REVIEW

AN UPDATED REVIEW ON *CATHARANTHUS ROSEUS*: PHYTOCHEMICAL AND PHARMACOLOGICAL ANALYSIS

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ABSTRACT:
Catharanthus roseus commonly known as evergreen herb is one of famous medicinal herb in the field of cancer treatment. Many famous phytochemicals such as vincristine and vinblastine were isolated from this medicinal plant. It has many pharmacological properties such as anti-oxidant, anti-microbial, anti-diabetic, wound healing, anti-ulcer, hypotensive, antidiarrhoeal, hypolipidemic and memory enhancement. Alkaloids are one of major phytochemicals responsible for its anti-cancer properties followed by phenolic compounds such as flavonoids. The purpose of the current study is to document updated data about its traditional uses, isolated bioactive compounds and pharmacological activities reported.

KEYWORDS: Catharanthus roseus; Phytochemicals; Pharmacological activities; Medicinal herbs; Traditional medicine.

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INTRODUCTION

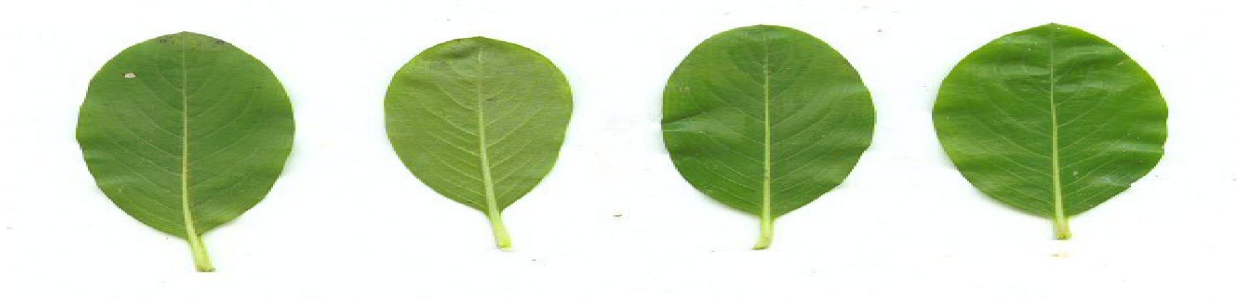
Medicinal plants have a long history of usage in traditional medicine. Ethno-botanical information on medicinal plants and their usage by indigenous cultures is useful in the conservation of traditional cultures, biodiversity, community health care and drug development [1]. The authentic knowledge of the usage of medicinal plants passed from one *generation* to another, after refining and addition [2]. The folk recipes are prepared either from the whole plant or from their different parts, like leaf, stem, bark, root, flower, seed, *etc*. and also from their secondary product such as gum, resins, and latex [3]. In the human body, medicinal plants interact directly or indirectly with the body chemistry by the chemical constituents. Once the active constituents are absorbed into the blood, theses constituents derive the required benefits by circulating and influencing the blood steam [4]. Plants supply minerals, vitamins, and certain hormone precursors in addition to protein and energy to human body [5]. Trace elements have significant roles in combating a variety of human aliments and disease was observed by the study of elements with respect to indigenous medicinal plants [6].

Catharanthus roseus is an evergreen sub herb plant growing to 1 m tall. The leaves are oval to oblong, 2.5- 9.5 cm. long and 1-3.5 cm. broad glossy green hairless with a pale midrib and a short petiole about 1- 1.8 cm. long and they are arranged in the opposite pairs. The flowers are white to dark pink with a dark red center, with a basal tube about 2.5-3 cm. long and a corolla about 2-5 cm. diameter with 5 petal like lobes. The fruit is a pair of follicles about 2-4 cm. long and 3 mm broad [7].

