## Proximate Composition and Lipids

The plant leaves contained 28.3% crude protein and 16.6% crude fat and were not deficient in copper, zinc or iron (Adam, 1999). Investigation of roots of *R. stricta* of Pakistan origin lead to the isolation of two fatty esters 9-octadecenoic acid-2',3'-dihydroxy propyl ester and hexadecanoic acid-2',3'-dihydroxy propyl ester (Atta-ur-Rahman *et al*., 2008). *R. stricta* has been reported rich in Cu, Co, Fe, Mg, Mn and Zn (Kaneez *et al*., 2001). The plant, growing on mining area at Mahad Ad'Dahab, Saudi Arabia was found to accumulate heavy metals (Al-Farraj and Al-Wabel, 2007).

## Alkaloids

The chemical constituents, and in particular the alkaloids, pharmacological and toscixological properties of the medicinal plant *Rhazya stricta* have been reviewed by several authors (e.g. Atta-ur-Rahman and Fatima, 1982; Atta-ur-Rahman, 1983, 1986, 1987; Atta-ur-Rahman *et al*., 1989b; Ali *et al*., 2000a; Gilani *et al*., 2007; Marwat *et al*., 2012). Hooper (1906), was the first investigator who studied the presence of a volatile alkaloid which resembled coniine alongwith a non-characterized, non-volatile base. Over 100 alkaloids have been isolated, characterized and identified from the plant.

Two monoterpenoid indole alkaloids and four β-carbolines were isolated from a hybrid cell suspension culture generated from *Rauwolfia serpentine* Benth. and *Rhazya stricta* Decaisne. This indicates that the function of alkaloid biosynthesis is retained after hybrid formation and that alkaloids not previously detected in the parental plants or cell cultures are formed (Aimi *et al*., 1996). The treatment of *Rauwolfia serpentina* × *Rhazya stricta* somatic hybrid cell suspension culture with 100 µM of methyl jasmonate led to a general increase in

indole alkaloid content and to qual. changes in the alkaloid pattern.

The content of six alkaloids were investigated with respect to their content in both the cell biomass and nutrition medium. Intracellular 17-*O*-acetyl-norajmaline content on the 5th day after treatment had increased about 40-fold compared with the control culture. The respective concnentrations of the other alkaloids increased by a factor of two to five. In total 26 indole alkaloids were identified in extracts of the Me jasmonate-treated culture. The identification of macrophylline, yohimbine oxindole, and yohimbine pseudoindoxyl has not been reported before in *Rauwolfia serpentina* or *Rhazya stricta* plants nor in cell cultures derived from these plants (Sheludko *et al*., 1999). Several other alkaloids have been identified from somatic cell suspension culture of the genus and species combination of *Rauwolofia serpentrina x Rhazya stricta viz.* tubotaiwine, vallesiachotamine, vomilenine, stemmadenine, tuberosine, 1,2-dehydroaspidospermidine, rhazinilam and 3-oxo-rhazinilam (Kostenyuk *et al*., 1994, 1995; Sheludko *et al*., 2000; Gerasimenko *et al*., 2001).

Eleven main alkaloids were identified from cell suspension cultures of *Rhazya stricta* grown in 4X-medium for 15 days. The alkaloids comprised the 5 groups corynanthane, strychnos, eburnane, secodine and aspidosperma and can be regarded as being typical *Rhazya* alkaloids, although the strychnos alkaloid akuammicine has been isolated for the first time from the genus *Rhazya*. The most abundant alkaloid was (+)-1,2-dehydroaspidospermidine (15mg/L medium) whereas all other constituents were synthesized in amounts lower by factors of ~ 5-10. More than 15 additional alkaloids were formed as minor components (Pawelka and Stoeckigt, 1986).

Radioactive 1,2-dehydroaspidospermidine was formed when mevalonate-2-14C was administered to *R. stricta*. The C-5, -20, and -21 groups of this compound contained no radioactivity and the C-8 group contained 65% of the total activity. When Na mevalonate-3-14C was supplied to this plant the C-20 group of 1,2- dehydroaspidospermidine contained 47% of the total activity. The biosynthesis of the indole and ipecacuanha alkaloids was probably related to the formation of the cyclopentanoid monoterpene skeleton, and the C-2 and C-6 group of one mevalonate unit was rendered equivelant (Battersby *et al*., 1966). The biosynthesis of indole alkaloids in *R. stricta* has been studied by several researchers (e.g. Battersby *et al*., 1967).

Lounasmaa *et al*. (1995) presented evidence to support the view that rhazimanine and bhimberine, two indole alkaloid samples isolated from *Rhazya stricta* and claimed to be identical with (16*R*)-3-*epi*-*E*-isositsirikine and (16*S*)-3-*epi*-*E*-isositsirikine, respectively, consist mainly of one and the same compound, (16*R*)-*E*-isositsirikine.

The structure of a chiral β-carboline derivative, compound D which was found during the chemical investigation of metabolites formed by cultured hybrid cells of two Apocynaceae plants, *Rauwolfia serpentina* Benth. and *Rhazya stricta* Decaisne, was rigorously confirmed by chemical synthesis starting from tryptamine and D-glucose (Kitajima *et al*., 1996).

Strictosidine which gives on wild hydrolysis vallesiachotamine and glucose) was reported as a key intermediate in the biogenesis of indole alkaloids (Smith, 1968). The isolation of geissoschizine from the plant was reported impostant from a biogenetic viewpoint since it is one of the key performed intermediates in the biosynthesis of $C_{19}$-$C_{20}$ indole alkaloids (Chatterjee *et al*., 1976b). Quantitative estimation of the alkaloids of *Rhazya stricta*, growing in Saudi Arabia leaves, stems and roots revealed that leaves contained greater amounts of alkaloids. The leaf contained 8 alkaloids, whereas seeds contained only 2, and were devoid of rhazine, which was present in all other organs. Rhazine was present in leaves, roots, and stems at 3.92, 2.21, and 0.96% (of total alkaloids), respectively. Betaine occurred in leaves as 0.85% of the quaternary alkaloids. The occurrence of the largest no. of alkaloids

in the leaf suggests that the leaf is the site of alkaloid formation (Hassan *et al*., 1977a).

