

Chapter II

Historical

I. Alkaloids Isolated from Lauraceous Plants

Greshoff, in 1890, isolated laurotetanine, the first Lauraceous alkaloids, from *Actinodaphne procera* Nees and *Litsea chrysocoma* Blume. In 1978, Ralph and coworkers summarized the Lauraceous alkaloids in nature which isolated from 103 species of 19 genera. There are about 105 alkaloids of 15 structural types. Most of Lauraceous alkaloids are isoquinoline type. (Greshoff, 1890; Ralph, Bick and Sinchai, 1978).

The occurrence of alkaloids found in the various species of the Lauraceae is summarized in Table 1.

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

Table 1. Distribution of the Lauraceous alkaloids.

Plant species	Alkaloid	Reference
<i>Actinodaphne acutivena</i> (Hayata) Nakai	laurohitsine	Lu, Wang and Lin, 1969
<i>A. hookeri</i> Meissn	actinodaphnine	Krishna and Ghose, 1932; Ghose, Krishna and Schlittler, 1934
<i>A. nitida</i> Teschn	boldine laurohitsine	Johns, Lamberton and Sioumis, 1969
<i>A. obovata</i> Blume	actinodaphnine laurotetanine N-methyl-lauro- tetanine	Uprety, Bhakuni and Dhar, 1972
<i>A. procera</i> Nees	laurotetanine	Ralph, Bick and Sinchai, 1978
<i>Alseodaphne archboldiana</i> (C.K. Allen) Kosterm.	(+), (-)-coclaurine (-)-N-norarmepavine (+)-reticuline	Johns, Lamberton and Sioumis, 1967

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Alseodaphne semicarpiifolia</i> Nees	srilankine	Smolnycki, Moniot, Hindenlang, Miana and Shamma, 1978
<i>Aniba coto</i> (Rusby) Kosterm.	anabasine	Mors and Gottlieb, 1959
<i>A. duckei</i> Kosterm.	anibine duckein	Mors, Gottlieb and Djerassi, 1957; Correa and Gottlieb, 1975
<i>A. rosaeodora</i> Ducke	anibine	Mors, Gottlieb and Djerassi, 1957
<i>Beilschmiedia elliptica</i> White & Francis	isoboldine laurelliptine	Clezy, Gellert, Lau and Nichol, 1966
<i>B. oreophila</i> Schlechter	6-epioreobeline isoboldine oreobeline thaliporphine wilsonirine	Tillequin and Koch, 1985

Table 1. (cont.)



Plant species	Alkaloid	Reference
<i>Beilschmiedia podagrica</i> Kostermans	(+)-2, 11-dihydroxy- -1, 10-dimethoxy- aporphine glaucine (+)-2, hydroxy-1 9,10-trimethoxy- noraporphine isoboldine isocorydine laurelliptine norpredicentrine predicentrine	Johns, Lamberton, Sioumis and Tweeddale, 1969
<i>B. tawa</i> Benth. & Hook. (The valid name should be <i>Nesodaphne tawa</i> Nees)	isoboldine	Russell and Fraser, 1969
<i>Cassytha americana</i> Nees (The valid name should be <i>Cassytha fili-</i> <i>formis</i> L.)	actinodaphnine bulbocapnine cassamedine cassameridine cassyfiline (cassythine) cassythicine	Cava, Rao, Douglas and Weisbach, 1968

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Cassythia americana</i> Nees (The valid name should be <i>Cassythia fili-</i> <i>formis</i> L.)	cassythidine dicentrine launobine N-methylactino- daphnine O-methylcassyfi- line neolitsine nuciferine	
<i>C. filiformis</i> L.	cassyfiline (cassythine) cassythidine laurotetanine nantenine ocoteine (O, N-di- methylcassyfiline)	Webb, 1948; Tomita, Lu and Wang, 1965; Johns and Lamberton, 1966; Merchant and Desai, 1973
<i>C. glabella</i> R. Br.	cassythicine	Johns, Lamberton and Sioumis, 1966
<i>C. melantha</i> R. Br.	actinodaphnine cassythicine (N-methylactino- daphnine)	Johns, Lamberton and Sioumis, 1966

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Cassytha pubescens</i> R. Br.	domesticine isoboldine laurelliptine nantenine nordomesticine sinoacutine	Johns, Lamberton and Sioumis, 1966
<i>C. racemosa</i> Nees	(+)-coclaurine 1,2-dimethoxy-9, 10-methylenedioxy- -7-oxodibenzo- -quinoline isoboldine laurelliptine laurotetanine N-methyl-lauro- tetanine nantenine nornantenine	Johns, Lamberton and Sioumis, 1967
<i>Cinnamomum camphora</i> (Linn.) Sieb.	laurolitsine reticuline	Tomita and Kozuka, 1964
<i>C. laubattii</i> F. Muell	(+)-reticuline	Ellis, Gellert and Summons, 1972

