



IJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** X **Month of publication:** October 2024

DOI: <https://doi.org/10.22214/ijraset.2024.64767>

www.ijraset.com

Call:  08813907089

E-mail ID: ijraset@gmail.com

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

Somenath Bhattacharya¹, Soumallya Chakraborty²

^{1, 2}Assistant Professor, Department of Pharmaceutical Chemistry, Global College of Pharmaceutical Technology, Nadia, West Bengal, India

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	<i>Adhatoda vasica</i>	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	<i>Cinchona calisaya</i> , <i>Cinchona officinalis</i> , <i>Cinchona succirubra</i> , <i>Cinchona ledgeriana</i>	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	<i>Strychnos nux-vomica</i>	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	<i>Catharanthus roseus</i>	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	<i>Pilocarpus jaborandi</i> , <i>Pilocarpus trachylophus</i> , <i>Pilocarpus microphyllus</i> , <i>Pilocarpus selloanus</i> , <i>Pilocarpus pennatifolius</i>	India, South America, Caribbean Islands, Central America	Pilocarpine, Isopilocarpine, Pilosine, Isopilosine, Pseudopilocarpine	Cholinergic, for treating glaucoma	[1, 31-32]
Ashwagandha	Dried roots	Solanaceae	<i>Withania somnifera</i>	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	<i>Veratrum album</i> , <i>Veratrum viride</i>	USA, Canada	Veratridine, Protoveratrine A and B, Cevadine, Veratrine, Germitriene, Germidine, Cevadine, Veratrosine, Pseudojervine, Protoveratrine	Hypotensive, Cardiac depressant	[1, 35-36]
Aconite	Dried roots	Ranunculaceae	<i>Aconitum napellus</i>	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]
Shankpushpi	Aerial part	Gentianaceae	<i>Canscora decussata</i>	India, Sri Lanka, Myanmar	Convulouine, Shankhpuspine	Antiepileptic and treating different nervous disorders	[1, 39-40]
Bhringraj	All herbs	Asteraceae	<i>Ecilipta alba</i>	India	Wedelolactone, Wedelic acid	Hepatoprotective, Brain tonic, treating different hair and skin disorders	[1, 41-42]
Kurchi	Dried stem bark	Apocynaceae	<i>Holarrhena antidysenterica</i>	India	Conessine, Isoconessine, Holarrhmine, Holarrhidine, Norconessine, Dioxyconessine	Anti-protozoal, Anti-dysentery, Anti-amoebic agent	[1, 43-44]
Hemlock	Dried unripe fruits	Umbelliferae	<i>Conium maculatum</i>	Europe, North Africa, North America, New Zealand	Conine, Pseudo-conhydrine, Conhydrine, Gamma conicrine	Sedative, Antispasmodics	[1, 45-46]
Kola	Seeds	Sterculiaceae (for <i>Cola nitida</i>), Malvaceae (for <i>Cola acuminata</i>)	<i>Cola nitida</i> , <i>Cola acuminata</i>	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	<i>Lobelia nicotianaefolia</i>	India, USA, Holland	Lobelidine, Lobeline, Lobelamine, Lobelanidine, Isolobelanine	Respiratory stimulant, for treating asthma and bronchitis	[1, 50-51]
Rauwolfia	Dried roots and rhizomes	Apocynaceae	<i>Rauwolfia serpentina</i>	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	<i>Coffea Arabica</i> , <i>Coffea liberica</i>	India, Brazil, Mexico, Vietnam, Indonesia, Sri Lanka, Ethiopia	Trigonelline, Caffeine	Central nervous system stimulant, Diuretic	[1, 55-56]
Punarnava	Fresh and dried herb	Nyctaginaceae	<i>Boerhavia diffusa</i>	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)	<i>Camellia sinensis</i> (<i>Thea sinensis</i>)	India, China, Sri Lanka, Japan, Indonesia	Caffeine, Theobromine	Central nervous system stimulant, Diuretic	[1, 59-60]
Areca Nut	Dried ripe seeds	Palmae	<i>Areca catechu</i>	India, Philippines, Sri Lanka	Guvacine, Arecaidine, Arecoline, Guvacoline	Respiratory stimulant, Sialogogue, Parasympathomimetic	[1, 61-62]
Colchicum	Dried ripe seeds	Liliaceae	<i>Colchicum luteum</i> , <i>Colchicum autumnale</i>	India, Poland, Holland, England	Demecolcine, Colchicine	Anti-gout, Anti-rheumatic, Anti-tumor agent	[1, 63-64]
Camptotheca	Dried stem wood	Nyssaceae	<i>Camptotheca lowreyana</i> , <i>Camptotheca acuminata</i>	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	<i>Physostigma venenosum</i>	West Africa	Eseramine, Physostigmine, Eseroline, 8-norphysostigmine, Physovenine	Parasympathomimetic, Anticholinestase agent, for treating glaucoma and different cardiovascular disorders	[1, 67-68]
Ipecacuanha	Dried roots and rhizomes	Rubiaceae	<i>Cephaelis ipecacuanha</i> , <i>Cephaelis acuminata</i>	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	<i>Atropa belladonna</i> , <i>Atropa acuminata</i>	India, England	Atropine, Homotropine, Hyoscine, Hyoscyamine, Belladonine, Scopoletin	Parasympatholytic, Anti-cholinergic agent, Antispasmodic	[1, 71-72]
Duboisia	Dried leaves	Solanaceae	<i>Duboisia myoporoides</i> , <i>Duboisia leichhardtii</i>	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	<i>Datura stramonium</i>	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	<i>Erythroxylum coca</i> , <i>Erythroxylum truxillense</i>	India, Peru, Sri Lanka, Columbia, Bolivia, Java	Cocaine, Cinnamylcocaine, Ecgonine, Dihydroxytropine, Methylecgonine, Benzoylecgonine, Cinnamoylecgonine, Benzoyltropine, α -truxilline	Local anesthetic, Stimulant	[1, 77-78]

