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Formulation and Evaluation of Herbal Syrup as Bronchodilator

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Abstract: ***Bronchodilator is the Pharmaceutical formulations by which the excessive storage of mucus is removed from the lungs. It is one of the novel formulations used for life savings. Different types of formulations are available in the market. Some of the formulations are having phyto-pharmacognostical chemicals or some of them are synthetically prepared. The advantage of this type formulation is very readily available, inexpensive and quick onset of action. In this research work, we have focused the formulations of bronchodilator through liquid dosage formulations and evaluation study. For this study, we have collected different plant crude organized part from various herbal sources. Then we have extracted all of these materials and screen them. Then we have formulated formulations and validated their different parameters like pH, colour, odour, activity checking study, stability study, etc. Liquid dosage preparation is one of the best methods used in here to prepare these formulations for the greater availability.***

Keywords: Bronchodilator, Liquid Dosage, Syrup, Phyto-active ingredients, Screening, Formulations, Evaluation.

I. INTRODUCTION

A. Bronchodialators

For those whose pulmonary airflow is less than ideal, bronchodilators are advised. Targeting the smooth muscles in the bronchioles of the lung, beta-2 agonists are the basis of therapy. Bronchodilators may be necessary for a number of respiratory disorders, such as asthma and chronic obstructive pulmonary disease. They are used to individuals with chronic obstructive pulmonary disease to either enhance lung function or reverse the symptoms of asthma. Lung function is evaluated through pulmonary function testing. Based on their impact on pulmonary function tests, bronchodilators are crucial in the diagnosis and treatment of lung diseases. The forced expiratory volume to forced vital capacity ratio contrasts the quantity of air that flows during the first second of exhalation (FEV) with the maximum amount of air that a person is theoretically capable of exhaling (FVC). (1)

The parasympathetic nervous system directly innervates the bronchial smooth muscle of the airways, and cholinergic receptors there regulate bronchomotor tone. The airways are rich in two adrenergic receptors but do not directly receive sympathetic innervation. For bronchodilator treatment, cholinergic and adrenergic receptors are important targets. There are two main, complimentary mechanisms that might cause bronchodilation. Two receptors that are activated directly cause the smooth muscle to relax. Anticholinergic medications, also known as muscarinic receptor antagonists, compete with acetylcholine (ACH) at postganglionic nerve receptors to relax smooth muscle and dilate the airways.(2)

B. Pharmacology of Bronchodilator

The effects of beta 2 agonists function by attaching to beta2 receptors in the smooth muscle of the airway. When they bind to the receptor, they begin a complex series of events that are comparable to those brought about by the activity of natural neurotransmitters. (3)

Cyclic adenosine monophosphate (cyclic AMP) levels rise throughout the cells. Cyclic AMP stimulates target enzymes in cells and opens ion channels in the cell membrane through the activity of an enzyme called protein kinase A. Bronchodilation and muscular relaxation are the ultimate results.(4)

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C. Bronchitis and Related Disease: [5]

1) *Bronchitis:* Bronchitis is defined as bronchial tube inflammation (inflammation = itis). The inflammation promotes thickening of the lining of these breathing passages, constricting them and encouraging inflammatory fluid output.
2) *Bronchiolitis:* Bronchiolitis is the name given to inflammation of the smaller bronchi known as bronchioles. This is generally caused by respiratory syncytial viruses (RSV) in babies and affects the small bronchi and bronchioles more than the big bronchi and bronchioles.
3) *Acute Bronchitis:* Acute bronchitis is an infection of the bronchi caused by a virus.Although bacteria and chemicals can also cause acute bronchitis, infection is the most common cause. Acute bronchitis is characterized by a quick onset of coughing, which is generally caused by a viral infection of the bigger airways. Colds (also known as viral upper airway infections) frequently affect the throat (pharyngitis), nasal passages, and, on occasion, the larynx (leading in a decreased hoarse voice, also known as laryngitis). A runny nose, nasal stuffiness, and sore throat are all possible symptoms. Croup often affects newborns and young children, affecting the voice box and upper big airways (the trachea and large bronchi).
4) *Chronic Bronchitis:* For research purposes, chronic bronchitis is defined as a daily cough with sputum production for at least three months, two years in a succession. Chronic bronchitis is often diagnosed based on clinical evidence of a long-term chronic cough that is commonly connected with cigarette use. The diagnosis is made pathologically by distinctive microscopic findings involving inflammatory cells in airway tissue samples.