(A)

(B)

(C)



(D)

Figure -1: (A) Catharanthus Roseus (B) Flower (C) Fruit and Seed (D) Leaves

TRADITIONAL USE OF *CATHARANTHUS ROSEUS*

The plant has historically been used to treat a wide assortment of diseases. It was used as folk remedy for diabetes in Europe for centuries [8]. In India, juice from the leaves was used to treat wasp stings. In Hawaii, the plant was boiled to make a poultice to stop bleeding. In china, it was used as an astringent, diuretic and cough remedy [9]. In central and south America, it was used as a homemade cold remedy to ease lung congestion and inflammation. Throughout the Caribbean, an extract from the flowers was used to make a solution to treat eye irritation and infections. It also had a reputation as amagic plant, Europeans thought it could ward off evil spirits, and the French referred to it as "violet of the sorcerers" Western researchers finally noticed the plant in 1950's when they learnt of a tea that Jamaicanswere drinking to treat diabetes. They discovered that the plant contains a lot of useful alkaloids (130 in all at last count). Some, such as catharanthine, leurosinesulfate, lochnerine, tetrahydroalstonine, vindoline and vindolinine lower blood sugar level, however, others act as haemostatics (arrest bleeding) and two others, vincristine and vinblastine have anticancerous properties. Periwinkle also contains the alkaloids reserpine and serpentine, which are powerful tranquilizers. Table1. Summarized traditional uses of the *Catharanthus roseus* in different-countries.

Table: 1: **Traditional Medicinal Uses of *Catharanthus roseus* in various developed and developing countries.**

Countries	Uses	Reference
Australia	Hot water extract of dried leaves is taken orally for menorrhagia, diabetes, and extract of root bark is taken orally as afebrifuge.	[10] &[11]
Brazil	The hot water extract of dried whole plant is taken orally by ahuman for diabetes mellitus.	[12]&[13]
China	Hot water extract of the aerial parts is taken orally as a menstrual regulator.	[9]&[14]
Cook-Island	Decoction of dried leaves used orally to treat diabetes, hypertension and Cancer.	[15]
Dominica	Hot water extract of leaves is taken orally by pregnant woman to combat primary inertia in childbirth and the boiled leaves are used to treat diabetes.	[16]
England	Hot water extract of dried whole plant is taken orally for the curing of diabetes	[17]

Europe	Decoction of dried leaves is taken orally for diabetes mellitus.	[8]
France	Hot water extract of entire plant is taken as an antigalactagogue	[9]
French	Guina Hot water extract of theentire plant is taken orally as a cholagogue.	[18]
India	The hot water extract of dried entire plant is taken orally by human for cancer. Hot water extract of dried leaves areuse orally to Hodgkin's disease. The root the extract is taken orally for menorrhagia.	[14]&[19]
Jamaica	Hot water extract of dried leaves is taken orally for diabetes.	[20]
Kenya	Hot water extract of dried leaves is taken orally for diabetes.	[20]
Mexico	Infusion of whole plant is taken orally for stomach problem.	[21]
Malaysia	Hot water extract of dried leaves is taken orally for diabetes.	[22]
Mozambique	Hot water extract of leaves is taken orally for diabetes and rheumatism and the root extract is use orally as hypotensive and febrifuge	[23]
North Vietnam	Hot water extract of the aerial parts is taken orally as a menstrual regulator	[9]&[14]
Pakistan	Hot water extract of dried ovules is utilized orally for diabetes.	[24]
Peru	Hot water extract of dried whole plant is used orally by human adults for cancers, heart disease and leishmaniasis.	[25]
Philippines	Hot water extract of theroot is taken orally by pregnant women to produce abortion.	[26], [27]&[14]
South Africa	Hot water extract of dried leaves is taken orally for menorrhagia and diabetes.	[10]
South Vietnam	Hot water extract of the entire plant is used orally by human adults as an antigalactagogue.	[9], [14]
Taiwan	Decoction of dried whole plant is used orally by human adults to treat diabetes mellitus1, and liver disease,	[27]&[28]
Thailand	Hot water extract of dried entire plant is taken orally for diabetes.	[29]
USA	Hot water extract of leaves is smoked as a euphoriant.	[30]
Venda	Water extract of dried root is taken orally for venereal disease.	[31]
Vietnam	Hot water extract of dried aerial parts is taken orally as adrug in Vietnamese traditional medicine, listed in Vietnamesepharmacopeia (1974 Edition).	[32]
West Indies	Hot water extract of leafy stems is taken orally for diabetes.	[33]