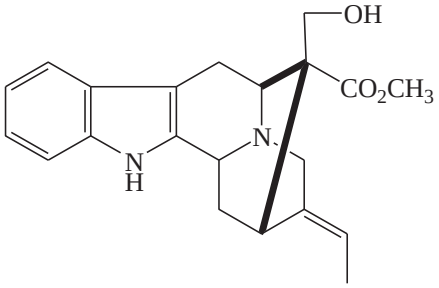
Atta-ur-Rahman *et al*. (1989b) classified the alkaloids isolated from *Rhazya orientalis* and *Rhazya stricta* (75 alkaloids at that time) in seventeen different groups; these groups are:

a. Ajmaline-type alkaloids e.g. leepacine and strictisidine.
b. Aspidosperma alkaloids e.g. aspidospermidose and vincadine.
c. Aspidospermatin-type alkaloids e.g. geissoschizine and rhazimanine.
d. Corynantheine-type alkaloids e.g. geissoschizine and rhazimanine.
e. Dimeric alkaloids e.g. presecamin and secamine.
f. Eburnamine-type alkaloids e.g. eburnamine.
g. Heteroyohimbine-type alkaloids e.g. strictosamide.
h. Hunterburine-type alkaloids e.g. antirhine.
i. Movacurine-type alkaloids e.g. strictine.
j. Picraline-type alkaloids e.g. picralinal.
k. Quinoline-type alkaloids e.g. rhazicine.
l. Rhazinilam-type alkaloids e.g. rhazinilam.
m. Sarpagine-type alkaloids e.g. akuammidine (rhazine).
n. Secodine-type alkaloids e.g. dihydrosecodine
o. Strictosidine-type alkaloids e.g. strictosidine.
p. Strychnos-type alkaloids e.g. stricticine.
q. Miscellaneous alkaloids e.g. strictine.

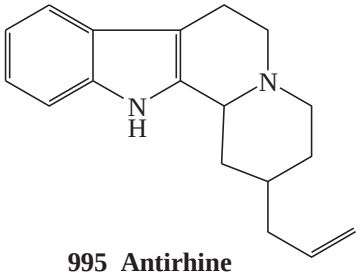
The following alkaloids are isolated from *R. stricta*:

1- *N*-Acetylaspidaspidospermidine from leaves and roots (Atta-ur-Rahman *et al*., 1991a).
2- (+)-Akuammidine (Rhazine) (**994**) (Miana *et al*., 1982), from roots (Bashir *et al*., 1994a), Abdel-Sattar *et al*. (1994); Atta-ur-Rahman *et al*., 1989b).
3- (-)-Akuammidine (Zaman, 1990, Qureshi, 1991).
4- Antirhine (Rhazinine) (**995**) (Banerji *et al*., 1970; Atta-ur-Rahman *et al*., 1989b,c).
5- (+)-Aspidospermidine (**996**) from aerial parts (Schnoes *et al*., 1962; Smith and Wahid, 1963; Abdel-Mogib *et al*., 1998).
6- Aspidospermidose (**997**) from leaves (Atta-ur-Rahman *et al.*, 1987c).
7- Aspidospermiose (**998**) from leaves (Habib-ur-Rahman and Atta-ur-Rahman, 1996).
8- Atrictamine (Jewers *et al*., 1980).
9- Betaine from leaves (Edsall, 1943; Hassan *et al*., 1977a).
10- Bharhingine (**999**) from leaves (Ahmad *et al*., 1987; Atta-ur-Rahman *et al*., 1987b).
11- Bhimberine (**1000**) (Malik, 1985; Atta-ur-Rahman *et al*., 1986d`).
12- Bhimberine N-oxide (Bisset, 1958).
13- Bisstrictidine (Zaman, 1990; Qureshi, 1991).
14- 1-Carbomethoxy-β-carboline from leaves (Habib-ur-Rahman and Atta-ur-Rahman, 1996).
15- 5-α-Carboxystrictosidine (**1001**) (Smith *et al*., 1971).
16- Condylocarpine from roots (Atta-ur-Rahman *et al*., 1986f).
17- 16*S*,16'-Decarbomethoxytetrahydrosecamine (**1002**) from roots (Atta-ur-Rahman and Zaman, 1988; 1989; Abbas, 1995).
18- 16*R*,16'-Decarbomethoxytetrahydrosecamine from roots (Atta-ur-Rahman and Zaman, 1988).
19- Decarbomethoxy-15,20,16,17-tetrahydrosecodine (2-Ethyl-3[2-(3-ethyl)piperidino] indole) (Qureshi, 1991; Marwat *et al.*, 2012).
20- 16*S*,16'-Decarboxytetrahydrosecamine (Marwat *et al.*, 2012).
21- Decarbomethoxy-15,20,16,17-tetrahydrosecodine (Marwat *et al.*, 2012).
22- Dehydroaspermidine
23- (+)-1,2-Dehydroaspidospermidine (eburenine) (Smith and Wahid, 1963; Schnoes *et al*.,

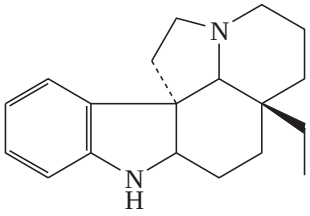
1962; Jewers *et al*., 1980; Abdel-Mogib *et al*., 1998).