Daruhaldi	Dried roots, rhizomes and bark	Berberidaceae	<i>Berberis aristata</i>	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	<i>Datura metel</i>	India, England	Scopolamine, 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	<i>Hyoscyamus niger</i>	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	<i>Papaver somniferum</i>	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	<i>Ephedra gerardiana</i> , <i>Ephedra equisetina</i> , <i>Ephedra sinica</i>	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	<i>Theobroma cocoa</i>	India, Sri Lanka, South America	Caffeine, Theobromine	Diuretic, Stimulant	[1, 93-97]
Gloriosa	Dried rhizomes and roots (tubers)	Liliaceae	<i>Gloriosa superba</i>	India, Africa	Colchicine	Anti-inflammatory, Anti-gout agent	[1, 98-100]
Ergot (Ergota, Ergot of Rye)	Dried sclerotium	Clavicipitaceae or Hypocreaceae	<i>Claviceps purpurea</i>	Hungary, Switzerland, Yugoslavia, Czechoslovakia	Ergotamine, Ergometrine, Ergosine, Methysergide, Ergocornine, Ergocryptine, Ergocristine, Ergosinine, Ergocriptinine, Ergometrinine, Ergocorminine, 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

REFERENCES

- [1] Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. Nirali Prakashan. 2012;47:3.1-3.92.
- [2] Roy A. A review on the alkaloids an important therapeutic compound from plants. IJPB. 2017;3(2):1-9.
- [3] Badri S, Basu VR, Chandra K, Anasuya D. A review on pharmacological activities of alkaloids. World Journal of Current Medical and Pharmaceutical Research. 2019 Dec 31:230-4.
- [4] Shi QI, Hui SU, Zhang AH, Hong-Ying XU, Guang-Li YA, Ying HA, Xi-Jun WA. Natural alkaloids: basic aspects, biological roles, and future perspectives. Chinese Journal of Natural Medicines. 2014 Jun 1;12(6):401-6.