PHARMACOLOGICAL ACTIVITIES:

ANTI OXIDANT PROPERTY:

In the last years, oxidative stress-related diseases/disorders have gained a special attention. Metabolic, neurodegenerative, cardiovascular, mitochondrial diseases and even cancer, are among the most frequent [34] &[35].Numerous studies have been investigating the underlying triggering factors, in order to understand the mechanisms of action of free radicals, as well as to discover effective substances towards preventing and even reversing the occurrence of oxidative damages [36] & [37]. Antioxidants, both from natural and synthetic sources, have proved to be highly effective to control the magnitude of free radicals production, to prevent its undesirable effects, as well as to support the organism's antioxidant and detoxifying mechanisms [38], [39] & [40]. Phenolic compounds have shown promising antioxidant properties, with its potential

being directly related to the type of solvent used in the extraction, but also with plant origin, growing conditions, harvesting time, and storage conditions [41] & [42]. The study of the antioxidant potential of phenolic extracts derived from plant species is one of the hot topics among the scientific community; however, in vitro studies are the most common [43], [44] & [45].

Catharanthus roseus contains significant amounts of volatile and phenolic compounds including caffeoylquinic acids and flavonol glycosides which are known to possess antioxidant activity. It has an important role in the body'sdefense system that acts as antioxidants against reactive oxygen species (ROS), which are harmful by forming such products through normal cell aerobic respiration [46]. Accumulation of free radicals can cause pathological conditions such as ischemia, asthma, arthritis, inflammation, neuro-degeneration, Parkinson's diseases, mongolism, aging process and perhaps dementia [47]. The flower petals, seeds and other parts of *Catharanthus roseus* exhibit antioxidant properties. Thus, phenolic compounds have redox properties that act as reducing agents, hydrogen donors, singlet oxygen quenchers or metal chelators. It has multiple applications in foods, cosmetics, and pharmaceutical industries. Besides antioxidant activity, these compounds exhibit antiallergic, anti-inflammatory, antimicrobial, anti-thrombotic, cardio protective and vasodilatory effects [48].

The anti oxidant potential of the ethanolic extract of the roots of the two varieties of *Catharanthus roseus* namely rosea (pink flower) and alba (white flower) was obtained by using a different system of the assay such as hydroxyl radicalscavenging activity, superoxide radical-scavenging activity, DPPH radical- scavenging activity and nitric oxide radical inhibition method. The result obtained proved that the ethanolic extract of the roots of Periwinkle varieties has exhibited the satisfactory scavenging effect in the entire assay in a concentration dependent manner but *Catharanthus roseus* was found to possess more antioxidant activity than that of C. Alba [49].

ANTI CANCER ACTIVITY:

The anticancer alkaloids vinblastine and vincristine are derived from stem and leaf of *Catharanthus roseus*. These alkaloids have growth inhibition effect to some human tumors. Vinblastine is used experimentally for thetreatment of neoplasms and is recommended for Hodgkin's disease andchoriocarcinoma. Vincristine another alkaloid is used for leukemia in children. Different percentage of the methanolic crude extracts of *Catharanthus roseus* was found to show the significant anticancer activity against numerous cell types in vitro condition and especially greatest activity was found against the multidrug resistant tumor types. Vinblastine is sold as Velban and Vincristine as oncovin[50] & [51].

ANTI DIABETIC ACTIVITY:

The ethanolic extracts of the leaves and flower of *Catharanthus roseus* showed a dose-dependent lowering of blood sugar compare to the standard drug, glibenclamide. The hypoglycemic effect has appeared due to the result of the increase glucose utilization in the liver. The aqueous extract was found to lower the blood glucose to about 20% in diabetic rats when compared to that of the dichloromethane and methanol extracts which lowered the blood glucose level to 49-58%. The hypoglycemic effect has appeared due to the result of the increased glucose utilization in the liver. The hypoglycemic activity of alkaloids isolated from *Catharanthus roseus* have been studied pharmacologically and a remedy derived from the plant has been marketed under the proprietary name Vinculin as a treatment for diabetes [52] & [53].

