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Alkaloids - An Important Aspect of Medicinal Plants in Pharmaceutical World: An Overview

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Abstract: ***Alkaloids are major important constituent among different chemical constituents. Alkaloids have obtained in lots of plants in different location of world. These constituents have been used for different types of medicinal purposes as well as for the treatment of different diseases. These materials have potent role in also maintaining the plant profile. Lots of major chemical groups fall under this category. Many plants like Ephedra, Pilocarpus, Belladonna, Vasaka, Datura, Vinca, Cinchona, Kurchi, Ashwagandha, etc are belonging to this constituent. Among those Cinchona, Vasaka, Vinca, Belladonna and so many plants are showing significant role for treating different health issues from ancient days to till now. The article objects that the important, classification, constituents as well as the distribution of alkaloids into large amount of plant profiles.***
Keywords: Alkaloids, Ephedra, Pilocarpus, Belladonna, Vasaka, Datura, Vinca, Cinchona, Kurchi, Ashwagandha.

I. INTRODUCTION

Phytochemicals are having very important roles for Pharmaceutical world. They may be treated as different applications for treating various kinds of diseases. Alkaloids, Glycosides, Tannins, Terpenoids, Resins, Flavonoids are various constituents in plant. Alkaloid is one of much signified constituent among those chemical constituents. Alkaloids are secondary metabolites containing chemical compounds basically hetero aromatics or non hetero aromatics or polynuclear aromatic hydrocarbons present in the plant. This chemical compound not only maintaining the medicinal role but it also regulates the growth, development of plant and protect the plant from various foreign substances. They are also maintaining the development of their fruits, seeds, leaves, etc. All of these parts are used for potent sources of alkaloids. Based on the chemical nature, Alkaloids are divided into so many categories. Like as an example of atropine is one of the alkaloid present in Belladonna plant under solanaceae family. Besides, Solanaceae, Rubiaceae, Liliaceae are important family name for findings potent or rich sources of alkaloids. Some another examples of alkaloids are Quinine, Quinidine, Reserpine, Vasicine, Vincristine, Vinblastine, Brucine, Pilocarpine, etc. These alkaloids are generally used different areas like sedative, expectorant, bronchodialators, analgesic, antispasmodic, blood purifiers, astringent, diuretic, etc as well as they have also used for treatment many diseases like tumor, neuronal syndromes, cardiovascular diseases, gout cum rheumatism management, bacterial cum viral infections, diarrhea, dysentery, amoebiasis, etc. Vinca, Vasaka, Cinchona, Nux vomica, Belladonna, Datura, Kurchi, Ashwagandha, Rauwolfia in all over the world are the common plants in where the alkaloids are obtained on the basis of huge amounts [1-2].

II. ALKALOIDS: SOME MAJOR TYPES

Table 1: Some major types of alkaloids are chemically classified as mentioned in the following table [1, 3-5].

Sl. No.	Types of Alkaloids	Constituents	Plant
1	Isoquinoline	Emetine	Ipecacunha
2	Quinazoline	Vasicine	Vasaka
3	Steroidal	Withanine	Ashwagandha
4	Indole	Vincristine	Vinca
5	Tropane	Atropine	Belladonna
6	Amino	Ephedrine	Ephedra
7	Purine	Caffeine	Tea
8	Pyridine	Lobeline	Lobelia
9	Quinoline	Quinine	Cinchona
10	Imidazole	Pilocarpine	Pilocarpus
11	Diterpene	Aconitine	Aconite
12	Phenanthrene	Morphine	Opium
13	Piperidine	Conine	Hemlock
14	Pyridine	Arecoline	Areca Nut

III. ALKALOIDS: ACTIVE CONSTITUENTS

Alkaloids are having different variations. Some of them are indole, imidazole, purine, pyridine, phenanthrene, quinoline, isoquinoline types. Atropine is the major constituent present in Datura whereas Aconine is the main for Aconite. Besides another categories for alkaloids are Ergotametrine, Ergotamine find in Ergot as well as Colchicine present in Colchicum. Lobeline is one of important plant alkaloid constituent of Lobelia for maintaining respiratory stimulant [1, 6-8].