A reduction in the ratio of the volume of airflow at 1 second to total airflow is less than 70% when referring to pulmonary function tests. This verifies the existence of chronic bronchitis, a kind of obstructive airway illness. Imaging investigations (chest X-ray, CT or MRI of the chest) might reveal certain findings.

D. Symptoms: [5]

1) Breathlessness
2) Wheezing
3) Sputum Production
4) Difficulty in Talking
5) Dyspnoea
6) Tightness of Neck Muscle
7) Coughing after Physical Activity

E. Liquid Dosage Form

At normal temperature the physical shape of a pourable pharmacological product exhibits Newtonian or pseudoplastic flow behaviour and conforms to its container. A semisolid, on the other hand, is not pourable and does not flow at low shear stress or conform to its container at ambient temperature. Liquid dosage form can be classified as dispersed systems of solutions based on their physical properties.(6)

1) *Monophasic Liquid Dosage Form*

a) Internal use

- Syrup - Syrup is a sugar-in-water saturated aqueous solution with or without medicinal, ingredients. [7,8]
- Mixture- A mixture is a liquid medicine in which an insoluble compound is suspended in the liquid.
- Linctuses- Linctus is a viscous, monophasic liquid solution with a high syrup concentration that is used to treat cough and sore throat. [9,10]
- Elixers- An elixir is a sweet fragrant liquid mixture that is administered orally for medical purposes. [11,12]

b) External use

- Gargles- Gargles are aqueous concentrated solutions that are used to treat throat infections by coming into touch with the mucus membrane in the buccal cavity. [13]
- Mouthwash- Mouthwashes are aqueous solutions, used to keep the buccal cavity clean and deodorised. [14,15]
- Lotion- Lotions are applied to the skin's surface with cotton wool for purposes of protection, such as cooling and relaxing. [16]
- Nasal drop- Nasal drops Nasal drops are liquid or greasy solutions that are sprayed into the nostrils with a dropper. [17,18]
- Eye drop- Eye drops are liquid drops applied directly to the surface of the eye in small amounts such as single drops.

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- Ear drop- Ear drops are solutions made from water, glycerin, or propylene glycol that are infused into the ear using a dropper. [19,20]
- Liniments- Liniment is a liquid dose form of medication that is applied to the affected area with friction or rubbing action.
- Throat pains- Throat paints are the viscous liquid dosage form of medicaments which are used for the purpose of mouth and throat infections. [21,22]

2) Biphasic Liquid Dosage Form

a) Internal use

- Suspension- It is a heterogenous mixture of a fluid that contains solid particles sufficiently large for sedimentation. [23]

b) External use

- Emulsion- It is a mixture of two or more liquids that are normally immiscibleowing to liquid-liquid phase separation. [24]

F. Natural vs Synthetic Bronchodilator

In natural bronchodilator natural ingredients are used whereas in synthetic bronchodilators , chemicals are used which may sometime causes harmful effects to the patients . Hence , it's better to use natural bronchodilators.

G. Mechanism of Action

Bronchodilators function by targeting the beta-2 receptor, a G-protein-coupled receptor located in the pulmonary airways. When the beta-2 receptor is activated, the smooth muscle of the airway relaxes. Consequently, the patient enjoys improved ventilation for a time. The downregulation of the beta-2 receptor in the airways diminishes the effectiveness of beta-2 agonists with prolonged use. Consequently, a greater quantity of medication is needed to achieve the same result. In the digestive tract, cytochrome P-450 enzymes catalyse bronchodilator metabolism. Eighty to one hundred percent are eliminated in the urine, while less than twenty percent are eliminated in the faeces. Three to six hours is the half-life of short-acting bronchodilators, while
twenty-four to forty-eight hours is the half-life of long-acting bronchodilators. Anticholinergics function by inhibiting the activity of airway parasympathetic nervous system receptors. Reversing the parasympathetic nervous system should result in bronchodilation and decreased bronchial secretions, as the parasympathetic nervous system is responsible for increased bronchial secretions and constriction.[25]