- [5] Eguchi R, Ono N, Hirai Morita A, Katsuragi T, Nakamura S, Huang M, Altaf-Ul-Amin M, Kanaya S. Classification of alkaloids according to the starting substances of their biosynthetic pathways using graph convolutional neural networks. *BMC bioinformatics*. 2019 Dec;20:1-3.
- [6] Rajput A, Sharma R, Bharti R. Pharmacological activities and toxicities of alkaloids on human health. *Materials Today: Proceedings*. 2022 Jan 1;48:1407-15.
- [7] Schläger S, Dräger B. Exploiting plant alkaloids. *Current opinion in biotechnology*. 2016 Feb 1;37:155-64.
- [8] Kaur RA, Arora SA. Alkaloids-important therapeutic secondary metabolites of plant origin. *J Crit Rev*. 2015;2(3):1-8.
- [9] Koleva II, van Beek TA, Soffers AE, Dusemund B, Rietjens IM. Alkaloids in the human food chain—natural occurrence and possible adverse effects. *Molecular nutrition & food research*. 2012 Jan;56(1):30-52.
- [10] Heinrich M, Mah J, Amirkia V. Alkaloids used as medicines: Structural phytochemistry meets biodiversity—An update and forward look. *Molecules*. 2021 Mar 25;26(7):1836.
- [11] Brihi N. Pharmacological activity of alkaloids: a review. *Asian journal of botany*. 2018 Apr;1(1):1-6.
- [12] Sofowora A, Ogunbodede E, Onayade A. The role and place of medicinal plants in the strategies for disease prevention. *African journal of traditional, complementary and alternative medicines*. 2013 Aug 14;10(5):210-29.
- [13] Shaikh JR, Patil M. Qualitative tests for preliminary phytochemical screening: An overview. *International Journal of Chemical Studies*. 2020 Mar 1;8(2):603-8.
- [14] Kancherla N, Dhakshinamoothi A, Chitra K, Komaram RB. Preliminary analysis of phytoconstituents and evaluation of anthelmintic property of *Cayratia auriculata* (in vitro). *Maedica*. 2019 Dec;14(4):350.
- [15] Sasikala M, Sundaraganapathy R. Qualitative analysis of alkaloids exist in the hydroalcoholic extract of *Ipomoea aquatica* for SSK in Tamil Nadu. *International Journal of ChemTech Research*. 2017;10(7):446-54.
- [16] Kumar S, Singh BB, Kumar N. Physico-chemical and phytochemical investigation of plant *Sesbania sesban*. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*. 2014;5(1):110-7.
- [17] Sharma V, Chaudhary U. Pharmacognostic and phytochemical screening of *Helicteres isora* roots. *Asian J Pharm Clin Res*. 2016 May;9(2):96-101.
- [18] Singh SK, Patel JR, Dangi A, Bachle D, Kataria RK. A complete over review on *Adhatoda vasica* a traditional medicinal plants. *J Med plants stud*. 2017;5(1):175-80.
- [19] Claeson UP, Malmfors T, Wikman G, Bruhn JG. *Adhatoda vasica*: a critical review of ethnopharmacological and toxicological data. *Journal of ethnopharmacology*. 2000 Sep 1;72(1-2):1-20.
- [20] Shoaib A. A systematic ethnobotanical review of *Adhatoda vasica* (L.), Nees. *Cellular and Molecular Biology*. 2021;67(4):248-63.
- [21] Parveen S, Maurya N, Meena A, Luqman S. Cinchonine: A Versatile Pharmacological Agent Derived from Natural *Cinchona* Alkaloids. *Current Topics in Medicinal Chemistry*. 2024 Feb 1;24(4):343-63.
- [22] Boratyński PJ, Zielińska-Błajet M, Skarzewski J. *Cinchona* alkaloids—derivatives and applications. *The Alkaloids: Chemistry and Biology*. 2019 Jan 1;82:29-145.
- [23] Gachelin G, Garner P, Ferroni E, Tröhler U, Chalmers I. Evaluating *Cinchona* bark and quinine for treating and preventing malaria. *Journal of the Royal Society of Medicine*. 2017 Feb;110(2):73-82.