IV. IMPORTANCE OF ALKALOIDS IN PHARMACEUTICAL & MEDICINAL FIELD

Different chemical compositions under alkaloids are present in plants. They are having significant role in maintaining human health. Reserpine one example of alkaloid is the principle constituent of Rauwolfia presenting the anti-hypertensive activity as well as its uses for the treatment of hypertension. Another one example of quinine is the precursor material present in Cinchona bark. Therefore this bark is used for the treatment of malaria as anti-malarial agent. Vasicine in Vasaka shows anti-tussive property where as Vincristine and Vinblastine show anti-neoplastic activity for cancer treatment. Pilocarpine in Pilocarpus produces the treatment therapy for glaucoma as well as caffeine in tea is the rich source of central nervous system stimulant. By therefore alkaloids maintain different pivotal roles in management of different disorders in medicinal world [1, 9-12].

V. ROLE OF ALKALOIDS IN PLANTS

Alkaloids maintain various functions in plants. The various roles are given below [1-6].

1) The alkaloids promote overall plant growth and development.
2) They can store nitrogen.
3) They can protect the plants from pathogens and insects.
4) They maintain and store different plant hormones.
5) They also maintain their fruit, seeds, leaves development.
6) They also store nutrients for plant growth and development.
7) They also regulate the detoxification process.

VI. IDENTIFICATION TESTS OF ALKALOIDS

Alkaloids are detected in different plants by these techniques and reagents in the table given below. The following precipitated color in that table confirms the presence of alkaloids.

Table 2: Identification Tests of Alkaloids [1, 13-17]

Sl. No.	Test Name	Reagent Name	Color Obtained
1	Dragendorff's Test	Potassium bismuth iodide solution	Cream color precipitated out
2	Mayer's Test	Potassium mercuric iodide solution	Reddish brown precipitated out
3	Wagner's Test	Potassium iodide-iodine solution	Reddish brown precipitated out
4	Hager's Test	Picric acid	Yellow color precipitated out
5	Murexide Test	Potassium chlorate and Hydrochloric acid under the vapors of dilute ammonia	Purple color precipitated out for caffeine and purine alkaloids
6	Tannic Acid Test	Tannic acid solution	Buff color precipitated out