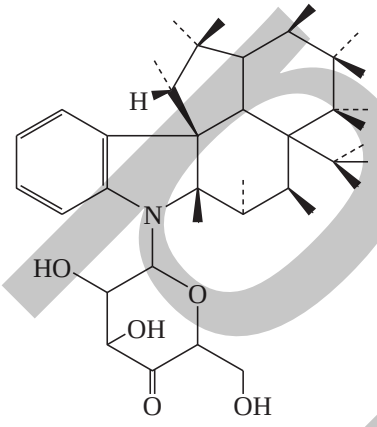

**994 Akuammidine**



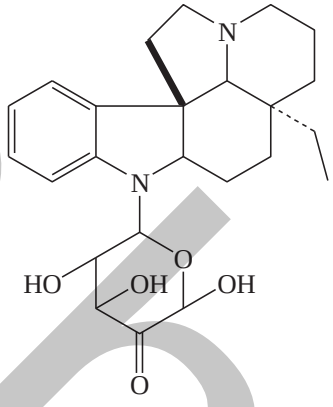

**995 Antirhine**



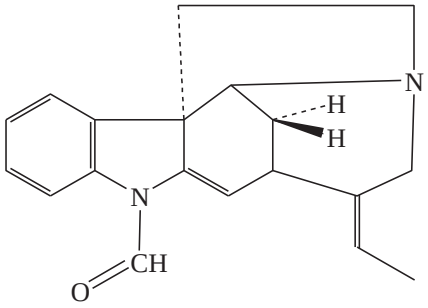

**996 (+)- Aspidosermidne**



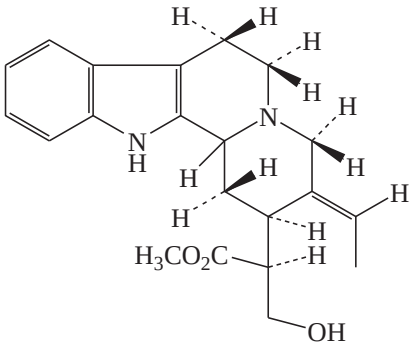

**997 Aspidospermidose**



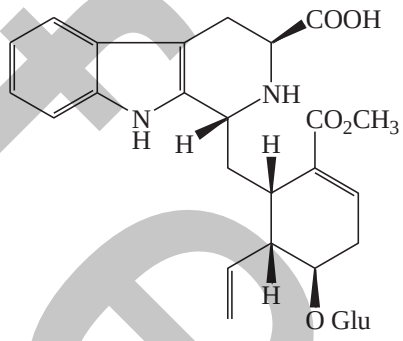

**998 Aspidospermiose**



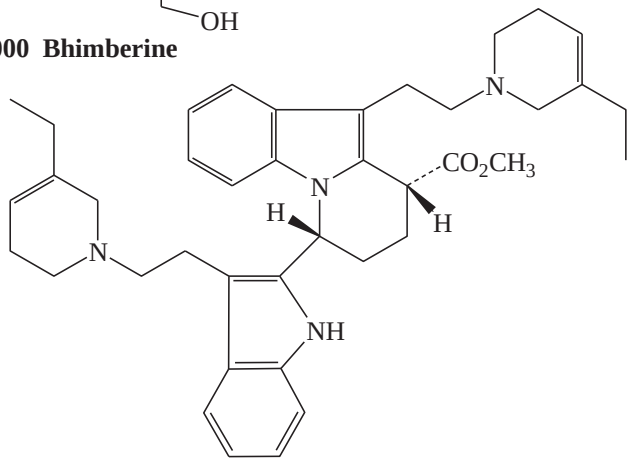

**999 Bharhingine**




**1000 Bhimberine**



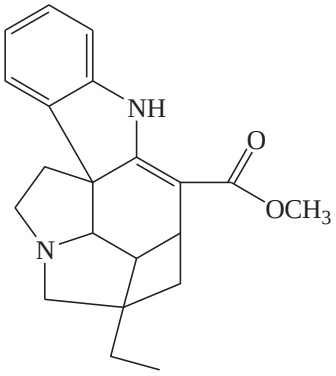

**1001 5-α-Carboxystrictosidine**



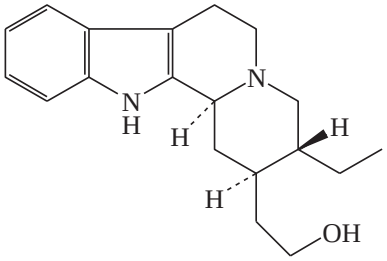

**1002 16S,16'- Decarbomethoxy-tetrahydrosecamine**

24- 1,2-Dehydroaspidospermidine-N-oxide from roots (Atta-ur-Rahman and Zaman, 1986b).