ANTI MICROBIAL ACTIVITY:

Crude extracts from different parts of the plant were tested for anti-bacterial activity. Extract from leaves showed significantly higher efficacy. The anti-bacterial activity of the leaf extract of the plant was checked against microorganism like *Pseudomonas aeruginosa* NCIM2036, *Salmonella typhimuruim* NCIM2501, *Staphylococus aureus* NCIM5021 and was found that the extracts could be used as the prophylactic agent in the treatment of many of the disease[54].

ANTI-ULCER PROPERTY:

Vincamine and Vindoline alkaloids of the plant showed antiulcer property. The plant leaves proved for anti-ulcer activity against experimentally induced gastric damage in rats [55].

HYPOTENSIVE PROPERTY:

Extract of leaves of the plant made a significant change in decreasing the blood pressure. The leaves have been known to contain 150 useful alkaloids among other pharmacologically active compounds. Significant antihyperglycemic and hypotensive activity of the leaf extracts (hydroalcoholic or dichloromethane-methanol) have been reported in laboratory animals [56].

ANTI DIARRHEAL PROPERTY:

The anti-diarrheal activity of the plant's ethanolic leaf extractwas tested in the Wistar rats with castor oil as experimental diarrhea inducing agent.*Catharanthus roseus*showed a dose dependent inhibition of the castor oil-induced diarrhea[57].

WOUND HEALING PROPERTY:

Rats treated with 100 mg /kg/day of *Catharanthus roseus* ethanol extract had a high rate of wound contraction significantly decreased epithelization period, and showed significant increase in dry weight and hydroxyproline content of the granulation tissue when compared with the controls. Wound contraction together with increased tensile strength and hydroxyproline content support the use of *Catharanthus roseus* in the management of wound healing[58].

HYPOLIPIDIMIC EFFECT:

Significant anti atherosclerotic activity was observed in a study as suggested by reduction in the serum levels of total cholesterol, triglycerides, LDL-c, VLDLc and histology of aorta, liver and kidney with the leaf juice of *Catharanthus roseus* (Linn.) G. Donn[59].

MEMORY ENHANCEMENT ACTIVITY:

Vinpocetine has been reported to have a variety of actions that would hypothetically be beneficial in Alzheimer's disease (AD). The only study investigating this agent in a well-defined cohort of AD patients found no benefit. Meta-analysis of older studies of vinpocetine in poorly-defined dementia populations concluded that there is insufficient evidence to support its clinical use at this time. Vinpocetine has been well tolerated at doses up to 60 mg/d in clinical trials of dementia and stroke, and no significant adverse events were observed [60].

CHEMICAL CONSTITUENTS

Table: 2. Chemical constituents of *Catharanthus roseus*

S.No	CHEMICAL CONSTITUENTS	REFERENCE
1.	(-)Tabersonine	[61]
2.	10-Geraniol hydroxylase	[62]
3.	1 O-Hydroxy deacetyl akuammiline	[63]
4.	ll-Methoxy tabersonine	[64]
5.	16-Epi vindolinine-N(B)-oxide	[65]
6.	16-Epi-19-(s) vindoline-N-oxide	[66]
7.	16-Epi-trans iso-sitsirikine	[67]
8.	16-Epi-Z-iso-sitsirikine	[67]
9.	16-Hydroxy tabersonine	[68]
10.	16-Methoxy tabersonine	[68]
11.	17-Deacetoxy leurosine	[69]
12.	17 -Deactoxy vincaleukoblastine	[69]
13.	19(s) 16-Epi-vindolinine	[70]
14.	19(s)-Vindolinine	[71]
15.	19-20-Cis 16(R) iso-sitsirikine	[72]
16.	19-20-Trans 16(R) iso-sitsirikine	[72]
17.	19-Acetoxy-ll-hydroxy tabersonine	[73]