VII. ALKALOIDS DISTRIBUTION

Table 3: Description of Different Drugs among Alkaloids

Name of Drug	Parts Used	Name of Family	Scientific Name	Geographical Findings	Major Active Chemical Constituents	Medicinal Uses	References
Vasaka	Dried as well as fresh leaves	Acanthaceae	*Adhatoda vasica*	India, Malaysia, Myanmar	Vasicine, Vasicol, Vasicinone, Adhatodine, Vasakin, Betain, Adhatodic acid	Bronchodilators, Expectorant, Anti-tussives	[1, 18-20]
Cinchona	Dried roots, stems and bark	Rubiaceae	*Cinchona calisaya, Cinchona officinalis, Cinchona succirubra, Cinchona ledgeriana*	India, Peru, Columbia, Indonesia, Sri Lanka, Ecuador	Quinidine, Cinchonine, Quinine, Homocinchonidine, Cinchonidine, Hydroquinine, Cupreine, Hydrocinchonidine	Anti-malarial, Bitter tonic	[1, 21-24]
Nux Vomica	Dried ripe seeds	Loganiaceae	*Strychnos nux-vomica*	India, Australia, Sri Lanka	Brucine, Isostrychnine, Protostrychnine, Strychnine, N-oxystrychnine, Novacine	Central nervous system stimulant, Bitter stomachic, Tonic, for treating different cardiovascular problems	[1, 25-26]
Vinca	Dried whole plant	Apocynaceae	*Catharanthus roseus*	India, Europe, USA, Caribbean Islands, Australia, South Africa	Vincristine, Catharanthine, Vinblastine, Dihydroindole, Lochnerine, Tetrahydroalstonine, Serpentine	Anti-neoplastic agent, for treating Hodgkin's disease and leukemia	[1, 27-30]
Pilocarpus	Dried leaves	Rutaceae	*Pilocarpus jaborandi, Pilocarpus trachylophus, Pilocarpus microphyllus, Pilocarpus selloanus, Pilocarpus pennatifolius*	India, South America, Caribbean Islands, Central America	Pilocarpine, Isopilocarpine, Pilosine, Isopilosine, Psudopilocarpine	Cholinergic, for treating glaucoma	[1, 31-32]
Ashwagandha	Dried roots	Solanaceae	*Withania somnifera*	India, South Africa, Morocco, Egypt	Withaferin A, Withanolide A	Sedative, Anti-rheumatic, Hypnotic, Immuno-modulatory agent, Anti-stress, Hypotensive	[1, 33-34]
Veratrum	Dried rhizomes	Liliaceae	*Veratrum album, Veratrum viride*	USA, Canada	Veratridine, Protoveratrine A and B, Cevadine, Veratrine, Germitriene, Germidine, Cevadine, Veratrosine, Psudojervijne, Protoveratrine	Hypotensive, Cardiac depressant	[1, 35-36]
Aconite	Dried roots	Ranunculaceae	*Aconitum napellus*	India, England, Germany, Spain, Switzerland	Aconine, Aconitine, Hypoaconitine, Napelline, Neoline, Neopelline, Aconitic acid	Analgesic, Cardiac depressant, treating neuralgia, Anti-inflammatory, Anti-rheumatic agent	[1, 37-38]
Shankhpushpi	Aerial part	Gentianaceae	*Canscora decussata*	India, Sri Lanka, Myanmar	Convoluine, Shankhpuspine	Antiepileptic and treating different nervous disorders	[1, 39-40]
Bhringraj	All herbs	Asteraceae	*Ecilipta alba*	India	Wedelolactone, Wedelic acid	Hepatoprotective, Brain tonic, treating different hair and skin disorders	[1, 41-42]
Kurchi	Dried stem bark	Apocynaceae	*Holarrhena antidysenterica*	India	Conessine, Isoconessine, Holarrhmine, Holarrhidine, Norconessine, Dioxyconessine	Anti-protozoal, Anti-dysentery, Anti-amoebic agent	[1, 43-44]
Hemlock	Dried unripe fruits	Umbelliferae	*Conium maculatum*	Europe, North Africa, North America, New Zealand	Conine, Peudo-conhydrine, Conhydrine, Gamma conicrine	Sedative, Antispasmodics	[1, 45-46]
Kola	Seeds	Sterculiaceae (for *Cola nitida*), Malvaceae (for *Cola acuminate*)	*Cola nitida, Cola acuminata*	Africa, Brazil, Sri Lanka, Jamaica, Indonesia	Theobromine, Caffeine	Central nervous system stimulant	[1, 47-49]

