39]. Ten or more enantiomers of this 1,8-cineole were observed in another sample [40].

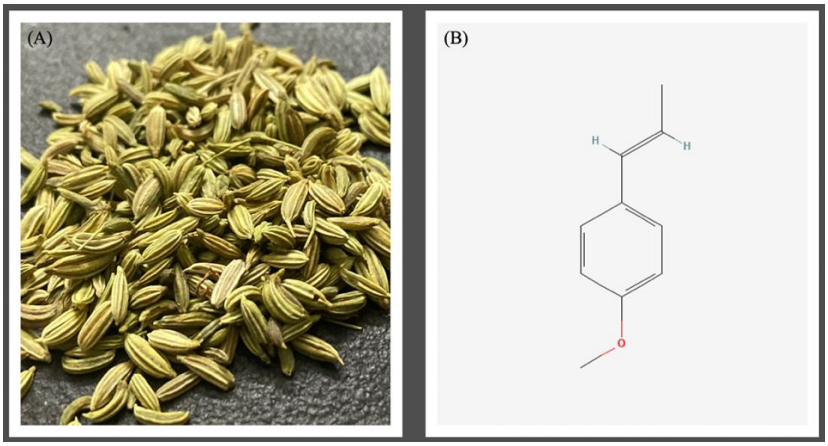

Figure 2: (A) fennel (Foeniculum vulgare) seeds; (B) anethole (phytoestrogen)

Fennel seeds with caraway, anise, melissa, goat's rue, lemongrass, and 1% stinging nettle in unspecified concentration (Natal, Hipp [Turkey]) was used in another study. There was no significant difference in maternal serum prolactin and infant weight gain was seen between groups. But after 7 days, an increase in milk production was reported in the mothers [41]. Mothers given birth were randomized either a syrup containing fennel 3 grams, honey, frankincense (n = 35), or a syrup containing honey, frankincense took once a day before breakfast for 15 days. Prolactin levels were lowered on day 15 than on day 1 in both groups [42]. Some sources recommend the limited usage of fennel seeds in breastfeeding women since they could develop allergic reactions, diarrhea, hepatomegaly [43], and elevated liver enzyme production [34]. Excessive sunlight or ultraviolet light exposure should be avoided by the mothers who consume fennel seeds. Increases prolactin concentration is observed in the blood of the fennel seeds consuming mother. Elevated prolactin concentration was observed in the mothers with fennel seeds consumption [37]. This may be due to the estrogenic property of the anethole or decreased dopamine effect on dopamine receptors [44, 45]. Infants and mothers who have allergies to carrots, celery, or other plants in the Apiaceae family should avoid the consumption of fennel seeds.

C. Fenugreek [46]

Fenugreek (*Trigonella foenum-graecum*) seeds are the most widely used galactagogue worldwide. It also has a long history of fenugreek usage for elevated lactation in India and China. The fenugreek seed extract contains components like trigonelline, mucilage, luteolin, 4-hydroxy isoleucine, sotolon, phenolic acids, diosgenin, and protodioscin [47]. The safety profile of the fenugreek is not well studied. However, animal studies showed that increased insulin and oxytocin levels in the blood [48]. Usually, fenugreek seeds are more effective in the first few days of postpartum [49].

More milk production was seen in the mothers who received 3 cups of 200 mL still tea (Humana-Istanbul, Turkey) which contains 2.6 g pf hibiscus, 200 mg of fennel extract, 20 mg of fennel oil, 200 mg of rooibos, 200 mg of verbena, 200 mg of raspberry leaves, 100 mg of fenugreek, 100 mg of goat's rue, and 500 mg of vitamin C in 100 g daily. Scientist claims that the presence of fenugreek is responsible for the galactagogue activity of the still tea [50]. In a study in postpartum mothers, the average daily milk volume increased from 207 mL (week 1) to 464 mL (week 2) [46]. Effect of fenugreek was evaluated on infants of the 0-4-month-old female who fed with mother's consumed herbal tea (7.5 g fennel seed powder, 3 g of black tea per 3 g of black tea) three times a day. Different parameters like frequency of feedings, the number of wet diapers, frequency of defecation, weight gain, head circumference, and height of the infant were determined. There was a significant difference between the infants with control and the test group observed [51]. In a survey of 188 nursing mothers, 54 % felt increased milk supply and 45 % reported side effects [52]. Mothers of 0-6 months old infants were prescribed to take capsules containing 200 mg of fenugreek, 100 mg of turmeric, and 120 mg of ginger (Fenucaps; Herbal Acharn's Home Co. Ltd., Thailand) 3 times daily for 4 weeks from the first day of delivery. The milk supply increase by 49 % in the second week and 103 % in the fourth week [53]. Side effects like vomiting, nausea, diarrhea, liver toxicity, flatulence, increased heart rate, hepatomegaly, allergic reactions, breast congestion, 14% decrease in serum potassium, and exacerbation of asthma, also have been reported [54]. 1-6 g per day is the dosage suggested. Dosage around 25 grams or more per day lowers cholesterol and blood sugar level. Interaction with warfarin, cross-reaction with chickpeas, peanuts, and other legumes are possible [52]. Nursing mothers of Australia who use fenugreek as galactagogues rated that between "slightly effective" to "moderately effective" category [55].