18.	19-Epi, 3-iso ajmalicine	[74]
19.	19-Epi-ajmalicine	[75]
20.	19-Epi-vindolinine	[73]
21.	19-Hydroxy-ll-methoxy tabersonine	[73]
22.	20-Epi-vindolinine	[65]
23.	20-Hydroxy tabersonine	[76]
24.	21-Hydroxy cyclochnerine	[72]
25.	21'-Oxo leurosine	[77]
26.	24-Methylene cholesterol	[78]
27.	2-Hydroxy-6-methoxy benzoic acid	[79]
28.	3'-4'-Anhydro-vincaleukoblastine	[80]
29.	3-Epi-ajmalicine	[63]
30.	3-Hydroxy voafrine A	[81]
31.	3-Hydroxy voafrine B	[81]
32.	3-lso-ajmalicine	[65]
33.	4-Deacetoxy vincaleukoblastine	[82]
34.	4-Deacetoxy-3'-hydroxy vincaleukoblastine	[83]
35.	S' Phosphodiesterase	[84]
36.	7-Hydroxy-indolenine ajmalicine	[63]
37.	Adenine phosphoribosyltransferase	[85]
38.	Adenoside diphosphate	[86]
39.	Adenoside triphosphate	[86]
40.	Adenosine	[87]
41.	Ajmalicine synthetase	[88]
42.	Ajmalicine	[89] &[90]
43.	Ajmaline	[91]
44.	Akuamicine	[92]
45.	Akuammicine	[93]&[94]
46.	Akuammigine	[76]
47.	Akuammiline	[65]
48.	Akuammine	[95]
49.	Alpha amyrin acetate	[96]
50.	Alpha-3, 4-anhydrovinblastine synthase	[97]
51.	Alstonine	[98] &[99]
52.	Ammocalline	[93]
53.	Ammorosine	[93]
54.	Amotin	[100]
55.	Anthranilate synthetase	[101]
56.	Antirhine	[74]
57.	Aparicine	[102]
58.	ATP sulfurylase	[103]
59.	Bannucine	[104]
60.	Beta sitosterol	[105]
61.	Calmodulin	[106]
62.	Campesterol	[78]
63.	Cantharanthine	[107]
64.	Carosidine	[108]

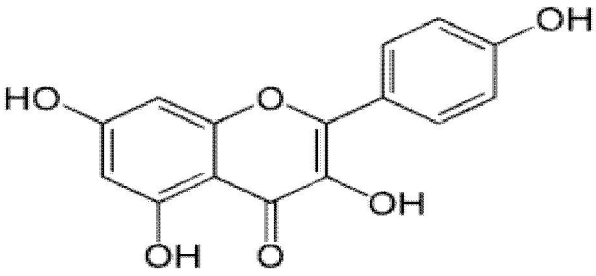
65.	Carosine	[95]
66.	Cathalanceine	[109]
67.	Catharanhine	[110]
68.	Catharanthamine	[111]
69.	Catharanthine	[89]
70.	Catharanthus roseus alkaloid (Mp 300+)	[112]
71.	Catharanthus roseus alkaloid (MW 336)	[113]
72.	Catharanthus roseus alkaloid B	[113]
73.	Catharanthus roseus alkaloid C	[113]
74.	Catharanthus roseus alkaloid D	[113]
75.	Catharanthus roseus iridoid glucoside (Mp 194-5)	[114]
76.	Catharicine	[108] & [95]
77.	Catharine	[95]
78.	Catharosine	[115]
79.	Cathasterone	[116]
80.	Cathenamine	[117]
81.	Cathindine	[118] &[93]
82.	Cathovaline:	[119]
83.	Cavincidine	[118] &[93]
84.	Cavincine	[95]
85.	Cholesterol	[78]
86.	Choline	[120]
87.	Cinnamate 4-hydroxylase	[121]
88.	Coronaridine	[122]
89.	Deacetoxy vincaleukoblastine	[123]
90.	Deacetoxy vindoline	[124] &[68]
91.	Deacetyl aduammiline	[125]
92.	Deacetyl akuammiline	[63]
93.	Deacetyl vincaleukoblastine	[126]
94.	Deacetyl vindoline acetyl transferase	[127]
95.	Deacetyl vindoline	[128] & [68]
96.	Dehydro loganin	[87]
97.	De-n-methyl vincaleukoblastine	[129]
98.	Deoxy loganin	[114]
99.	Deoxy vincaleukoblastine	[130]
100.	Diacylglycerol pyrophosphate	[131]
101.	Dihydro sitsirikine	[95]
102.	Dihydro vindoline	[132]
103.	Dimethyl tryptamine	[133]
104.	Diol pseudo vincaleukoblastine	[134]
105.	Epi-vindolinine	[124]
106.	Extensin	[135] &[136]
107.	Fluorocarpamine	[66]
108.	Fluorocarpamine-N-oxide	[66]
109.	Fructose-2-6-bis-phosphate	[137]
110.	Geissoschizine dehydrogenase	[138]