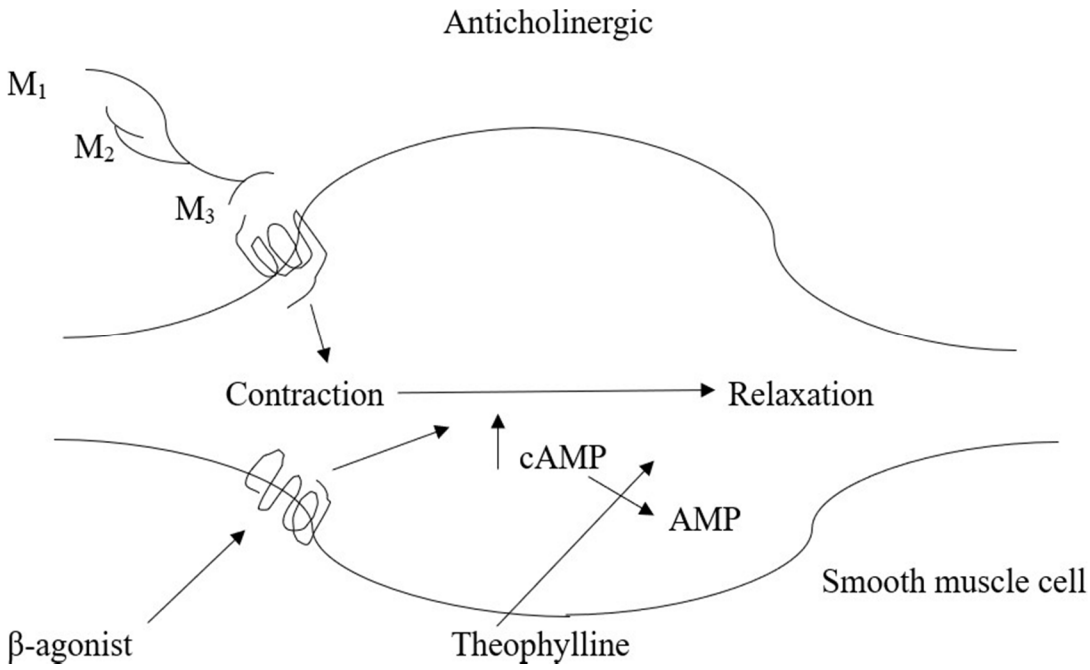


Figure 1: Mechanism of Action of Bronchodilator

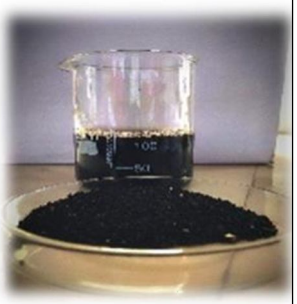
II. MATERIALS AND METHOD

A. Collection of Plant Parts And Raw Materials

Randomly collected leaf samples from mature plants of the following species::Ocimumteniflorum (Tulsi)flower buds of Syzygiumaromaticum (Clove), seeds of Foeniculum vulgare (Fennel), Zingiber officinale Roscoe (ginger), fruits of Elettearia cardamomum (Cardamom), seeds of Nigella sativa L(Black Cumin) are collected from herbal garden and local market. Sorbitol, Sodium Benzoate are purchased from local market.