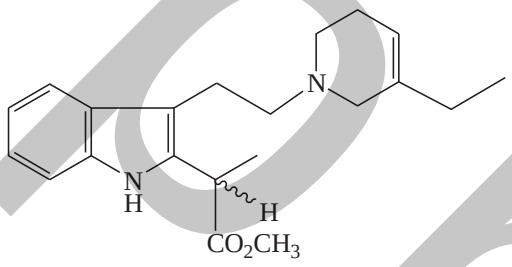
25- Didemothoxycarbonyl-1-carbomethoxy-β-carboline from leaves (Marwat *et al.*, 2012).
26- (20*R*),19,20-Dihydrocondylocarpine (**1003**) from fruits (Qureshi, 1991).
27- Didemethoxycarbonyltetrahydrosecamine from the roots (Atta-ur-Rahman *et al.*1986f).
28- (20*S*),19,20-Dihydrocondylocarpine from frui (Atta-ur-Rahman *et al*., 1991a).
29- Dihydrocorynantheol (**1004**) from roots (Atta-ur-Rahman and Zaman, 1986a).
30- Dihydroeburnaminine from leaves and roots (Atta-ur-Rahman *et al*., 1991a).
31- Dihydroprescamine (**1005**) (Brown *et al*., 1970; Cordell *et al*., 1970b).
32- 3,14-Dihydrorhazigune (Zaman, 1990, Qureshi, 1991).
33- Dihydrosecamine from leaves (Marwat *et al*., 2012).
34- Dihydrosecodine (**1006**) (Cordell *et al*., 1970a).
35- Dihydrosecamine (**1007**) (Evans *et al*., 1968b)
36- (+)-Eburenine (Adel-Sattar *et al*., 1994).
37- (+)-21*S*-Eburnamenine from leaves and roots (Pleiocarpine) (Atta-ur-Rahman *et al*., 1991a; Quereshi, 1991).
38- Eburnamine (**1008**) (Pleiocarpinidine) (Schnoes *et al*., 1962; Atta-ur-Rahman *et al*., 1989b).
39- Eburnamonine (**1009**) (Schnoes *et al*., 1962; Atta-ur-Rahman *et al*., 1989b).
40- 3-*epi*-Antirhine from leaves (Marwat *et al.*, 2012).
41- 2-Ethyl-3[2-(3-ethylpiperidino)ethyl]-indole from leaves roots (Atta-ur-Rahman *et al*., 1991a)
42- nor-*C*-Fluorocurarine (Crowley and Harley-Mason, 1971; Ahmad *et al*., 1977; Atta-ur-Rahman *et al*., 1989b).
43- 16-Formylstrictamine from leaves (Marwat *et al*., 2012).
44- Geissoschizine (**1010**) (Banerji *et al*., 1970; Chatterjee *et al*., 1976b).
45- Harhingine from leaves (Marwat *et al*., 2012).
46- 16'-Hydroxyrhazisidine (Zaman, 1990; Qureshi, 1991).
47- 15β-Hydroxyvincadifformine from leaves (Atta-ur-Rahman *et al*., 1988e).
48- Isorhazicine (**1011**) from leaves (Atta-ur-Rahman and Khanum, 1987a).
49- Isosaifinine from roots (Abbas, 1995).
50- Isositsirikine (Kutney and Brown; 1966, Brown and Leonard, 1979).
51- 16-*epi*-*Z*-Isositsirikine from leaves (Mukhopadhyay *et al*., 1983; Marwat *et al*., 2012).
52- 16*R*-19,20-*E*-Isositsirikine acetate from leaves and roots (Atta-ur-Rahman *et al*., 1991a).
53- Isovallesiachotamine (**1012**) from legumes (Atta-ur-Rahman and Malik, 1984b; Malik, 1985).
54- Leepacine (**1013**) from leaves and roots (Atta-ur-Rahman *et al*., 1991a).
55- Leuconolam (**1014**) (Goh *et al*., 1984; Goh and Ali, 1986; Atta-ur-Rahman, 1989b).
56- *nor*-*C*-Luorocurarine (Marwat *et al.*, 2012).
57- 2-Methoxy-1,2-dihydrorhazimine from leaves (Atta-ur-Rahman and Khanum, 1985).
58- 17-Methoxy-1,2-dihydrorhazimine (Marwat *et al.*, 2012).
59- (-)16*R*,21*R*-*O*-methyleburnamine from leaves and roots (Atta-ur-Rahman *et al*., 1991a).
60- *N*-Methylleuconolam from roots (Qureshi, 1991 Atta-ur-Rahman *et al*., 1995b).
61- $N_b$-Methylstrictamine (**1015**) from leaves (Atta-ur-Rahman *et al*., 1987e).
62- Polyneuridine (**1016**) (Ohashi *et al*., 1963; Mukhopadhyay *et al*., 1981).
63- Postsecamidine (Didemethoxycarbonyltetrahydrosecamine) from roots (Malik, 1985; Atta-ur-Rahman *et al*., 1986f).
64- Prescamine (**1017**) (Cordell *et al*., 1970b,c; Brown *et al*., 1970).
65- Pseudoyohimbine (Abbas, 1995).