111.	Geissoschizine	[139]
112.	Geraniol	[140]
113.	Glucose	[120]
114.	Glutamine	[120]
115.	Glycoprotein	[141]
116.	Gomaline	[71]
117.	Hemicellulose	[142]
118.	Hirsutidin	[143] &[144]
119.	Horhammericine	[124]
120.	Indole-3-acetic acid	[145]
121.	Iso-fucosterol	[78]
122.	Iso-leu rosine	[93]
123.	Iso-pent-2-enyl adenine riboside	[146]
124.	Iso-pent-2-enyl adenine riboside-s'-monophosphate	[146]
125.	Iso-pent-2-enyl adenine	[146]
126.	Isositsirikine	[95]
127.	Isositsirikine	[74]
128.	Isovallesiachotamine	[147]
129.	Isovincoside	[148]
130.	Kaempferol	[79]
131.	L-(+)-bornesitol	[149]
132.	Lanceine	[109]
133.	Leurocolombine	[113]
134.	Leurocristine	[150]
135.	Leurosidine	[150]
136.	Leurosidine-N' -B-oxide	[94]
137.	Leurosine	[151]
138.	Leurosine-N-oxide	[152]
139.	Leurosinone	[153]
140.	Leurosivine	[93] & [95]
141.	Linoleic acid	[154]
142.	Lirioresinol B, D-glucoside	[155]
143.	Lochnerallol	[10]
144.	Lochnericine	[105]
145.	Lochneridine	[130]
146.	Lochnerine	[105]
147.	Lochnerinine	[156]
148.	Lochnerivine	[93] &[118]
149.	Lochnerol	[10]
150.	Lochrovicine	[108]
151.	Lochrovidine	[108]
152.	Lochrovine	[108]
153.	Loganic acid	[157]
154.	Loganin	[87]
155.	Maandrosine	[93]
156.	Malic acid	[158]

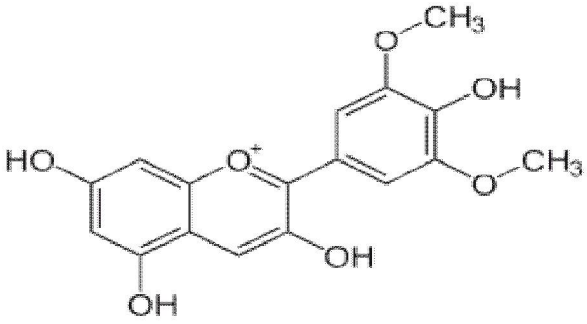
157.	Malvidin	[143] &[144]
158.	Mannoside	[149]
159.	Mevalonate kinase	[159]
160.	Minovincinine	[65]
161.	Mitraphylline	[64]
162.	Myricyl alcohol	[160]
163.	N-deformylleurocristine	[161]
164.	N-demethyl vincaleukoblastine	[162]
165.	Neoleurocristine	[108] & [95]
166.	Neoleurosidine	[95]
167.	Nor Harman	[119]
168.	Oleanolic acid	[163]
169.	Oleic acid	[136]
170.	Para-coumaric acid	[79]
171.	Pericalline	[164] &[93]
172.	Pericyclivine	[94]
173.	Perimivine	[118]
174.	Perividine	[93]
175.	Perivine	[105]
176.	Perosine	[118] &[93]
177.	Petunidin	[144] &[143]
178.	Phosphodiesterase	[165]
179.	Phytochelatin A	[166]
180.	Pleiocarpamine	[65]
181.	Pleurosine	[95]
182.	Prolyl hydroxylase	[167]
183.	Protocatechuic acid	[79]
184.	Pseudo-vincaleukoblasti ned iol	[149]
185.	Putrescine	[168]
186.	Quercetin	[79]
187.	Quinone reductase	[169]
188.	Reserpine	[76] & [170]
189.	Rhazimol	[64]
190.	Ricinoleic acid	[171]
191.	Rosamine	[172]
192.	Roseadine	[173]
193.	Roseoside	[87]
194.	Rosicine	[174]
195.	Rovidine	[108]
196.	Secologanic acid	[175]
197.	Secologanin	[157]
198.	Secologanoside	[175]
199.	Serpentine	[176] &[177]
200.	Sitsirikine	[74]
201.	Stigmasterol	[78]
202.	Strictosideine glucosidase 1	[178]
203.	Strictosidine glucosidase 11	[178]