D. Ginger [56]

Ginger (*Zingiber officinale*) root extract has active pharmaceutical ingredients like gingerols. It is also used as a galactagogue in Turkey and some parts of Asia [33, 57]. There are no shreds of evidence for the safety and efficacy of ginger in mothers and infants [58]. However, the positive galactagogue effect is observed only in the mothers who had a normal delivery. Bad taste, heartburn, abdominal discomfort, weight gain, headache, dry mouth, and nausea are reported occasionally. A survey conducted among Australian nursing mothers showed that ginger is a "slightly effective" galactagogue [55].

E. Garlic [59]

Garlic (*Allium sativum*) has been used as a galactagogue in India and Turkey [33, 35]. Alliin present in garlic is metabolized by the enzyme alliinase to allicin [60]. Allicin is the active ingredient present the garlic which is responsible for the odor. Usually, this compound is secreted through human breast milk as allyl methyl sulfide which may increase infant sucking time. So that breastfeeding has been enhanced. However, there are no shreds of evidence for the application of garlic as a galactagogue [61]. Studies showed that taking 1.5 g of garlic capsules (General Nutrition Centre, Pittsburgh, PA) per day orally helps in the secretion of about 20 mL of breastmilk every 4 h after garlic ingestion [62]. Capsules containing 1.5 g of garlic extract (General Nutrition Centre, Pittsburgh, PA) were ingested by mothers of infants and observed that infants spend more time on nursing (33 min) than the mothers who received placebo (27 min) [63]. Garlic-derived metabolites like allyl methyl sulfoxide and allyl methyl sulfone were observed in the HBM for 5.2 h after ingesting 3 g of raw garlic in the study on 22-51 weeks postpartum mothers. The metabolite concentration has reached the peak between 2 and 3 h of ingestion [64]. In another study peak concentrations of allyl methyl sulfide (4 mcg/kg human milk), allyl methyl sulfoxide (145 mcg/kg human milk), and allyl methyl sulfone (200 mcg/kg human milk) were observed after 1 to 3.5 h of garlic ingestion [65]. Odorific component presence was not shown of milk when it was consumed roasted or cooked [60]. Very few studies have shown that garlic consumption doesn't have any side effects in infants and mothers. Garlic tends to reduce blood pressure, cholesterol, and platelet numbers in the bloodstream. Mothers having bleeding issues can avoid taking garlic. Those who are allergic to hyacinth, tulip, onion, leek, and chives also can avoid consuming garlic [59]. Combinations of herbal supplements were studied on women with insufficient milk supply 5 days after delivery. 2 capsules of Lactate (Pharma Private Ltd., Madras, India) contains 200 mg of asparagus, 100 mg of ashwagandha, 50 mg of fenugreek, 50 mg of licorice, and 20 mg of garlic was taken per day.

IV. CONCLUSION

Herbal plants are used as galactagogues in many of the countries. Still, for most of the herbs the dosage, possible side effects, and interaction with others herbs were not established. This review summarizes the galactagogues herbs (Fenugreek, fennel, cumin, ginger, and garlic) used by the south Indian population mainly the mothers from Tamilnadu. A lot of studies shows the effect of herbal galactagogue whether it's used alone or used in combination. The safety of these herbs is also well-accepted by Food and Drug Administration, USA since it's a food additive.