- [24] Kumar S. Alkaloidal drugs-A review. *Asian Journal of Pharmaceutical Science & Technology*. 2014;4(3):107-19.
- [25] Kushwaha RK, Berval R, Sharma A. The therapeutic and toxicological effect of kupilu (*Strychnos nux-vomica* L.)—A Review. *Ayushdhara*. 2014;1(2):1-4.
- [26] Xu YY, Si DY, Liu CX. Research on bioresponse of active compounds of *Strychnos nux-vomica* L. *Asian J Pharmacokin Pharmacodyn*. 2009;9:179-201.
- [27] Renjini KR, Gopakumar G, Latha MS. The medicinal properties of phytochemicals in *Catharanthus roseus*—a review. *Eur. J. Pharma. Med. Res*. 2017;4:545-51.
- [28] Chaturvedi V, Goyal S, Mukim M, Meghani M, Patwekar F, Patwekar M, Khan SK, Sharma GN. A comprehensive review on *Catharanthus roseus* L.(G.) Don: clinical pharmacology, ethnopharmacology and phytochemistry. *J. Pharmacol. Res. Dev*. 2022;4(2):17-36.
- [29] Retna AM, Ethalsha P. A review of the taxonomy, ethnobotany, chemistry and pharmacology of *Catharanthus roseus* (Apocyanaceae). *Int J Eng Res Technol*. 2013;2(10):3899-912.
- [30] Mayer S, Keglevich P, Keglevich A, Hazai L. New anticancer vinca alkaloids in the last decade-A mini-review. *Current Organic Chemistry*. 2021 May 1;25(10):1224-34.
- [31] Cho JH, Bhattarai S, Oh TJ, Jang JH. Enzymatic extraction of pilocarpine from *Pilocarpus jaborandi*. *Microbiology and Biotechnology Letters*. 2013;41(2):236-41.
- [32] de Jesus PM, Caldeira CF, Gastauer M, Ribeiro PG, Ramos SJ. Prediction of pilocarpine production from soil attributes and the nutritional status of *Pilocarpus microphyllus*. *Journal of Plant Nutrition*. 2023 Jun 15;46(10):2393-406.
- [33] Ningaraju GK, Praveenakumar R, Gopinath G. Integrated nutrient management in ashwagandha (*Withania somnifera*): A Review. *Journal of pharmacognosy and Phytochemistry*. 2018;7(3S):118-21.
- [34] Mishra LC, Singh BB, Dagenais S. Scientific basis for the therapeutic use of *Withania somnifera* (ashwagandha): a review. *Alternative medicine review*. 2000 Aug 1;5(4):334-46.
- [35] Krayer O, Acheson GH. The pharmacology of the veratrum alkaloids. *Physiological Reviews*. 1946 Jul 1;26(3):383-446.
- [36] Morgan KJ, Bartrop JA. Veratrum alkaloids. *Quarterly Reviews, Chemical Society*. 1958;12(1):34-60.
- [37] Nyirimigabo E, Xu Y, Li Y, Wang Y, Agyemang K, Zhang Y. A review on phytochemistry, pharmacology and toxicology studies of *Aconitum*. *Journal of Pharmacy and Pharmacology*. 2015 Jan;67(1):1-9.
- [38] Chan TY. *Aconitum* alkaloid poisoning because of contamination of herbs by aconite roots. *Phytotherapy Research*. 2016 Jan;30(1):3-8.
- [39] Kousalya L, Bai VN. Effect of growth regulators on rapid micropropagation and antioxidant activity of *Canscora decussata* (Roxb.) Roem. & Schult. á—A threatened medicinal plant. *Asian Pacific Journal of Reproduction*. 2016 Apr 1;5(2):161-70.
- [40] Sethiya NK, Nahata A, Dixit VK, Mishra SH. Cognition boosting effect of *Canscora decussata* (a South Indian Shankhpushpi). *European Journal of Integrative Medicine*. 2012 Mar 1;4(1):e113-21.
- [41] Mukhopadhyay G, Kundu S, Sarkar A, Sarkar P, Sengupta R, Kumar C. A review on physicochemical & pharmacological activity of *Eclipta alba*. *The Pharma Innovation Journal*. 2018;7(9):78-83.
- [42] Yadav NR, Huddar S. A Comprehensive Review of *Bhringraj* (*Eclipta alba* L.) from Ayurveda Perspective. *International Research Journal of Ayurveda and Yoga*. 2024 Jan 31;7(1):97-101.