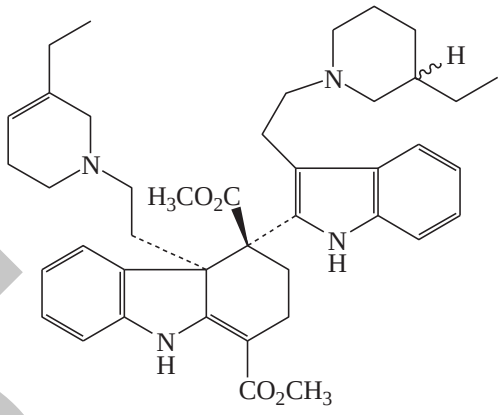

**1003 (20R),19,20-Dihydrocondylocarpine**



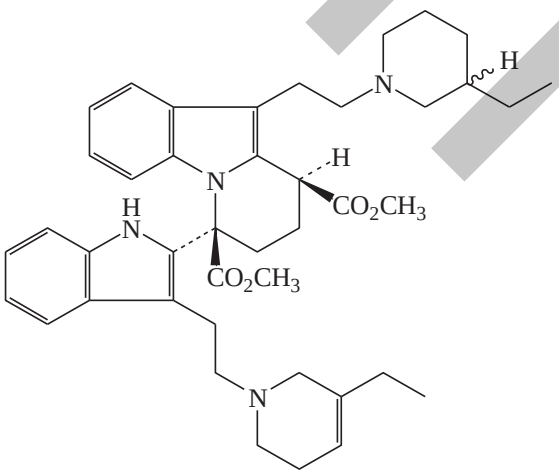

**1004 Dihydrocorynantheol**



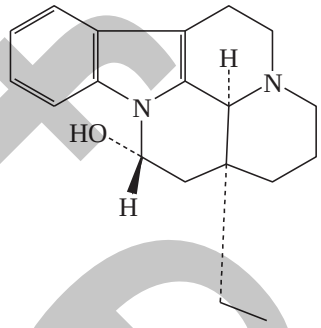

**1006 Dihydrosecodine**



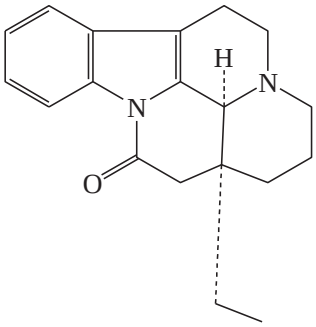

**1005 Dihydropresecamine**



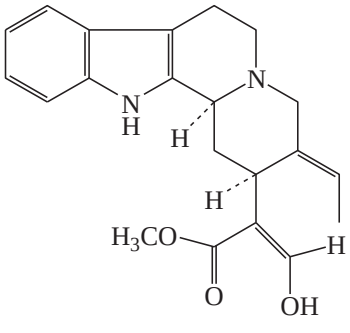

**1007 Dihydrosecamine**



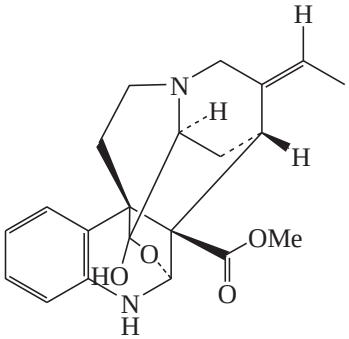

**1008 Eburnamine**



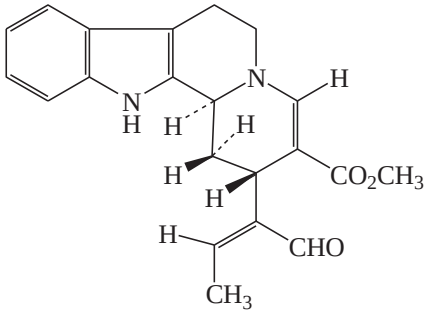

**1009 (+)- Eburnamonine**



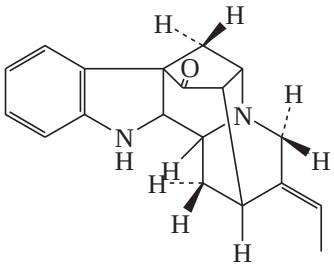

**1010 Geissoschizine**



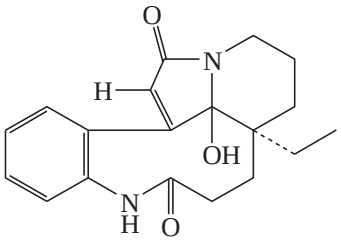

**1011 Isorhazicine**



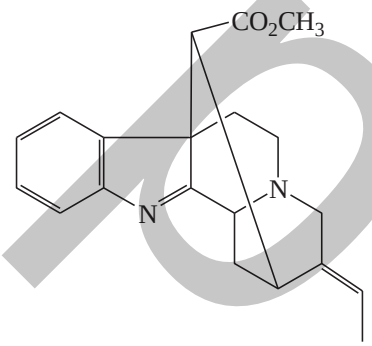
**1012 Iso Vallesiachotamine**



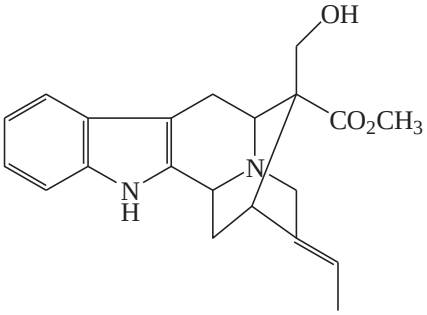
**1013 Leepacine**



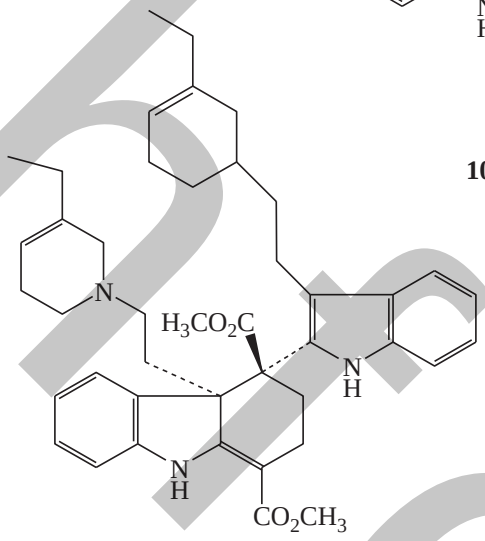
**1014 Leuconolam**



**1015 $N_b$ -methylstrictamine**



**1016 Polyneuridine**

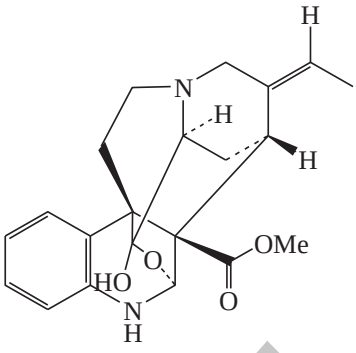


**1017 Presecamine**

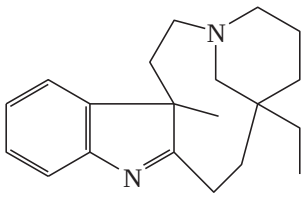
66- (-)-Quebrachamine (Chatterjee *et al*., 1961b, Chaudhury *et al*., 1963b, Siddiqui *et al*., 1966; Jewers *et al*., 1980; Miana *et al*., 1982, Abdel-Sattar *et al*., 1994).
67- Rhazicine (**1018**) from leaves (Atta-ur-Rahman and Khanum, 1984c).
68- Rhazidigenine (Qureshi, 1991).
69- Rhazidigenine *N*-oxide (**1019**) (Miana *et al*., 1982).
70- Rhazidine (**1020**, rhazidigenine) (Chaudhury *et al*., 1963a,b)
71- Rhazigine (Zaman, 1990, Qureshi, 1991).
72- Rhazimal (16-formylstrictamine) (**1021**) (Ahmad *et al*., 1979a, 1983, Atta-ur-Rahman and Habib-ur-arahman, 1986).
73- Rhazimanine (**1022**) from fruits (Malik, 1985; Atta-ur-Rahman *et al*., 1986e), roots (Bashir *et al*, 1994a).
74- Rhazimine (**1023**) from leaves (Atta-ur-Rahman and Khanum, 1984b).
75- Rhaziminine from leaves (Marwat *et al*., 2012).
76- Rhazimol (deacetylakuammiline) (**1024**) from roots (Ahmad *et al*., 1979a, 1983; Atta-ur-Rahman and Zaman, 1986a).
77- Rhazinaline (**1025**) (16-formyl-16-epistrictamine) (Banerji *et al*., 1970; Chatterjee *et al*.,