Lobelia	Dried leaves as well as all aerial parts	Campanulaceae	*Lobelia nicotianaefolia*	India, USA, Holland	Lobelidine, Lobeline, Lobelanine, Lobelanidine, Isolobelanine	Respiratory stimulant, for treating asthma and bronchitis	[1, 50-51]
Rauwolfia	Dried roots and rhizomes	Apocynaceae	*Rauwolfia serpentina*	India, Thailand, Sri Lanka, America, Myanmar	Rescinnamine, Ajmalicine, Ajmaline, Yohimbine, Reserpine, Deserpidine, Syrosingopine, Serpentine, Serpentinine, Rauwolfinine	Anti-hypertensive agent, Tranquilizer	[1, 52-54]
Coffee	Dried ripe seeds	Rubiaceae	*Coffee Arabica*, *Coffee liberica*	India, Brazil, Mexico, Vietnam, Indonesia, Sri Lanka, Ethiopia	Trigonelline, Caffeine	Central nervous system stimulant, Diuretic	[1, 55-56]
Punarnava	Fresh and dried herb	Nyctaginaceae	*Boerhavia diffussa*	India, Malaysia, Africa, China	Punarnavoside, Borhavine, Boeravinone-A,B,C and D	Expectorant, Diuretic, Stomachic, and treating jaundice	[1, 57-58]
Tea	Leaves and leaves buds	Theaceae (Ternstro-emiaceae)	*Camellia sinensis (Thea sinensis)*	India, China, Sri Lanka, Japan, Indonesia	Caffeine, Theobromine	Central nervous system stimulant, Diuretic	[1, 59-60]
Areca Nut	Dried ripe seeds	Palmae	*Areca catechu*	India, Philippines, Sri Lanka	Guvacine, Arecaidine, Arecoline, Guvacoline	Respiratory stimulant, Sialogogue, Parasympathomimetic	[1, 61-62]
Colchicum	Dried ripe seeds	Liliaceae	*Colchicum luteum*, *Colchicum autumnale*	India, Poland, Holland, England	Demecolcine, Colchicine	Anti-gout, Anti-rheumatic, Anti-tumor agent	[1, 63-64]
Camptotheca	Dried stem wood	Nyssaceae	*Camptotheca lowreyona*, *Camptotheca acuminata*	India, USA, China, Tibet	Camptothecine, 9-aminocamptothecin, 10-methoxy camptothecin, 10-hydroxy camptothecin, Topotecan, Irinotecan	Anti-tumor, Sometimes anti-viral agent	[1, 65-66]
Physostigma	Dried ripe seeds	Leguminosae	*Physostigma venenosum*	West Africa	Eseramine, Physostigmine, Eseroline, 8-norphysostigmine, Physovenine	Parasympathomimetic, Anticholinestease agent, for treating glaucoma and different cardiovascular disorders	[1, 67-68]
Ipecacuanha	Dried roots and rhizomes	Rubiaceae	*Cephaelis ipecacuanha*, *Cephaelis acuminata*	India, Brazil, Myanmar, Malaysia	Cephaeline, Emetine, Psychotrine, Emetamine, o-methyl psychotrine	Expectorant, Anti-amoebic, Emetic, Sometimes anti-tumor agent	[1, 69-70]
Belladonna	Dried leaves and flowering tops as well as aerial parts	Solanaceae	*Atropa belladonna*, *Atropa acuminata*	India, England	Atropine, Homotropine, Hyoscine, Hyoscyamine, Belladonine, Scopoletin	Parasympatholytic, Anti-cholinergic agent, Antispasmodic	[1, 71-72]
Duboisia	Dried leaves	Solanaceae	*Duboisia myoporoides*, *Duboisia leichhardtii*	Australia	Scopalamine, Atropine, Nor-hyoscyamine, Valtropine, Tigloidine, Tiglyoxytropine	Parasympatholytic, Anti-cholinergic, Anti-ulcer agent, Central stimulant, For treatment of asthma, parkinsonism	[1, 71, 73-74]
Stramonium	Dried leaves and flowering tops	Solanaceae	*Datura stramonium*	USA, France, South America, Hungary Germany	l-hyoscyamine, Atropine, Hyoscine	Anti-cholinergic, Sedative, Anti-asthmatic agent, for treating motion sickness	[1, 71, 75-76]
Coca	Dried leaves	Erythroxylaceae	*Erythroxylum coca*, *Erythroxylum truxillense*	India, Peru, Sri Lanka, Columbia, Bolivia, Java	Cocaine, Cinnamylcocaine, Ecgonine, Dihydroxytropane, Methylecgonine, Benzoylecgonine, Cinnamoylecgonine, Benzoyltropine, α-truxilline	Local anesthetic, Stimulant	[1, 77-78]