- [43] Sinha S, Sharma A, Reddy PH, Rathi B, Prasad NV, Vashishtha A. Evaluation of phytochemical and pharmacological aspects of *Holarrhena antidysenterica* (Wall.): A comprehensive review. *Journal of Pharmacy research*. 2013 Apr 1;6(4):488-92.
- [44] Tiwari R, Khatri C, Tyagi LK, Tiwari G. Expanded Therapeutic Applications of *Holarrhena Antidysenterica*: A Review. *Combinatorial Chemistry & High Throughput Screening*. 2024 Jun 1;27(9):1257-75.
- [45] Al-Snafi AE. Pharmacology and toxicology of *Conium maculatum*-A review. *The Pharmaceutical and Chemical Journal*. 2016;3(2):136-42.
- [46] Chizzola R, Lohwasser U. Diversity of Secondary Metabolites in Roots from *Conium maculatum* L. *Plants*. 2020 Jul 24;9(8):939.
- [47] Sanusi KO, Usman UZ, Usman D, Adeshina KA, Uthman YA, Jimoh L, Imam-Fulani AO. The Therapeutic Potential of *Cola nitida* in Health and Disease: A Review. *Biology, Medicine, & Natural Product Chemistry*. 2023;12(2):637-43.
- [48] Oduyayo OI, Adeyemi FA, Adebola PO, Sotimehim OI. Compatibility studies in *Cola nitida* genotypes. *Journal of Plant Breeding and Crop Science*. 2018 Apr 30;10(4):80-5.
- [49] Ekalu A, Habila JD. Phytochemistry, pharmacology and medicinal uses of *Cola* (Malvaceae) family: a review. *Medicinal Chemistry Research*. 2020 Dec;29:2089-105.
- [50] Folquitto DG, Swiech JN, Pereira CB, Bobek VB, Possagno GC, Farago PV, Miguel MD, Duarte JL, Miguel OG. Biological activity, phytochemistry and traditional uses of genus *Lobelia* (Campanulaceae): A systematic review. *Fitoterapia*. 2019 Apr 1;134:23-38.
- [51] D Mankar G, B Gulave A, D Datkhile K, B Zimare S. Altitudinal gradients influence the accumulation of pharmaceutically important phenolic compounds in the leaves of *Lobelia nicotianifolia* Roth. and regulates its antioxidant and anticancer property. *Indian Journal of Biochemistry and Biophysics (IJBB)*. 2021 May 22;58(3):253-60.
- [52] Phillips DD, Chadha MS. The alkaloids of *Rauwolfia serpentina* Benth. *Journal of the American Pharmaceutical Association*. 1955 Sep;44(9):553-67.
- [53] Rungtung W, Dutta S, Mondal DN, Ratha KK, Hazra J. Pharmacognostical profiling on the root of *Rauwolfia serpentina*. *Int. J. Pharmacogn. Phytochem. Res*. 2014;6:612-6.
- [54] Bairagi B, Ali MZ, Tiwari H. RAUWOLFIA SERPENTINA: A REVIEW ON BIOLOGICAL AND MEDICINAL PROPERTIES. *EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE*. 2024 Jun 29;4(6):523-9.
- [55] Van der Vossen H, Bertrand B, Charrier A. Next generation variety development for sustainable production of arabica coffee (*Coffea arabica* L.): a review. *Euphytica*. 2015 Jul;204(2):243-56.
- [56] ALAsmari KM, Zeid IM, Al-Attar AM. Medicinal properties of Arabica coffee (*Coffea arabica*) oil: An Overview. *Advancements in Life Sciences*. 2020 Nov 27;8(1):20-9.
- [57] Mahesh AR, Kumar H, Ranganath MK, Devkar RA. Detail study on *Boerhaavia diffusa* plant for its medicinal importance-A Review. *Res J Pharm Sci*. 2012 Sep;1(1):28-36.
- [58] Dora BB, Gupta S, Sital S, Pastore A. Punarnava (*Boerhavia diffusa*): A promising indigenous herbal drug and its effect on different disease conditions. *Research and Reviews: Journal of Herbal Science*. 2018;4:21-4.
- [59] Sharangi AB. Medicinal and therapeutic potentialities of tea (*Camellia sinensis* L.)—A review. *Food research international*. 2009 Jun 1;42(5-6):529-35.