Table 1: List Of Ingradients With Their Activities

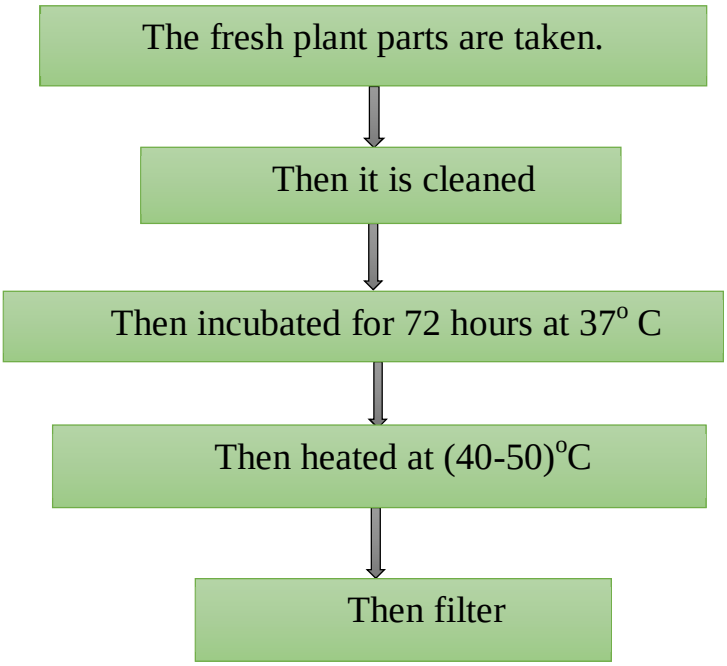
Sl. No.	Name	Scientific Name And PartsUsed	Chemical Constituents	Functions	Samples
1	Turmeric	*Curcuma longa* Family: Zingiberaceae Parts Used: Root.	Turmerone, turmeroneoids and curcumin.[26]	Antimicrobial, bacteriostatic, antibacterial property. [26]	
2	Clove	*Eugenia caryophyllus* Family: Myrtaceae Parts Used: Clove-buds	Eugenol , Ester eugenin. [27]	Carminative,Flavour, Antiseptic,Stimulant.[27]	
3	Tulsi	*Ocimum sanctum* Family: Labiatae Parts Used: Fresh,leaves	Eugenol, Methyl Eugenol, Carvacrol, Caryophylline.[28]	Anti-bacterial , Diaphoretic , Stimulant , Aromatic, Good-immunomodulatory agent. [28]	
4	Cardamom	*Elettearia cardamomum* Family: Zingiberaceae Parts Used: Fruits	α-terpineol, Borneol, Cineol.[29]	Aromatic,Carminative, Stimulant, Flavour. [29]	
5	Fennel	*Foeniculum vulgare* Family: Umbelliferae Parts Used: Fruits	Fenchene,Anethal, Ketone phellandrene limonene. [30]	Carminative, Stimulant, Expectorant, Aromatic. [30]	

6	Ginger	*Zingiber officinale* Family: Zingiberaceae Parts Used: Root	Volatile- oil, Zingiberene, Curcumene, Resi n, Gingerol, Shagaols. [31]	Aromatic,Carminative, Motion-in treating sickness, Flavouring agent. [31]	
7.	Black Cumin	*Nigella sativa L.* Family: Ranunculaceae Parts Used: Seed	Thymoquinone, Dithymoquinon e, Longifolene, Eicosadieonic acid.[32]	Different airway disorders, for pain such as chronic head ache and backpain, also useful in the treatment of diabetes. [32]	
8	Ajwain	*Trechyspermum ammi* Family: Apiaceae Parts Used: Seeds	Thymol, carvacrol. [33]	Improve the airflow and functioning of the lungs. [33]	
9	Sorbitol	---	---	Provide a soothing mouthfeel, mild sweetness and a refreshing. Resistance to dental caries. [34]	
10	Sodium benzoate	---	---	Anti-corrosive and Preservative. [35]	

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B. Extraction Process

Figure 2: Flow diagram of Extraction Procedure



C. Extraction Of Herbal Bronchodialator

TABLE 1: WATER SOLUBLE EXTRACTIVE

Sl. No	Ingredients	Amount of Sample Taken in 100 Ml Water	Petridish Weight (Blank)	Petridish Weight (Sample)	% Found
1.	Clove	1.01 gm	47.741 gm	47.892 gm	15.1%
2.	Fennel	1.04 gm	48.152 gm	48.351 gm	19.9%
3.	Ginger	1.01 gm	41.239 gm	41.316 gm	7.7%
4.	Tulsi	1.02 gm	51.641 gm	51.689 gm	4.8%
5.	Black Cumin	1.01 gm	53.069 gm	53.140 gm	7.1%
6.	Cardamom	1.03 gm	48.534 gm	48.694 gm	16%
7.	Turmeric	1.01 gm	41.781 gm	41.930 gm	14.9%
8.	Ajwain	1.01 gm	52.060 gm	52.140 gm	7.2%