It is also classified under "generally recognized as safe" (GRAS) compounds. So usage of the herbs doesn't need any prior approval for marketing. But still, the pieces of evidence and guidelines for the usage of herbs as a galactagogue are inadequate. The pharmacokinetics and pharmacodynamics of active pharmaceutical ingredients are not well studied. So it's required to conduct a robust study on lactation failure and possible remedies in nursing mothers. Clear government policies to sell herbal supplement with standard labelling has to be established in the future to overcome issues in nursing mothers.

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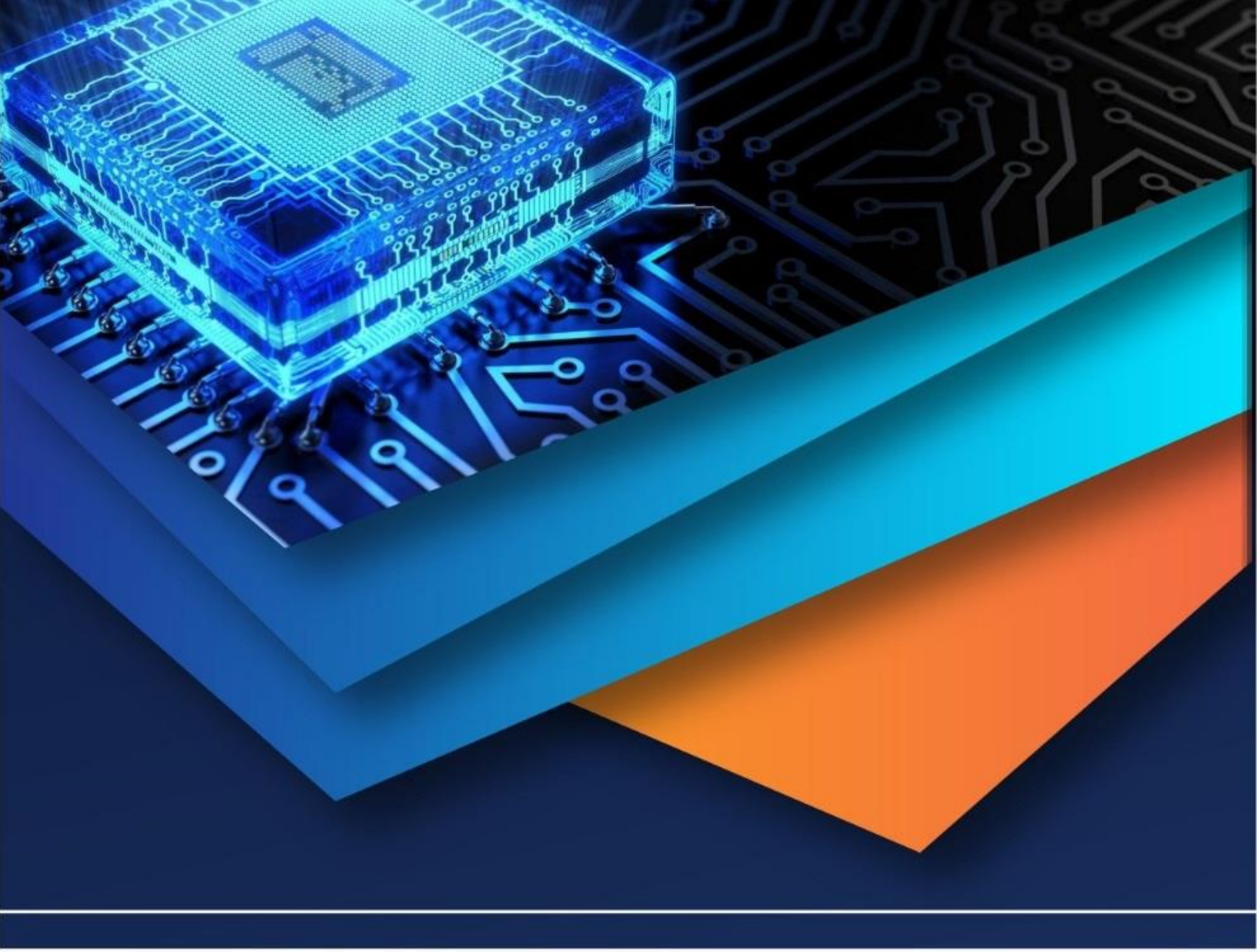

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