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Cinnamomum</i> sp.	cinnamolaurine (-)-cinnamolaurine (+)-corydine norcinnamolaurine (+)-reticuline	Gellert and Summon, 1969; 1970
<i>Cryptocarya alba</i>	(+)-reticuline	Urzua, Torres and Cassels, 1975
<i>C. amygdalina</i> Nees	(+)-reticuline	Manandhar, Shoeb, Kapil and Popli, 1979
<i>C. angulata</i> C.T. White	3,4-dimethoxy-1- dimethylamino- ethylphenanthrene (atherosperminine) N-methylisocory- dine roemerine	Cooke and Haynes, 1954; Bick and Douglas, 1965
<i>C. archboldiana</i> C.K. Allen	(-)-armepavine	Johns, Lamberton and Tweeddale, 1969

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Cryptocarya bowiei</i> (Hook.) Druce (The valid name should be <i>Laurus bowiei</i> Hook.)	cryptaustoline cryptowoline	Ewings, Hughes, Ritchie and Taylor, 1953
<i>C. chinensis</i> Hemsl.	(±), (-)-caryachine crychine (+)-O-methylcaryachine (+)-eschsholitzidine	Chen, Lee, Lai, Wu and Beal, 1979
<i>C. foveolata</i> C.T. White & Francis	reticuline	Lamberton and Vashist, 1972
<i>C. konishii</i> Hayata	armepavine (±)-coclaurine crykonisine (±)-N-norarmepavine (-)-N-norarmepavine	Lu, 1967 a,
<i>C. laevigata</i> Elmer	cryptopleurine	Hoffmann, Luzbatak, Torrance and Cole, 1978

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Cryptocarya longifolia</i> Kostermans	bisnorargemonine coclaurine isoboldine laurolitsine laurotetanine longifolidine longifolonine N-methylcoclaurine N-methyl-laurotetanine norargemonine norisocarydine reticuline scoulerine thalifoline	Ralph, Bick, Sévenet, Sinchai, Skelton and White, 1981
<i>C. odorata</i> (Panch & Seb.) Guillaum.	cryptodorine isocorydine laurotetanine N-methyl-laurotetanine (+)-reticuline	Bick, Preston and Potier, 1972

Table 1. (cont.)

Plant species	Alkaloid	References
<i>Cryptocarya phyllostemon</i> Kostermans	antofine dehydroantofine	Bick, Sinchai, Sévenet, Ranaivo, Nieto and Cavé, 1980
<i>C. pleurosperma</i> C.T. White & Francis	cryptopleuridine cryptopleurine cryptopleurosper- mine pleurospermine	de la Lande, 1948; Gellert, 1959; Johns, Lamberton, Sioumis and Willing, 1970
<i>C. tomentosa</i> Blume	laurotetanine	Wehmer, 1935
<i>C. triplinervis</i> R. Br.	N-methylisocorydine (menisperine)	Cooke and Haynes, 1954
<i>Cryptocarya</i> sp.	crykonisine	Lu, 1967
<i>Dehaasia</i> sp.	isocorydine	Guinaudeau, 1983
<i>Laurus nobilis</i> L.	actinodaphnine boldine cryptodorine isodomesticine launobine N-methylactino- daphnine	Tomita, Kozuka, Nakagawa and Mitsunori, 1963; Pech and Bruneton, 1982

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Laurus nobilis</i> L.	nandigerine norisodomecine	
<i>Lindera benzoin</i> (L.) Blume	laurotetanine	Babcock and Segalman, 1974
<i>L. citriodora</i> (Sieb. & Zucc.) Hemsl	laurotetanine	Kozuka, Shibakawa, Yoshimura, Yokoyama, Fugiwara, Miyaji and Sawada, 1984
<i>L. erythrocarya</i> Makino	laurotetanine N-methylaurotetanine	Kozuka <i>et al.</i> , 1984
<i>L. glauca</i> (Sieb. & Zucc.) Blume	laurotetanine (+)-norcinnamolau- rine (+)-reticuline	Kozuka <i>et al.</i> , 1984
<i>L. oldhamii</i> Hemsl	(+) -dicentrine dicentrinone lindoldhanine L-(+) -magnocurarine	Lu, Wang, Lai, Lin and Lin, 1972; Lu and Chen, 1976; Chen, 1977



Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Lindera oldhamii</i> Hemsl.	N-methylhernan- gerine (N-methylnandi- gerine) N-methylhernovine (N-methylovigerine) O-methylbulbocap- nine N-nordicentrine	
<i>L. pipericarpa</i> Boerl. (The valid name should be <i>Polyadenia</i> <i>pipericarpa</i> Miq.)	laurotetanine lindcarpine	Burkill, 1935; Kiang and Sim, 1967
<i>L. sericea</i> Blume	boldine launobine laurolitsine	Kozuka, Miyazawa, Yokoyama, Odani and Kubo, 1985
<i>L. sericea</i> var. <i>glabrata</i> Bl.	boldine launobine laurolitsine	Kozuka <i>et al.</i> , 1985

Table 1. (cont)

Plant species	Alkaloid	Reference
<i>Lindera strychnifolia</i> (Sieb. & Zucc.) F. Vill.	boldine laurolitsine reticuline	Tomita, Sawada, Kozuka, Hamano and Yoshimura, 1969; Kozuka, Yoshikawa and Sawada, 1984
<i>L. umbellata</i> Thunb	boldine launobine laurolitsine laurotetanine	Tomita <i>et al.</i> , 1969; Kozuka <i>et al.</i> , 1985
<i>L. umbellata</i> Thunb. var. <i>lancea</i> Momiya	boldine launobine laurolitsine	Kozuka <i>et al.</i> , 1985
<i>Litsea akoensis</i> Hayata	laurolitsine	Lu, Su and Duh, 1979
<i>L. amara</i> Blume	laurotetanine	Wehmer, 1935
<i>L. chrysocoma</i> Blume	laurotetanine	Greshoff, 1890
<i>L. citrata</i> Blume	laurotetanine N-methyl-laurotetanine	Spath and Suominen, 1933
<i>L. cubeba</i> Pers.	isocorydine laurotetanine (+)-magnocurarine	Tomita, Lu, Lan and Lin, 1965; Lu and Lin, 1967

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea cubeba</i> Pers.	N-methyl-laurotetanine	
<i>L. deccanensis</i> Gamble	actinodaphnine	Desai, 1966
<i>L. glutinosa</i> (Lour.) C.B. Rob	isoboldine laurelliptine laurolitsine laurotetanine liriodenine	Hart, Johns, Lamberton, Lodder, Moorhouse, Sioumis and Smith, 1969
<i>L. glutinosa</i> var. <i>glabraria</i> Hook	actinodaphnine boldine laurolitsine (norbaldine) laurotetanine N-methylactinodaphnine N-methyl-laurotetanine	Tewari, Bhakuni and Dhar, 1972
<i>L. hayatae</i> Kanehira (The valid name should be <i>L. obovata</i> Hayata)	laurolitsine liriodenine (oxoushinsumine) ushinsumine	Lu, Wang and Lin, 1969
<i>L. intermedia</i> Boerl	laurotetanine	Wehmer, 1935

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea japonica</i> Mirb.	laurolitsine	Kozuka, 1962
<i>L. javanica</i> Blume	laurotetanine	Wehmer, 1935
<i>L. kawakamii</i> Hayata	cassameridine laurolitsine N-methylactinodaph- nine	Lu, Su and Duh, 1979
<i>L. laeta</i> Benth & Hook.	dicentrinone glaucine laetanine (2,10-dihydroxy- -1, 9-dimethoxy- noraporphine) laetine nordicentrinone	Borthakur and Rastogi, 1979; Rastogi and Borthakur, 1980
<i>L. latifolia</i> Blume	laurotetanine	Ralph, Bick and Sinchai, 1978
<i>L. laurifolia</i> (Jacq.) Cordemoy	actinodaphnine boldine glaziovine isoboldine laurelliptine laurolitsine	Leboeuf, Cave, Provost and Forgaes, 1979; Guinaudeau <i>et al.</i> , 1983

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea laurifolia</i> (Jacq.) Cordemoy	laurotetanine N-methylactinodaph- nine N-methylhernan- gerine N-methyl-lauroteta- nine nandigerine reticuline	
<i>L. lecardii</i> Guillaum	(+) -actinodaphnine (+) -boldine (+) -cassythicine (+) -coclaurine (+) -isoboldine (+) -laurolitsine (+) -litserferine (+) -norisocorydine (-) -pallidine (+) -reticuline	Weber, Bruneton and Pusset, 1936
<i>L. leefeana</i> Merr.	boldine laurolitsine (+) -reticuline	Lamberton and Vashist, 1972
<i>L. lucida</i> Blume	laurotetanine	Wehmer, 1935