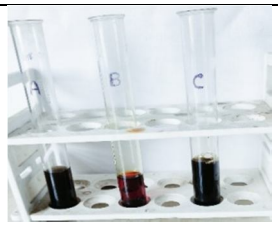
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D. Phytochemical Screening for Bronchodialator Ingredients

Table 3: Phytochemical Screening of Plant Extract

Sl No.	Name of Herbs	Tests	Observations	Images
1	Tulsi	3 ml Extract of Ocimum sanctum in test tube + few drops HCl	Yellowish-Green colour due to presence of flavonoids. A=Plant extract B=HCl C=End Product	
2	Clove	Aqueous Extract+ferric chloride 5% solution	Dark colourisation occurred due to the presence of tannin. A=Plant extract B=$Fecl_3$ C= End Product	
3	Ginger	Few ml ginger extract + few drops Wagner's reagent.	Green precipitate confirms the present of alkaloids. A=Plant extract B= Wagner's reagent C= End Product	
4	Fennel	2ml extract + 1ml Mayer's reagent.	Light green precipitate formed , indicating the presence of alkaloids. A=Plant extract B= Mayer's reagent C= End Product	
5	Cardamom	Aqueous extract of eletteria cardamom + violateoil + sudan III	Red Colour due to volatile oil. A=Plant extract B= Sudan III C=End Product	

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6	Black Cumin	Few ml Black Cumin extract + few drops Wagner's reagent	Green precipitate confirms the present of alkaloids. A= Plant extract B= Wagner's reagent C= End Product	
7	Turmeric	Aqueous Solution of turmeric + boric acid	Yellowish brown due to presence of curcumin. A=Plant extract B=Boric acid C=End Product	
8	Ajwain	Few ml Ajwain extract + few drops Wagner's reagent.	Green precipitate confirms the present of alkaloids. A=Plant extract B= Wagner's reagent C=End Product	

E. Formulation Table

Table 4: Formulation Table

Sl. No	Ingredient name	Each 5 ml contain	Purposes
1	Clove	0.151gm	Analgesic
2	Fennel	0.199gm	Anti-inflammatory, Antifungal
3	Ginger	0.077 gm	Anti-inflammatory and anti bacterial
4	Tulsi	0.048 gm	Strong Anti-inflammatory
5	Cardamom	0.16 gm	Helps in indigestion, nausea, vomiting.
6	Black Cumin	0.071 gm	Helps in relieving different airway disorders.
7	Sorbitol	1.0 ml	Sweetener
8	Turmeric	0.745 gm	Antioxidant and Anti-inflammatory effects
9	Ajwain	0.5145 gm	Broncho-dilating effect, which helps dilate the bronchial tubes in the lungs to provide relief from mild asthma.
10	Sodium benzoate	0.025 gm	Preservative
11	Water	2ml	Filler

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III. RESULTS AND DISCUSSION

After a one-month examination, the syrup retained its colour and homogeneity, indicating stability. There were no signs of phase separation in the formulation of the syrup formulation. The pH of the syrup remained constant and exhibited a mildly acidic character. The specially prepared syrup demonstrated effectiveness against various human infections, including S. aureus (+ve) and E. coli (-ve).

The formulation was found to be free of microorganisms, as it did not promote microbial growth when added to the agar medium. This alcohol-free syrup was entirely derived from plants. Both chemical and physical changes were assessed to determine the stability of the formulation. No significant or noticeable variations in the properties of the formulation were observed.

The consumption of syrup during coughing has been shown to provide broncho dilatory effects due to the presence of broncho dilatory substances such as ajwain, cloves, and other important plant extracts. This can potentially provide relief for individuals with bronchitis, bronchiolitis etc.