204.	Strictosidine lactam	[92]
205.	Strictosidine synthase	[179]
206.	Strictosidine synthetase	[180]
207.	Strictosidine	[181]
208.	SuIfotransferase	[103]
209.	Sweroside	[114]
210.	Syringic acid	[79]
211.	Tabersonine	[182]
212.	Tetrahydro alstonine	[183], [184] &[132]
213.	Tetrahydroserpentine	[156]
214.	Tryptamine	[185]
215.	Tryptophan decarboxylase	[186]
216.	Tryptophan synthetase	[101]
217.	Tryptophan	[101]
218.	Tubotaiwine	[187]
219.	Uridine	[188]
220.	Ursolic acid	[189]
221.	Vallesiachotamine	[73]
222.	Vanillic acid	[79]
223.	Vinamidine	[190]
224.	Vinaphamine	[118]
225.	Vinaspine	[108]
226.	Vincadioline	[191]
227.	Vincaleukoblastine	[192] & [193]
228.	Vincaline 1	[194]
229.	Vincaline 11	[194]
230.	Vincamicine	[130]
231.	Vincarodine	[94]
232.	Vincathicine	[118]
233.	Vincolidine	[195]
234.	Vincoline	[196]
235.	Vincubine	[197]
236.	Vindolicine	[108] &[95]
237.	Vindolidine	[108]
238.	Vindoline	[198], [110]&[170]
239.	Vindolinine	[199]
240.	Vindolinine-N(B)oxide	[65]
241.	Vindolinine-N-oxide	[199]
242.	Vindorosine	[200]
243.	Vinosidine	[93]
244.	Vinsedicine	[108]
245.	Vinsedine	[108]
246.	Virosine	[105] &[93]
247.	Vivaspine	[118]
248.	Yohimbine	[74]
249.	Zeatin glucosyl	[201]
250.	Zeatin riboside-5'-monophosphate	[146]

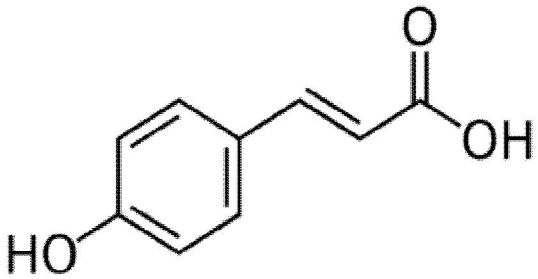
251.	Zeatin ribosyl	[201]
252.	Zeatin	[201]
253.	Zeatin-9-riboside	[146]