1976b).
78- Rhazine from air-dried roots and leaves (Chatterjee *et al*., 1961b, 1962; Chaudhury *et al*., 1963b; Jewers *et al*., 1980).
79- Rhazinilam (**1026**) (Banerji *et al*., 1970; De Silva *et al*., 1972; Jewers *et al*., 1980).
80- Rhazinine (Ganguli *et al*., 1962; Siddiqui *et al*., 1966).
81- Rhazinol (a hydroxyl methyl analog of strictamine) (Ahmad *et al*., 1979a, 1983).
82- Rhazisidine (Atta-ur-Rahman, 1986b).
83- Rhazizine (**1027**) from leaves (Atta-ur-Rahman *et al*., 1989c).
84- Rhimberine N-oxide (Bisset, 1958; Zaman, 1990).
85- Saifine (**1028**) from roots (Abbas, 1995 Atta-ur-Rahman *et al*., 1995b).
86- Saifinine from roots (Abbas, 1995).
87- Secamine (**1029**) from leaves (Evans *et al*., 1968b).
88- Sewarine (**1030**) (10-hydroxyakuammicine) (Siddiqui *et al*., 1966; Ahmad *et al*., 1970, 1971; Mukhopadhyay *et al*., 1981).
89- Stemmadenine from leaves (Mariee *et al*., 1988).
90- Strictalamine (**1031**) (Ahmad *et al*., 1977).
91- Strictamine (**1032**) (Vincamidine) (Schnoes *et al*., 1966; Ahmad *et al*., 1977; Atta-ur-Rahman and Habib-ur-Rahman, 1986; Atta-ur-Rahman *et al*., 1989b).
92- Strictamine N-oxide from leaves (Atta-ur-Rahman and Khanum, 1984a).
93- Strictanine (**1033**) from fruits (Atta-ur-Rahman and Malik, 1987).
94- Strictanol from fruits (Atta-ur-Rahman and Malik, 1987), roots (Bashir *et al*., 1994a; Abbas, 1995).
95- Strictavine (Cordell, 1970; Qureshi, 1991).
96- Strictazine (Zeadon and Kaposi, 1970, Qureshi, 1991).
97- Strictibine (**1034**) from leaves (Habib-ur-Rahman and Atta-ur-Rahman, 1996).
98- Stricticine (**1035**) (Ahmad *et al*., 1983; Atta-ur-Rahman *et al*., 1987d).
99- *bis*-Strictidine from leaves (Marwat *et al*., 2012).
100- Strictimidine from leaves (Marwat *et al*., 2012).
101- Strictigine (Qureshi, 1991).
102- Strictimine (a bispiperidine alkaloid) from the roots (Atta-ur-Rahman and Zaman, 1984).
103- Strictine (**1036**) (Ahmad *et al*., 1983; Atta-ur-Rahman and Khanum, 1987b).
104- Strictosamide (**1037**) from leaves and roots (Atta-ur-Rahman *et al*., 1991).
105- Strictisidine (**1038**) (Qureshi, 1991).
106- Strictosidine (Issovincoside) (**1039**) (Smith, 1968; Atta-ur-Rahman *et al*., 1989b; Qureshi, 1991)
107- Tabersonine (**1040**) (Marwat *et al*., 2012).
108- Tetrahydroalstonine (**1041**) (Atta-ur-Rahman and Malik, 1984a, Malik, 1984, 1985).
109- Tetrahydroprescamine (**1042**, Cordell *et al*., 1978).
110- Tetrahydrosecamine from leaves and roots (Mukhopadhyay *et al*., 1981; Bashir *et al*., 1994a).
111- Tetrahydrosecamines (Cordell *et al*., 1970b; Evans *et al*., 1968b; Abbas, 1995).
112- Tetrahydrosecodine (**1043**) (Brown *et al*., 1970; Cordell *et al*., 1970a).
113- Vallesiachotamine (**1044**) (Mukhopadhyay *et al*., 1981; Atta-ur-Rahman and Malik, 1984b; Atta-ur-Rahman *et al*., 1989b).
114- (+)-Vincadifformine (Goh and Ali, 1986; Smith and Wahid, 1963; Zeadon and Kopsi, 1970).
115- (-)-Vincadifformine (**1045**) (Marwat *et al*., 2012).
116- (±)-Vincadifformine (Smith and Wahid, 1963, Zeadon and Kopsi, 1970).
117- Vincadine (**1046**) from legumes (Atta-ur-Rahman and Malik, 1985; Malik, 1985).

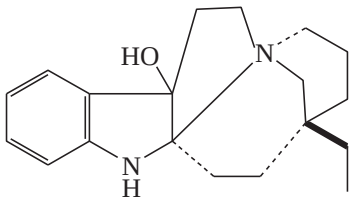
118- Vincanicine (**1047**) (12-methoxy-nor-*C*-fluorocurarine) (Atta-ur-Rahman *et al*., 1987f).