Daruhaldi	Dried roots, rhizomes and bark	Berberidaceae	*Berberis aristata*	India	Berberine, Palmatine, Oxyberberine, Taxilamine, Barbamine, Jatrorrhizine, Columbamine	Anti-inflammatory agent, Antibiotic, Antipyretic, Blood purifier, Febrifuge, Tonic, Anti-diarrheal agent, Anti-bacterial agent, Astringent	[1, 79-82]
Datura	Dried leaves and flowering tops	Solanaceae	*Datura metel*	India, England	Scopalamine, Hyoscine, Atropine	Anti-ulcer, Parasympatholytic, Anti-cholinergic agent, for treating motion sickness and asthma, cough	[1, 71, 83-84]
Hyoscyamus	Dried leaves and flowering tops	Solanaceae	*Hyoscyamus niger*	India, Europe, North Africa, Russia, Hungary, Belgium	Atropine, l-hyoscyamine, Hyoscine	Antispasmodic, Anti-cholinergic agent, Expectorant, Sedative, Anti-asthmatic agent	[1, 71, 85-86]
Opium	Dried latex from unripe capsules	Papaveraceae	*Papaver somniferum*	India, China, Russia, Iran, Turkey	Papaverine, Narcotine, Heroin, Morphine, Codeine	Sedative, Narcotic analgesic, Hypnotic, For treating diarrhea and relieving cough	[1, 87-88]
Ephedra	Dried stems	Ephedraceae	*Ephedra gerardiana, Ephedra equisetina, Ephedra sinica*	India, Spain, China, Kenya, Australia	Ephedrine, Pseudoephedrine, n-methyl ephedrine, Norephedrine,	Anti-asthmatic, Bronchodilator, Sympathomimetic, For treating hay fever	[1, 89-92]
Cocoa	Seeds	Sterculiaceae	*Theobroma cocoa*	India, Sri Lanka, South America	Caffeine, Theobromine	Diuretic, Stimulant	[1, 93-97]
Gloriosa	Dried rhizomes and roots (tubers)	Liliaceae	*Gloriosa superba*	India, Africa	Colchicine	Anti-inflammatory, Anti-gout agent	[1, 98-100]
Ergot (Ergota, Ergot of Rye)	Dried sclerotium	Clavicipitaceae or Hypocreaceae	*Claviceps purpurea*	Hungary, Switzerland, Yugoslavia, Czechoslovakia	Ergotamine, Ergometrine, Ergosine, Methysergide, Ergocornine, Ergocryptine, Ergocristine, Ergosinine, Ergocrptinine, Ergometrinine, Ergocorninine, Ergotaminine	Oxytocic, for treating migraine, postpartum haemorrhage	[1, 101-110]

VIII. CONCLUSION

Alkaloids are secondary metabolites found in various plants in overall the World. Rauwolfia, Belladonna, Vinca, Vasaka, Ashwagandha, Kurchi, Cinchona are the rich cum potent sources of Reserpine, Atropine, Vincristine, Vasicine, Withaferin, Conessine, Quinine respectively all over the world. These alkaloids are basically used for various diseases treatment like leukemia, Hodgkin's disease, dysentery, diarrhea, fever, pain, gout, rheumatism, epilepsy, hypertension, bacterial and viral infections, ulcer, inflammation, bronchitis, asthma, glaucoma, tumor, cancer, malaria, liver diseases, and cardiovascular diseases. Besides these alkaloids are also used as astringent, blood purifiers, stimulants, tonic, stomachic, analgesic, diuretic, antispasmodic, anti-tussive, tranquilizers, sedatives, hypnotics, expectorant. Already too many species of alkaloidal plants were discovered. More research is going on alkaloids from all over the World in very broad level. Scientists are trying to find and discover newest roles by using new alkaloids discovered from plants. In future, we will expect that alkaloids are one of greatest achievements discovered by the scientist for the development of human kinds.