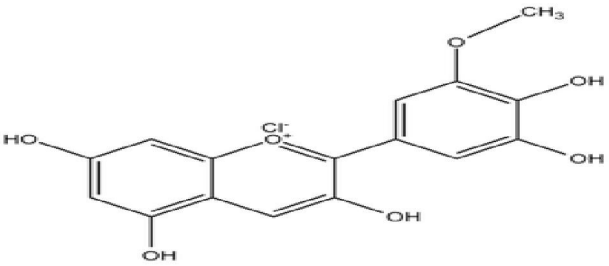
(A) Kaempferol



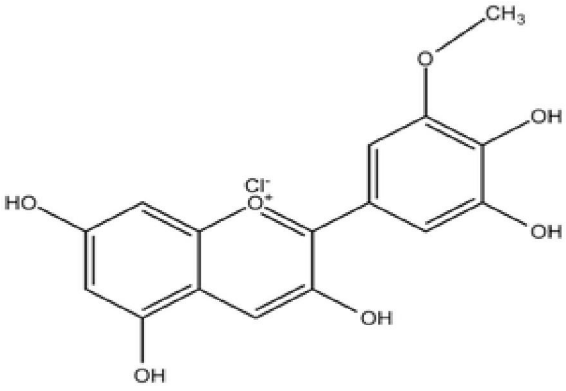
(B) Malvidin



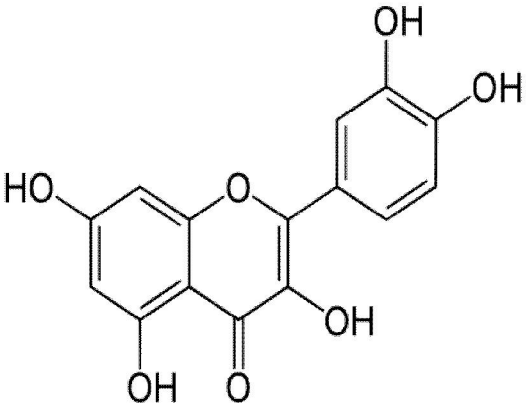
(C) Para-coumaric acid



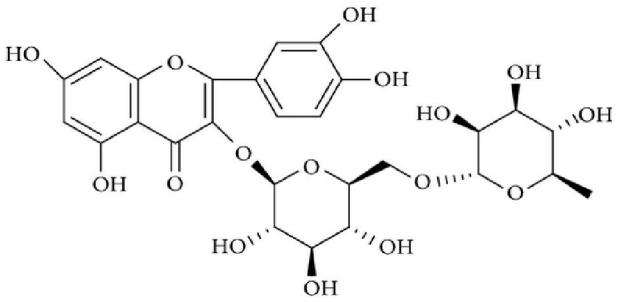
(D) Petunidin



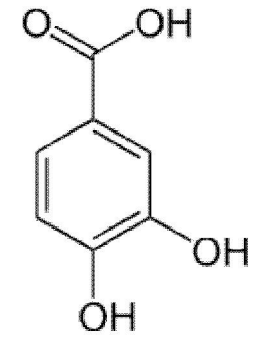
(E) Protocatechuic acid



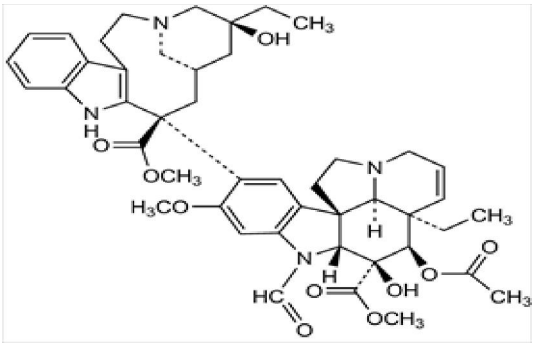
(F) Quercetin



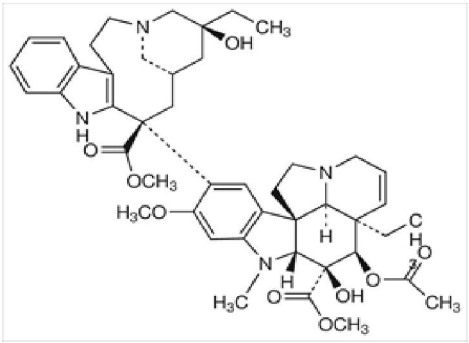
(G) Rutin



(H) Syringic acid



(I) Vincristine



(J) vinblastin

Figure 2: List of some important bioactive compounds

CONCLUSION:

Catharanthus roseus is one of the important medicinal herb with numerous biological properties. Lot of work is still in process to identify new bioactive compounds, understanding the methodology of transformation of bioactive compounds in one form to another form, new extraction technique such as green extraction and improving the drying method such as solar drying

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