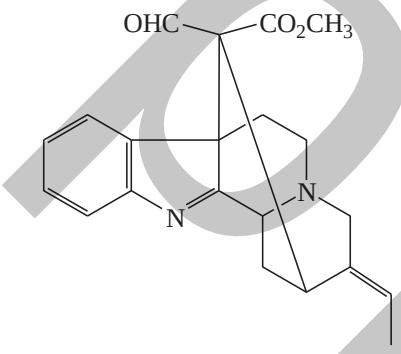

**1018 Rhazicine**



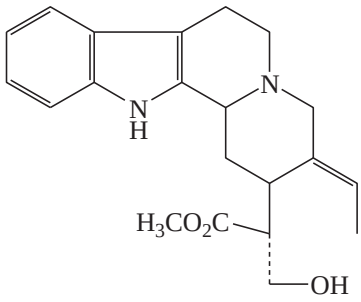

**1019 Rhazidigenine-N-oxide**



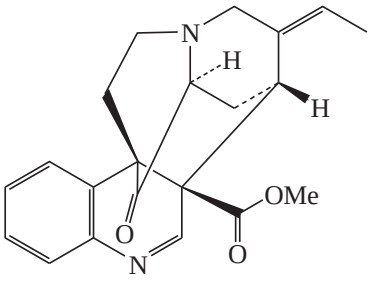

**1020 Rhazidine**



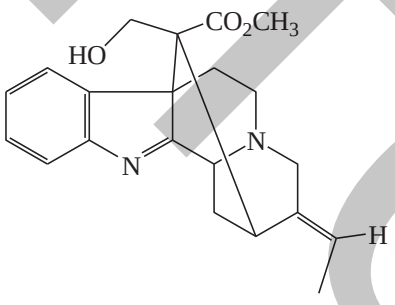

**1021 Rhazimal (16- formylstrictamine)**



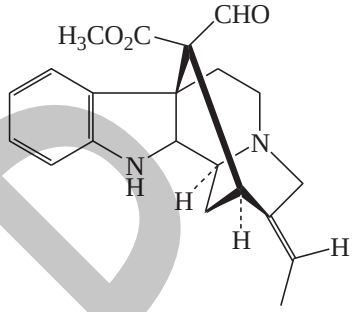

**1022 Rhazimanine**



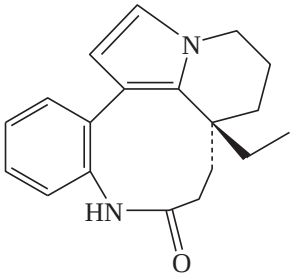

**1023 Rhazimine**



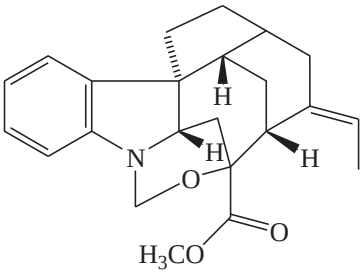

**1024 Rhazimol (deacetylakuammiline)**



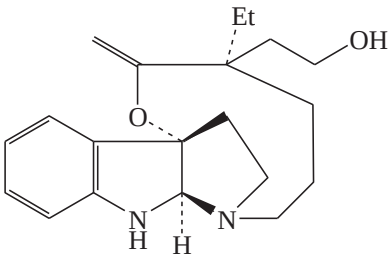

**1025 Rhazinaline**



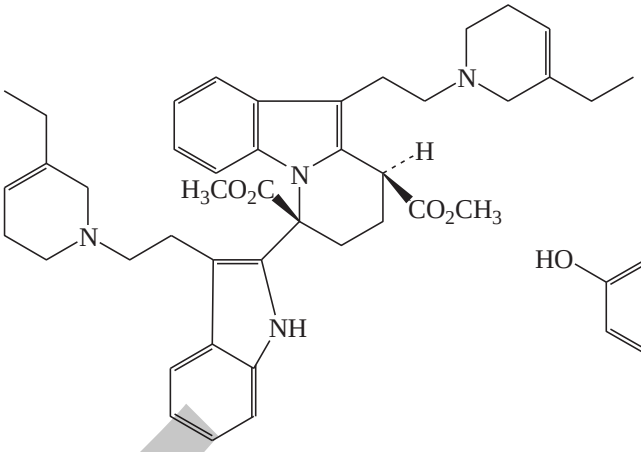

**1026 Rhazinilam**



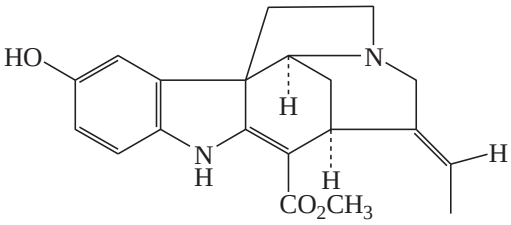

**1027 Rhazizine**



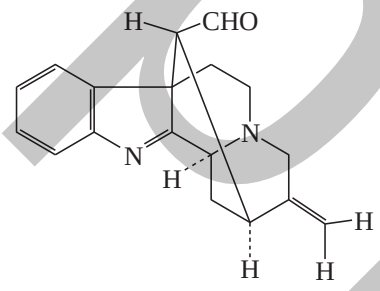

**1028 Saifine**



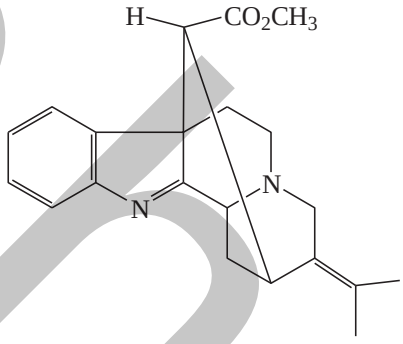
**1029 Secamine**



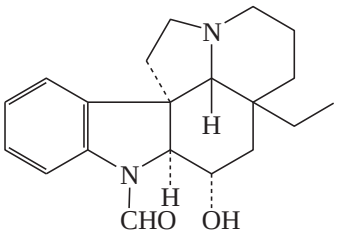
**1030 Sewarine**



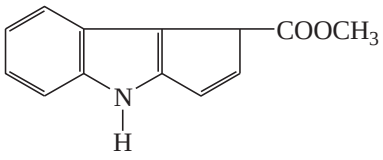
**1031 Strictalamine**



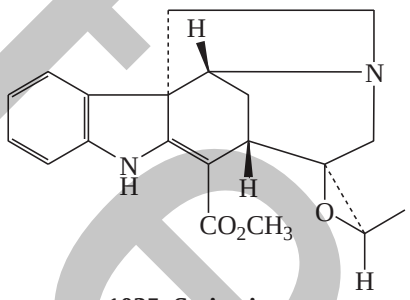
**1032 Strictamine (Vincamidine)**



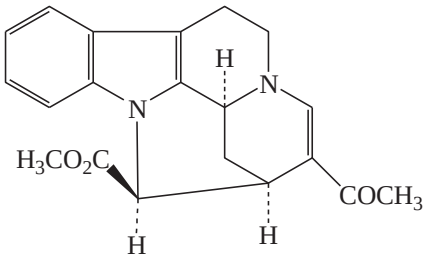
**1033 Strictanine**



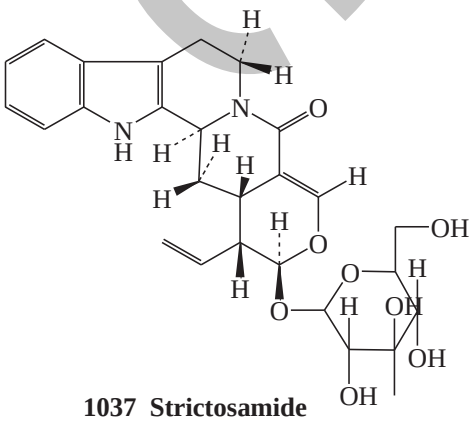
**1034 Strictibine**



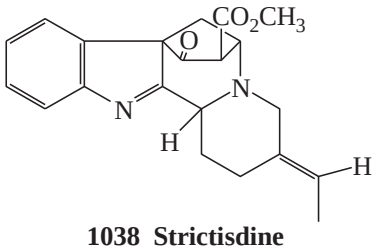
**1035 Strictcine**



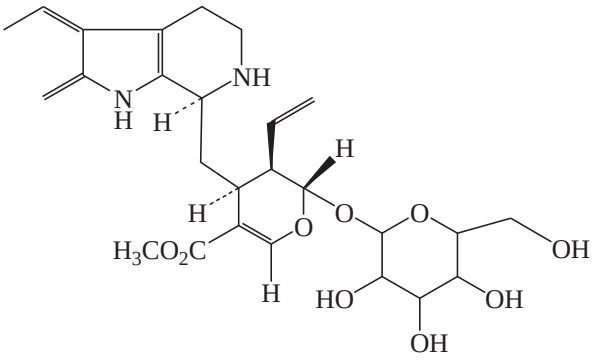
**1036 Strictine**



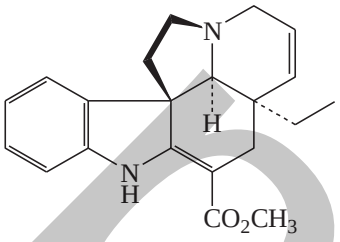
**1037 Strictosamide**



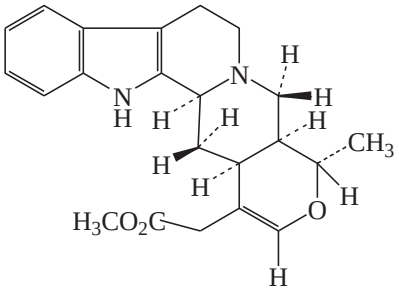
**1038 Strictisdine**



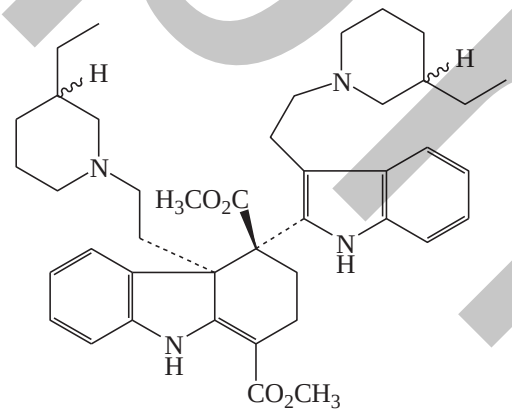
**1039 Strictosidne**



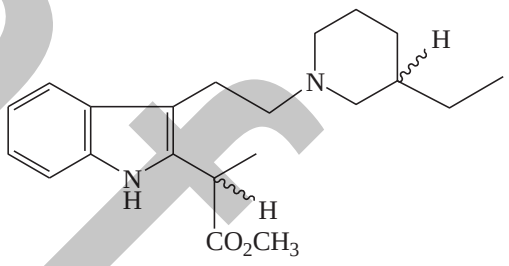
**1040 Tabersonine**



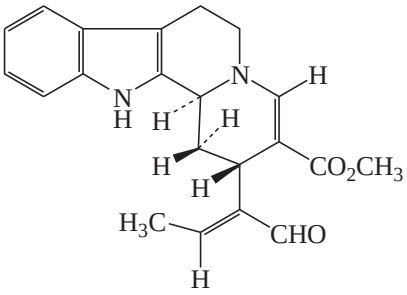