- [60] Zhang L, Ho CT, Zhou J, Santos JS, Armstrong L, Granato D. Chemistry and biological activities of processed *Camellia sinensis* teas: A comprehensive review. *Comprehensive Reviews in Food Science and Food Safety*. 2019 Sep;18(5):1474-95
- [61] Xiao Y, Yang Y, Yong J, Lu C. Chemical components and biological activities of *Areca catechu* L. *Biomedical Research and Reviews*. 2019;3(3):1-4.
- [62] Bhat SK, Ashwin D, Sarpangala M. Contamination and adulteration in arecanut (*Areca catechu* L.) and its chewing foms: The less focused subject by health researchers. *IOSR J. Environ. Sci. Toxicol. Food Tech*. 2017;11(1):07-12.
- [63] Akram M, Alam O, Usmanghani K, Akhter N, Asif HM. *Colchicum autumnale*: A review. *Journal of Medicinal Plants Research*. 2012 Feb 29;6(8):1489-91.
- [64] Özçakır B, Atay MÖ, Atlı B, Usluer E, Haşçelik S, Özkılınç BB, Rakhimzhanova A. Molecular, Biological and Content Studies on *Colchicum* L. Species. *Natural Products and Biotechnology*. 2021 Jun 15;1(1):49-63.
- [65] Sirikantaramas S, Asano T, Sudo H, Yamazaki M, Saito K. Camptothecin: therapeutic potential and biotechnology. *Current Pharmaceutical Biotechnology*. 2007 Aug 1;8(4):196-202.
- [66] Lin X, Lu C, Huang Y, Zheng Z, Su W, Shen Y. Endophytic fungi from a pharmaceutical plant, *Camptotheca acuminata*: isolation, identification and bioactivity. *World Journal of Microbiology and Biotechnology*. 2007 Jul;23:1037-40.
- [67] Zhao B, Moochhala SM, Tham SY. Biologically active components of *Physostigma venenosum*. *Journal of Chromatography B*. 2004 Dec 5;812(1-2):183-92.
- [68] Pinheiro GK, Araújo Filho ID, Araújo Neto ID, Rêgo AC, Azevedo EP, Pinheiro FI, Lima Filho AA. Nature as a source of drugs for ophthalmology. *Arquivos brasileiros de oftalmologia*. 2018 Sep;81:443-54.
- [69] Mondal S, Moktan S. A paradoxically significant medicinal plant *carapichea ipecacuanha*: A review. *Indian J. Pharm. Educ. Res*. 2020 Apr 1;54:s56-66.
- [70] Jha S, Sahu NP, Mahato SB. Production of the alkaloids emetine and cephaeline in callus cultures of *Cephaelis ipecacuanha*. *Planta medica*. 1988 Dec;54(06):504-6.
- [71] Bhattacharya S, Chakraborty S, Roy A, Bhattacharjee A. Solanaceae Containing Medicinal Plants and Its Importance: An Overview. *International Journal of Pharmaceutical Sciences Review and Research*. 2023;83(2):106-112.
- [72] Kilmer FB. *Belladonna* monographs. *Journal of the American Pharmaceutical Association*. 1932 Apr 1;21(4):366-75.
- [73] De Rios MD, Stachalek R. The *Duboisia* genus, Australian aborigines and suggestibility. *Journal of psychoactive drugs*. 1999 Apr 1;31(2):155-61.
- [74] Foley P. *Duboisia myoporoides*: the medical career of a native Australian plant. *Historical Records of Australian Science*. 2006;17(1):31-69.
- [75] Soni P, Siddiqui AA, Dwivedi J, Soni V. Pharmacological properties of *Datura stramonium* L. as a potential medicinal tree: an overview. *Asian Pacific journal of tropical biomedicine*. 2012 Dec 1;2(12):1002-8.
- [76] Gaire BP, Subedi L. A review on the pharmacological and toxicological aspects of *Datura stramonium* L. *Journal of integrative medicine*. 2013 Mar 1;11(2):73-9.
- [77] Grinspoon L, Bakalar JB. Coca and cocaine as medicines: an historical review. *Journal of ethnopharmacology*. 1981 Mar 1;3(2-3):149-59.
- [78] Toynne M. Transformation of Coca to Cocaine: An Overview of Traditional Drug Use and Modern Drug Abuse. *The University of Western Ontario Journal of Anthropology*. 2023 Mar 30;25(1):94-115.