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea nitida</i> Roxb	actinodaphnine dicentrine litsedine	Patnaik and Gopinath, 1975
<i>L. polyantha</i> Juss.	actinodaphnine	Dutta, 1968
<i>L. salicifolia</i> Hook.) (The valid name should be <i>Tetranthera</i> <i>salicifolia</i> Roxb.)	dicentrinone glaucine laetine nordicentrine N, O-dimethylherno- vine	Rastogi and Borthakur, 1980
<i>L. sebifera</i> Pers.	actinodaphnine boldine laurotetanine litseferine N-methylaurotetanine sebiferine	Uprety, Bhakuni and Dhar, 1972; Sivakumaran and Gopinath, 1976
<i>L. solomensis</i> Allen	laurolitsine reticuline	Hart, Johns, Lamberton, Lodder, Moorhouse, Sioumis and Smith, 1969

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea triflora</i> Guillaumin	actinodaphnine (+)-boldine (+)-coclaurine (+)-corydine glaucine (+)-isoboldine (+)-isocorydine laurelliptine (-)-N-methylco- claurine N-methyl-laurotetra- nine (+)-norboldine (+)-norisoboldine predicentrine (+)-predicentrinone (+)-reticuline	Castredo, Saa, Suau, Villaverde and Potier, 1980
<i>L. turfosa</i> Blume	boldine laurolitsine (norboldine)	Holloway and Scheimann, 1973
<i>L. wightiana</i> Benth & Hook. f.	boldine glaucine isoboldine	Uprety, Bhakuni and Dhar, 1972; Bhakuni and Gupta, 1983

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Litsea wightiana</i> Benth & Hook. f.	laurolitsine (norboldine) laurotetanine norboldine norcorydine	
<i>L. zeylanica</i> (C & T.) Nees	(+)-isoboldine (+)-N-norisoboldine (+)-reticuline	Kametani, Satoh, Fukumoto and Pai, 1971
<i>Litsea</i> sp.	actinodaphnine (+)-coclaurine (+)-isocorydine laurolitsine laurotetanine (-)-magnocurarine reticuline	Kozuka, 1962; Tomita, Lu, Fu and Lin, 1965; Tomita, Lu and Lan, 1965; Desai, 1966; Lu and Lin, 1967; Hart <i>et al.</i> , 1969
<i>Machilus acuminatissimus</i> (Hay) Kanehira	(+)-coclaurine (machiline) crykonisine (±)-N-norarmepavine (-)-N-norarmepavine	Lu, 1967 a
<i>M. arisanensis</i> Hayata	(+)-laudanidine (±)-(-)-N-norarmepavine	Tomita, Lu and Lan, 1965 a

Table 1. (cont)

Plant species	Alkaloid	Reference
<i>Machilus arisanensis</i> Hayata	(-)-N-norarmepa- vine	
<i>M. duthei</i> King & Hook	boldine isoboldine laurotetanine norboldine (+)-reticuline	Hussain, Amin and Shamma, 1980
<i>M. glaucescens</i> Wight	machigline	Talapatra, Goswami, Ghosh and Talapatra, 1982
<i>M. kusanoi</i> Hayata	coclaurine (-)-N-norarmepa- vine	Tomita, Yang and Lu, 1963; Lu, 1963
<i>M. macrantha</i> Nees	(±)-coclaurine	Tomita, Yang, Gaiind and Baveja, 1963
<i>M. obovatifolia</i> (Hayata) Kanehira & Sasaki	(+) - laudanidine (±)-N-norarmepa- vine (-)-N-norarmepa- vine	Tomita, Lu and Lan, 1965 a

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Machilus pseudolongi- folia</i> Hayata	(±)-N-norarmepavine (-)-N-norarmepavine	Lu, 1963
<i>M. thunbergii</i>	(±)-N-norarmepavine (-)-N-norarmepavine reticuline	Tomita and Kozuka, 1964; Tomita, Lu and Lan, 1965 b
<i>M. zuihoensis</i> Hayata	(±)-N-norarmepavine (-)-N-norarmepavine	Tomita, Lu and Lan, 1965 b
<i>Machilus</i> sp.	(±)-N-norarmepavine (-)-N-norarmepavine reticuline	Lu, 1963; Tomita, Lu and Lan 1965 b
<i>Mezilaurus synandra</i> (Mez.) Kosterm.	coclaurine corytuberine norcinnamolaurine	Silva, Nagem, Mesquita and Gottlieb, 1983
<i>Nectandra pichurim</i> (H.B.K.) Mez. (The valid name should be <i>Ocotea pichurim</i> H.B.K.)	isoboldine	Ferrari, Fervidi and Ferrari, 1971
<i>N. rigida</i> Nees	laurelliptine	Le Quesne, Larrahondo and Raffauf, 1980



Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Nectandra rodiei</i> R. Schomb.	ocoteine rodiasine sepeerine	Grundon and Garvey, 1960
<i>N. saligna</i> (Nees & Mart) Nees	dehydroocoteine isoboldine ocoteine	Baralle, Busch, Vernengo and Kuck, 1972
<i>Neolitsea</i> (Table 2)		
<i>Notaphoebe konishii</i> Hayata	(±)-N-norarmepavine (-)-N-norarmepavine (-)-laudanine	Lu, 1967 b
<i>N. umbelliflora</i> Blume	laurotetanine	Ralph, Bick and Sinchai, 1978
<i>Notaphoebe</i> sp.	actinodaphrine	Ghose, Krishna and Schlittler, 1934
<i>Ocotea acutangula</i> Mez.	S(-)-O-methyl- pallidine S(-)-O-methyl- pallidine S(-)-pallidine S(-)-pallidine	Vecchiatti, Casagrande, Ferrari, Danieli and Palmisano, 1981
<i>O. brachybotra</i> (Meiss.) Mez.	cassythicine dicentrine	Vecchiatti, Casagrande and

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Ocotea brachybotra</i> (Meiss.) Mez	14-episinomenine (+)-glaziovine leucoxine ocobotrine ocopodine pallidine predicentrine sinoacutine	Ferrari, 1976; 1977
<i>O. bucherii</i> Roij & Acuña	3-hydroxyglaucine	Hasso, Alfred, Klaus and Hilda, 1983
<i>O. caparrapi</i> (Sandino- Grott & Nates) Dugand	reticuline	Suarez and Enrique, 1980
<i>O. glaziovii</i> Mez.	(±)-apoglaziovine asimilobine caaverine (±)-crotsparine 1,10-dihydroxy- 2-methoxyaporphine (±)-glaziovine (±)-1-hydroxy-2- -methoxyaporphine isoboldine liridenine	Gilbert, Gilbert, De Oliveira, Ribeiro, Wenkert, Wickberg, Hollstein and Rapoport, 1964; Ferrari and Casagrande, 1967; Casagrande and Ferrari, 1975

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Ocotea glaziovii</i> Mez.	(-)-pronociferine	
<i>O. leucoxydon</i> Benth. & Hook.	dicentrine leucoxine leucoxydonine ocoteine ocoxydonine	Ahmad and Cava, 1977
<i>O. macrophylla</i> Mez. (The valid name should be <i>Nectandra macrophylla</i> Nees)	dehydroantenine (+)-glaucine (+)-isocorydine 1-(p-methoxybenzyl)-6, 7 dimethoxyisoquinoline 1-(p-methoxybenzyl)-6, 7 methylenedioxyisoquinoline (+)-nantenine	Franca, Giesbrecht, Gottlieb, Magalhães, Magalhães and Maia, 1975
<i>O. macropoda</i> Mez.	dihydrodicentrine dihydroocopodine dicentrine dicentrinone nordicentrine ocopodine	Cava, Watanabe, Bessho, Mitchell, da Rocha, Hwang, Douglas and Weisbach, 1968; Charubala, Pai, Govindachari

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Ocotea macropoda</i> Mez.	predicentrine	and Viswanathan, 1968; Cava and Venkateswarlu, 1971
<i>O. minarum</i> Nees (Mez.)	dicentrine dicentrinone 4-hydroxydicentrine isooconovine leucoxine leucoxyllonine nor-leucoxyllonine ocominarine ocominarone ocopodine ocoteine ocotominarine predicentrine thalicminine	Vecchiatti, Casagrande, Ferrari and Severini, 1979
<i>O. puberula</i> Nees	dehydroocoteine didehydroocoteine ocoteine thalicmine thalicminine	Vernengo, 1963; Baralle, Schwarzberg, Vernengo and Comin, 1972; Baralle, Schwarzberg,

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Ocotea puberula</i> Nees		Vernengo, Moltrasio and Giacobello, 1973
<i>O. rodioei</i> Mez	demerarine norrodiasine 2-(+)-nortetrandrine ocoteamine (sepeerine) ocotiene ocotosine rodiasine	Mckennis, Hearst, Drisko, Roe and Alumbaugh, 1956; Hearst, 1964; Chan, Evans, Hassall and Sangster, 1967
<i>O. variabilis</i> Mart	(+) -apoglaziovine (+) -glaziovine (+) -nantenine variabiline	Cava, Behforcuz and Mitchell, 1972
<i>O. venenosa</i> Gleason	bebeerine dimethylrodiasine rodiasine	Kostermans, Pinkley and Stern, 1970
<i>Ocotea</i> sp.	isocorydine 1-(p-methoxybenzyl)-6, 7-dimethoxyisoquinoline	Cava, Watanabe, Bessho, Mitchell, da Rocha, Hwang, Douglas and Weisbach,