Conflicts of Interest: Nil

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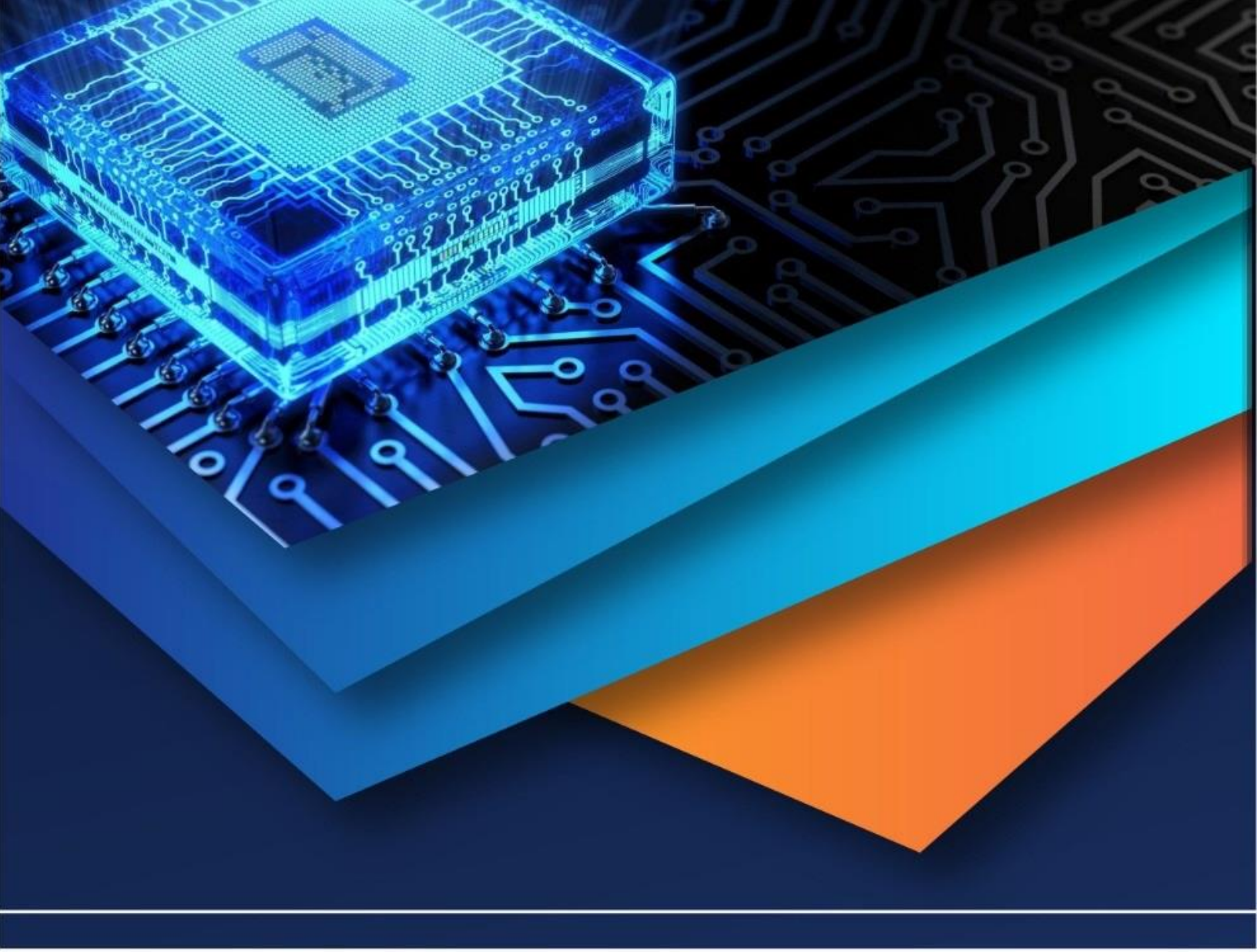

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