- [79] Khan MI, Rahman MA, Badruddeen, Khalid M, Khushhtar M, Mujahid M. Quality control standardization and evaluation of antimicrobial potential of Daruhaldi (Berberis aristata DC) stem bark. *Journal of dietary supplements*. 2020 Jan 2;17(1):97-109.
- [80] Komal S, Ranjan B, Neelam C, Birendra S, Kumar SN. Berberis aristata: A review. *Int J Res Ayurveda Pharm*. 2011;2(2):383-8.
- [81] Chander V, Aswal JS, Dobhal R, Uniyal DP. A review on Pharmacological potential of Berberine; an active component of Himalayan Berberis aristata. *J Phytopharmacol*. 2017;6(1):53-8.
- [82] Podar D, Hirwani RR, Dhulap S. Phyto-chemical and pharmacological applications of Berberis aristata. *Fitoterapia*. 2012 Jul 1;83(5):817-30.
- [83] Alam W, Khan H, Khan SA, Nazir S, Akkol EK. Datura metel: A review on chemical constituents, traditional uses and pharmacological activities. *Current pharmaceutical design*. 2021 Jun 1;27(22):2545-57.
- [84] Neha RS, Rai G, Mourya P, Pandey V. Therapeutic and detrimental effects of Datura: A systematic review. *Advance Pharmaceutical Journal*. 2022;7(6):181-8.
- [85] Begum AS. Bioactive non-alkaloidal secondary metabolites of Hyoscyamus niger Linn. seeds: A review. *Research Journal of Seed Science*. 2010;3(4):210-7.
- [86] Haj Rasouli Ha S, Maasoumi AA, Nejad Satari T, Hamdi MM, Mehrgan I. A review of the genus Hyoscyamus (Solanaceae) in Iran. *Taxonomy and Biosystematics*. 2015 Dec 22;7(25):83-94.
- [87] Labanca F, Ovesna J, Milella L. Papaver somniferum L. taxonomy, uses and new insight in poppy alkaloid pathways. *Phytochemistry reviews*. 2018 Aug;17:853-71.
- [88] Stranska I, Skalicky M, Novak J, Matyasova E, Hejnak V. Analysis of selected poppy (Papaver somniferum L.) cultivars: Pharmaceutically important alkaloids. *Industrial Crops and Products*. 2013 Jan 1;41:120-6.
- [89] Bent S, Tiedt TN, Odden M, Shlipak MG. The relative safety of ephedra compared with other herbal products. *Annals of internal medicine*. 2003 Jun 17;138(12):1006-7.
- [90] Amakura Y, Yoshimura M, Yamakami S, Yoshida T, Wakana D, Hyuga M, Hyuga S, Hanawa T, Goda Y. Characterization of phenolic constituents from Ephedra herb extract. *Molecules*. 2013 May 10;18(5):5326-34.
- [91] Dousari AS, Satarzadeh N, Amirheidari B, Forootanfar H. Medicinal and therapeutic properties of ephedra. *Revista Brasileira de Farmacognosia*. 2022 Dec;32(6):883-99.
- [92] Abourashed EA, El-Alfy AT, Khan IA, Walker L. Ephedra in perspective—a current review. *Phytotherapy research*. 2003 Aug;17(7):703-12.
- [93] Araujo QR, Gattward JN, Almoosawi S, Parada Costa Silva MD, Dantas PA, Araujo Júnior QR. Cocoa and human health: From head to foot—A review. *Critical reviews in food science and nutrition*. 2016 Jan 2;56(1):1-2.