To assess the antibacterial activity of different concentrations of the syrup, the agar diffusion method was employed. The results showed that for S. aureus(+ve), the zone of inhibition measured 8 mm, 11 mm, 15 mm, and 18 mm with 50 µl, 100 µl, 150 µl, and 200 µl of syrup, respectively. Similarly, for E. coli(-ve), the zone of inhibition was observed to be 6 mm, 9 mm, 12 mm, and 15 mm with the corresponding syrup concentrations.

These findings highlight the significant antibacterial activity of the herbal syrup and its ability to effectively inhibit bacterial growth.

TABLE-5 : Stability Studies Of Formulated Bronchodialator

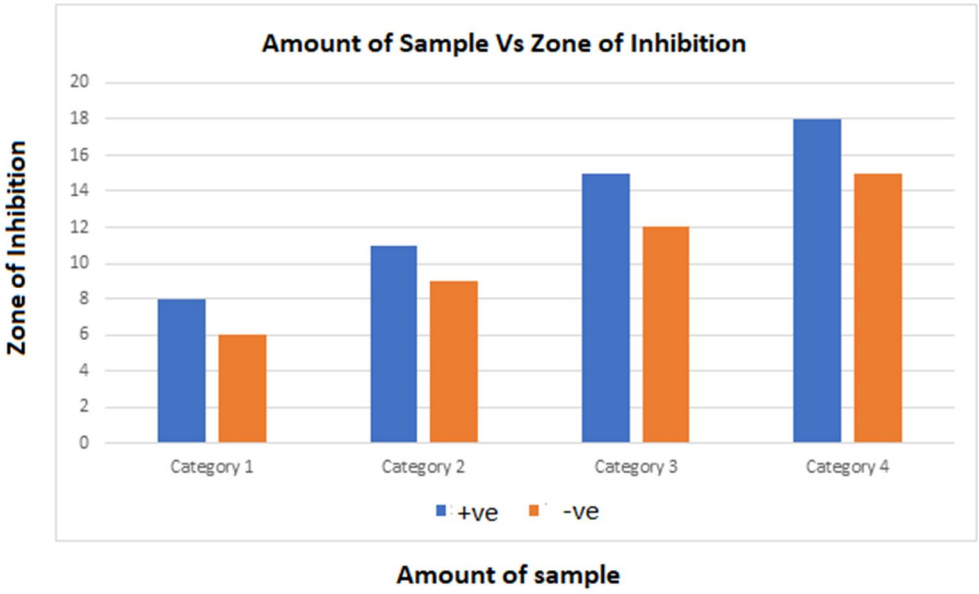
Sl No.	Parameter	Observation			
		Initial	10 Days	20 Days	30 Days
1.	Colour	Dark Brown	Dark Brown	Dark Brown	Dark Brown
2.	Odour	Characteristic	Characteristic	Characteristic	Characteristic
3.	Consistancy	Liquid	Liquid	Liquid	Liquid
4.	pH	6.71	6.70	6.69	6.69
5.	Phase separation	Nil	Nil	Nil	Nil
6.	Homogeneity	Good	Good	Good	Good

TABLE-6: Zone Of Inhibition

Organism	Zone Of Inhibition (Nm)			
	50 µl	100 µl	150 µl	200 µl
S. aureus (+ve)	8	11	15	18
E. coli (-ve)	6	9	12	15

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Figure 3: Antibacterial Activity



IV. CONCLUSION

In conclusion, herbal syrup offers a natural and holistic approach to health and well-being. With its wide range of medicinal properties derived from plant extracts, herbal syrup provides a viable alternative to conventional pharmaceuticals. Its potential benefits include soothing coughs, relieving sore throats, boosting the immune system, and promoting overall wellness. By harnessing the power of nature, herbal syrup offers a gentler and potentially safer option for individuals seeking relief from common ailments. However, it is important to note that herbal syrup should not replace professional medical advice or prescribed medications in severe or chronic conditions. As with any health-related product, it is advisable to consult with a healthcare professional before incorporating herbal syrup into your routine.