**1041 Tetrahydroalstonine**



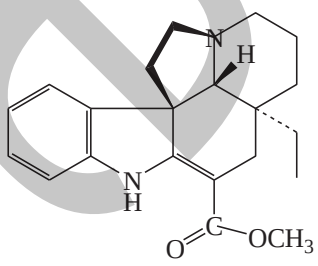
**1042 Tetrahydropresecamine**



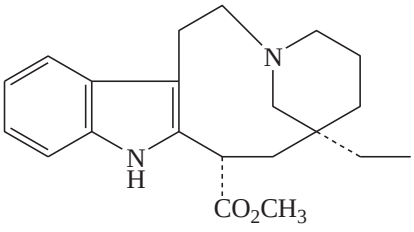
**1043 Tetrahydrosecodine**



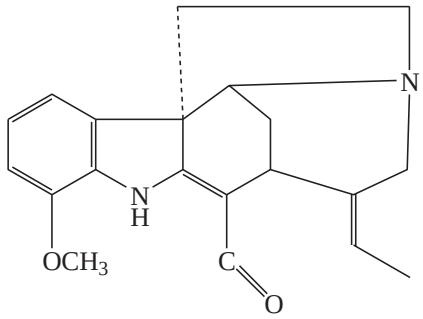
**1044 Vallesiachotamine**



**1045 (-)-Vingcadifformine**



**1046 Vincadine**




**1047 Vincanicine**

## Non-Alkaloidal Constituents

Two flavonoids rhazinoside A and rhazinoside B were isolated from dried leaves of *Rhazya stricta*. The sugar portion of both flavonoid glycosides contains 1 mole rhamnose and 2 moles galactose (Kaneko and Namba, 1967). In addition, robinin, isorhamnetin 3-(6-rhamnosylgalactoside)-7-rhamnoside and isorhamnetin 3-(2,6-dirhamnosyl-galactoside)-7-rhamnoside (Andersen *et al*., 1986) and 5,7-dihydroxy-6,2'-dimethoxy-flavone (Sultana *et al*., 2005) were identified from the plant.

The leaves contain ursolic acid and methyl quinate (Kaneko and Nambe, 1967). Lupeol, lupeol 3-*O*-acetate, β-sitosterol glucoside (Qureshi, 1991), stigmasterol and 3α-hydroxy-ursane-2-ene (Sultana and Khalid, 2010) were isolated from the fruits.

Vanillin, 5-methoxyeugenol, *trans*, *trans*-farnesol, phytol, dihydroactinidiolide and 4-hydroxy-4,8,12,16-tetramethylheptadecanoic acid were isolated from the air-dried parts of *R. stricta* growing in Saudi Arabia (Abdel-Mogib *et al*., 1998).

Trace elements (Al, Ag, Ba, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sr, Ti and Zn) were determined in the ashes of leaves, shoots, flowers, seeds and roots of the plant growing in sandy areas of Karachi, Pakistan (Fatima *et al*., 1999).