- [94] Van Vliet JA, Giller KE. Mineral nutrition of cocoa: a review. *Advances in agronomy*. 2017 Jan 1;141:185-270.
- [95] Kongor JE, Hinneh M, Van de Walle D, Afoakwa EO, Boeckx P, Dewettinck K. Factors influencing quality variation in cocoa (Theobroma cacao) bean flavour profile—A review. *Food Research International*. 2016 Apr 1;82:44-52.
- [96] Rusconi M, Conti A. Theobroma cacao L., the Food of the Gods: A scientific approach beyond myths and claims. *Pharmacological research*. 2010 Jan 1;61(1):5-13.
- [97] Lachenaud P, Motamayor JC. The Criollo cacao tree (Theobroma cacao L.): a review. *Genetic Resources and Crop Evolution*. 2017 Dec;64(8):1807-20.
- [98] Jana S, Shekhawat GS. Critical review on medicinally potent plant species: Gloriosa superba. *Fitoterapia*. 2011 Apr 1;82(3):293-301.
- [99] Ashokkumar K. Gloriosa superba (L.): a brief review of its phytochemical properties and pharmacology. *Int J Pharmacogn Phytochem Res*. 2015;7(6):1190-3.
- [100] Badwaik H, Giri TK, Tripathi DK, Singh M, Khan AH. A Review on Pharmacological Profile for Phytomedicine Known as Gloriosa superba Linn. *Research Journal of Pharmacognosy and Phytochemistry*. 2011;3(3):103-7.
- [101] Sharma N, Sharma VK, Manikyam HK, Krishna AB. Ergot alkaloids: A review on therapeutic applications. *European Journal of Medicinal Plants*. 2016 Apr 21;14(3):1-7.
- [102] Kraska R, Crews C. Significance, chemistry and determination of ergot alkaloids: A review. *Food Additives and Contaminants*. 2008 Jun 1;25(6):722-31.
- [103] Florea S, Panaccione DG, Schardl CL. Ergot alkaloids of the family Clavicipitaceae. *Phytopathology*. 2017 May 17;107(5):504-18.
- [104] Tudzynski P, Scheffer JA. Claviceps purpurea: molecular aspects of a unique pathogenic lifestyle. *Molecular Plant Pathology*. 2004 Sep;5(5):377-88.
- [105] Tudzynski PA. Genetics of Claviceps purpurea. *Medicinal and Aromatic Plants—Industrial Profiles*. 1999;6:79-93.
- [106] Al-Omari R, Al-Enazi A, Ahmad R, Ahmad N, Naqvi AA, Shehzad A. Clinical uses and toxicity of Ergot, Claviceps purpurea An evidence-based comprehensive retrospective review. *Bioscience Biotechnology Research Communications*. 2018;1:356-62.
- [107] Evans WC. *Trease and Evans Pharmacognosy*. Saunders Elsevier. 2009;16:394-398.
- [108] Tudzynski P, Hölter K, Correia T, Arntz C, Grammel N, Keller U. Evidence for an ergot alkaloid gene cluster in Claviceps purpurea. *Molecular and General Genetics MGG*. 1999 Feb;261:133-41.
- [109] Eadie MJ. Ergot of rye—the first specific for migraine. *Journal of Clinical Neuroscience*. 2004 Jan 1;11(1):4-7.
- [110] Reinhard H, Rupp H, Zoller O. Ergot alkaloids: Quantitation and recognition challenges. *Mycotoxin Research*. 2008 Mar;24:7-13.



10.22214/IJRASET



45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  (24*7 Support on Whatsapp)