V. ACKNOWLEDGEMENT

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VI. CONFLICT OF INTEREST

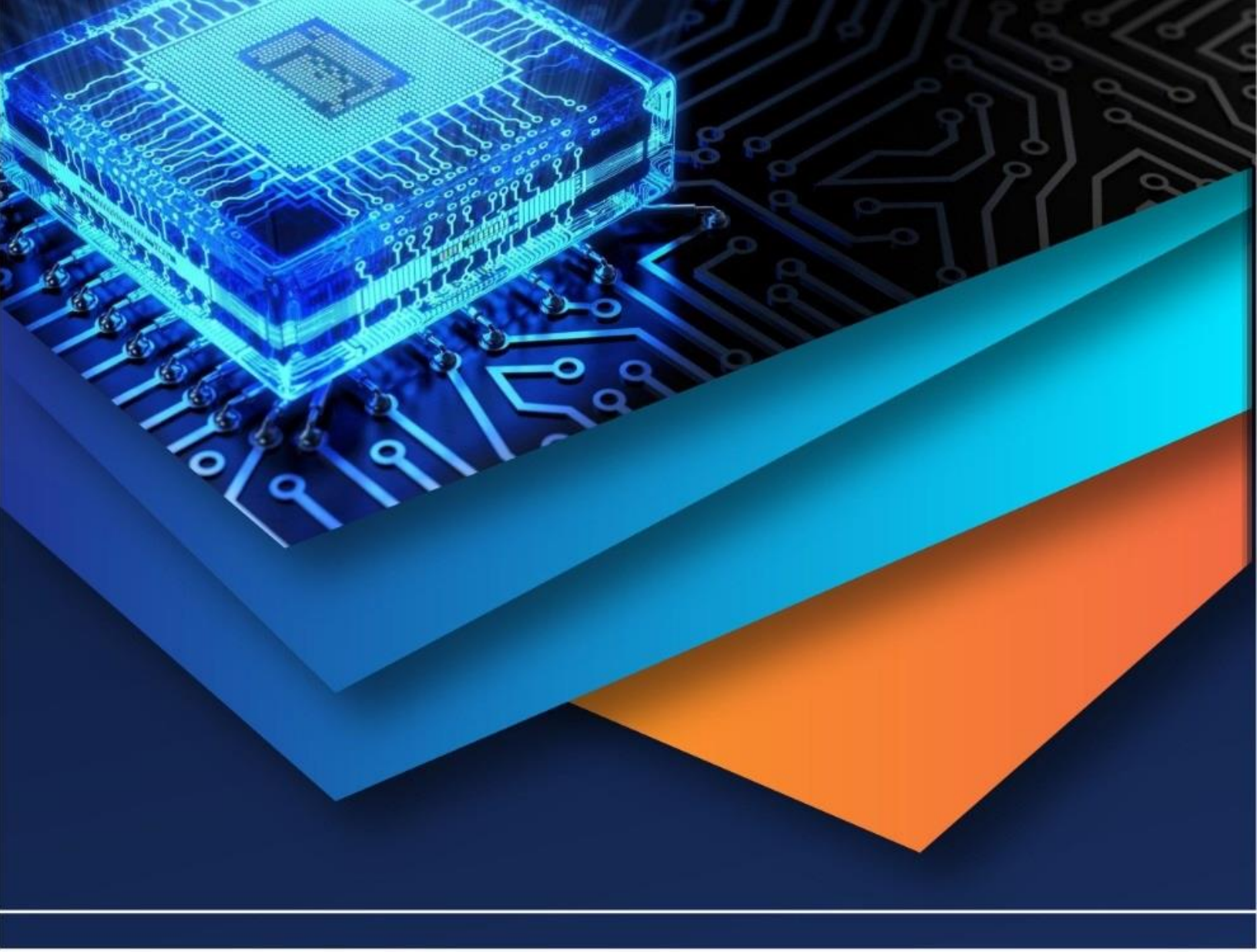
The authors declare that there is no conflict of interest to reveal.

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