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Ocotea</i> sp.	1-(p-methoxybenzyl)-6,7-methylenedioxyisoquinoline ocokryptine oconovine	1968; Franca, Giesbrecht, Gottlieb, Magalhães, and Maia, 1975
<i>Parabenzoin praecox</i> (Sieb & Zacc.) Nakai	nandigerine praecoxine (N-methylhernagine)	Kozuka, Inada, Konoshima and Sawada, 1984
<i>Persea gratissima</i> Gaertn. f.	dopamine (hydroxytyramine) serotonine (5-hydroxytryptamine)	Udenfriend, Lovenberg and Sjoerdsma, 1959
<i>Persea</i> sp.	dopamine serotonine tyramine	Udenfriend, Lovenberg and Sjoerdsma, 1959
<i>Phoebe clemensii</i> C.K. Allen	2, -11-dihydroxy-1,10-dimethoxy- aporphine 10-hydroxy-1, 2-methylenedioxyaporphine	Johns and Lamberton, 1967

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Phoebe clemensii</i> C.K. Allen	N-methylindcarpine isocorydine laurolitsine (-)-mecambroline	
<i>P. formosana</i> Hay.	lauformine laurolitsine liriodenine (oxoushinsunine) litsericine N-methylauformine N-methylitseri- cine roemerine ushinsunine	Lu and Su, 1973 b; Lu and Tsai, 1984
<i>P. mollicella</i> Blake	norpreocoteine norpurpleine preocoteine purpleine	Stermitz and Castro, 1983
<i>P. pittieri</i> Mez.	1, 2, 9-trimethoxy- 10-hydroxynorapor- phine (norlirioferine)	Castro, Lopez and Vergara, 1985

Table 1. (cont.)

Plant species	Alkaloid	Reference
<i>Phoebe pittieri</i> Mez.	1,2,3-trimethoxy-9, 10,methylenedioxy- norporphine norpurpleine reticuline	
<i>P. porfiria</i> (Gris.) Mez	Ocoteine	Baralle, Busch, Vernengo and Kuck, 1972
<i>Ravensara aromatica</i> J.F. Gmel	N-methylisocory- dine (menisperine)	Groebel, Lenoir and Pernet, 1969
<i>Sassafras albidum</i> (Nutt.) Nees (The valid name should be <i>Sassafras</i> <i>officinale</i> Nees & Eberm)	boldine cinnamolaurine isoboldine norboldine norcinnamolaurine reticuline	Chowdhury, Sethi, Lloyd and Kapadia, 1976

II. Alkaloids Isolated from *Neolitsea* Species

Members of the genus *Neolitsea* are found to contain a wide range of chemical constituents such as alkaloids, monoterpenes, sesquiterpenes, triterpenes, lignans and fatty acids.

Aporphines and benzylisoquinolines frequently occur in *Neolitsea* species. Boldine, isolated from *Neolitsea sericea* (Blume) Koidzumi by Nakasato and Nomura in 1957 was the first alkaloid isolated in this genus.

The occurrence of alkaloids found in the various species reported as *Neolitsea* is summarized in Table 2.



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

Table 2. Distribution of the alkaloids in genus *Neolitsea*

Plant species	Part used	Alkaloid	Reference
<i>Neolitsea aciculata</i> Koidz. (The valid name should be <i>Laurus aciculata</i> Teschn.)	root	boldine laurolitsine (+)-laurotetanine (+)-reticuline	Kozaku, Takeuchi and Sawada, 1984
<i>N. acuminatissima</i> Kanehira & Sasaki (The valid name should be <i>Tetradenia acuminatissima</i> Hayata)	bark	(+)-laurotetanine	Kataoku, 1965; Tomita, Lu, Fu and Lin, 1965
<i>N. aurata</i> (Hay.) Koidz. (The valid name should be <i>Tetradenia aurata</i> Hayata)	-	(+)-anonaine laurolitsine litsericine N-methylitsericine (-)-roemerine	Lu, Su and Wang, 1975
<i>N. buisanensis</i> Yamamoto & Kamikoti	-	laurolitsine litsericine	Lu, Su and Wang 1975
<i>N. daibuensis</i> Kamikoti	root	(+)-reticuline	Lu and Hong, 1977
<i>N. fuscata</i> (Thwait) Alston. (The valid name should be <i>Litsea fuscata</i> Thwait)	bark	isoboldine	Gunatilaka, Sotheeswaran, Sriyani and Balasubramaniam, 1981
<i>N. pubescens</i> (Teschn.) Merrill. (The valid name should be <i>Tetradenia pubescens</i> Teschn.)	bark	boldine laurolitsine N-methylaurotetanine roemerine	Johns, Lamberton and Sioumis, 1969
<i>N. pulchella</i> (Meiss.) Merr (The valid name should be <i>Litsea pulchella</i> Meissn.)	leaves	neolitsine neolitsinine isomeric pulchelline	Hui, Loo and Arthur, 1966

Table 2. (cont.)

Plant species	Part used	Alkaloid	Reference
<i>Neolitsea sericea</i> (Blume) Koidzumi (The valid name should be <i>Laurus sericea</i> Blume)	trunk	actinodaphnine	Nakasato and Nomura, 1957; 1958; 1959; Nakasato and Asada, 1966; Nakasato, Asada and Kozuka, 1966
	bark	anonaine	
		boldine	
		laurolitsine	
		laurotetanine	
		liriodenine	
		litsericine	
		N-methylactinodaphnine	
		N-methylaurotetanine	
		nuciferine	
	leaves	roemerine	
	(-)-roemerine		
<i>N. variabilissima</i> Kanehira & Sasaki (The valid name should be <i>Tetradenia variabilium</i> Hayata)	bark	(-)-hernovine	Lu and Su, 1973 a
		(-)-N-methylhernovine	
		(-)-nandigerine	

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

III. Chemistry of the Alkaloids in Lauraceous Plants

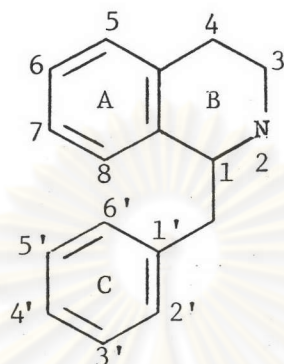
The Lauraceae plants also contained other types of alkaloid arising from phenylalanine or tyrosine. Most of the Lauraceous alkaloids are isoquinoline types; benzylisoquinolines, proaporphines, aporphines, dehydroaporphines, oxoaporphines, phenanthrenes, pavines, dibenzopyrrocolines, morphinans, bisbenzylisoquinolines, phenanthroquinolizidines, cryptopleurospermines. The biggest group is the aporphines. Apart from isoquinolines alkaloids, other alkaloids are pyridines, sedamine and indole types (Ralph, Bick and Sinchai, 1978).

The numbering and structure of these alkaloids are as follows :-

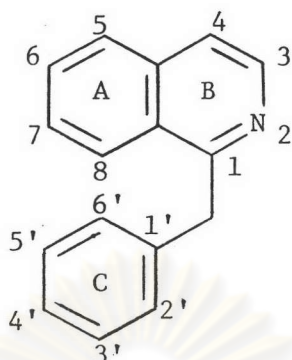
1. Benzylisoquinolines

The benzylisoquinolines occupy a paramount position in alkaloid chemistry because they act *in vivo* as precursor to so many of the other naturally occurring isoquinoline alkaloids. Ring A in the benzylisoquinoline alkaloids may possess two or three oxygenated substituents, while ring C has one or two substituents (Shamma, 1972 b). They are fundamentally two types of benzylisoquinoline, a 1, 2, 3, 4-tetrahydro type such as (+)-reticuline and a complete aromatic type such as papaverine (Cordell, 1981 b).

Lauraceous plants contain both benzylisoquinoline and tetrahydrobenzylisoquinoline types. In genus *Neolitsea*, it was found only one tetrahydrobenzylisoquinoline, reticuline, isolated from the root of Japanese plant, *Neolitsea aciculata* Koidz. (The valid name should be *Laurus aciculata* Teschn.) (Kozuka, Takeuchi and Sawada, 1984).

1.1 Tetrahydrobenzylisoquinolines

Alkaloid	Substituent positions				
	2	6	7	3'	4'
(-)-armepavine	CH ₃	OCH ₃	OCH ₃	OH	-
cinnamolaurine	CH ₃	-OCH ₂ O-		-	OH
coclaurine (machiline)	-	OCH ₃	OH	-	OH
laudanidine	CH ₃	OCH ₃	OCH ₃	OH	OCH ₃
longifolidine	CH ₃	-	OCH ₃	OH	- (OCH ₃ group at 8)
magnocurarine	CH ₃ , CH ₃	OCH ₃	OH	-	OH
N-methylcoclaurine	CH ₃	OCH ₃	OH	-	-
N-norarmepavine	-	OCH ₃	OCH ₃	-	OH
norcinnamolaurine	-	-OCH ₂ O-		-	OH
reticuline	CH ₃	OCH ₃	OH	OH	OCH ₃

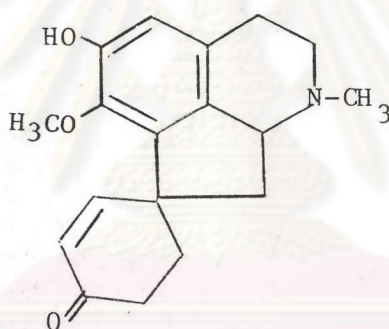
1.2 Benzyloisoquinolines

Alkaloid	Substituent positions		
	6	7	4'
crykonisine	OCH ₃	OCH ₃	OH
1-(p-methoxybenzyl)-6, 7-dimethoxy- isoquinoline	OCH ₃	OCH ₃	OCH ₃
1-(p-methoxybenzyl)-6, 7-methylene- dioxyisoquinoline	-OCH ₂ O-		OCH ₃

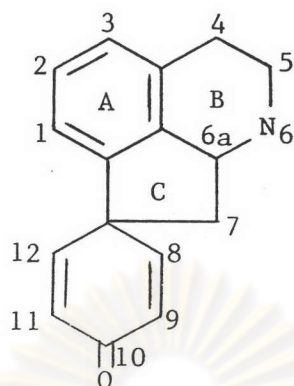
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2. Proaporphines

The proaporphine alkaloids occur in a variety of oxidation states. (+)-Pronuciferine possesses a cyclohexadienone system which is present in many other proaporphines such as (+)-crotonosine and (-)-orientalinone. The proaporphine numbering system is as indicated for (+)-pronuciferine. Because of the asymmetry at C-6a, one side of the dienone system is not equivalent to the other. The lower numbers (C-8 and C-9) are assigned to the side of the dienone above the mean plane of the molecule, and the higher number (C-11 and C-12) to the side below, as shown for (+)-linearisine (Shamma, 1972 c).

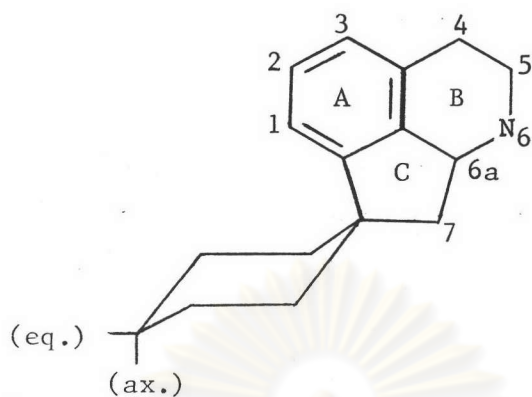


There are four proaporphine alkaloids occurring in the Lauraceae family. In genus *Neolitsea*, they were found two proaporphines, litsericine, isolated from *Neolitsea aurata* (Hay.) Koidz. (The valid name should be *Tetradenia aurata* Hayata); *N. buisanensis* Yamamoto & Kamikoti and *N. sericea* (Blume) Koidzumi (The valid name should be *Laurus sericea* Blume) (Nakasato and Nomura, 1959; Nakasato, Asada and Koezuka, 1966; Nakasato and Asada, 1966; Lu, Su and Wang, 1975) and N-methylitsericine, isolated from *Neolitsea aurata* (Hay.) Koidz. (Lu, Su and Wang, 1975).

2.1 Cyclohexadienone group

Alkaloid	Substituent positions		
	1	2	6
crotosparine	H	OCH ₃	H
glaziovine	OH	OCH ₃	CH ₃
pronuciferine	CH ₃	OCH ₃	CH ₃

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

2.2 Hexahydroproaporphine group

Alkaloid	Substituent positions				
	1	2	6	eq.	ax.
lauformine	-OCH ₂ O-		H	OH	H
litsericine	-OCH ₂ O-		H	H	OH
N-methyllauformine	-OCH ₂ O-		CH ₃	OH	H
N-methylitsericine	-OCH ₂ O-		CH ₃	H	OH

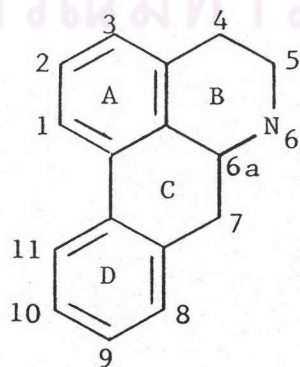
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3. Aporphines

The aporphines are the largest group of isoquinoline alkaloids (Cordell, 1981 c). They are derivable from the benzylisoquinolines by the abstraction of two hydrogens in such a manner that the two benzene nuclei now form part of a 4,5-dihydro-phenanthrene. Since the biosynthesis of these alkaloids almost certainly proceeds from the benzylisoquinolines and since the latter are derived from precursors in which the oxygen substituents are in the 10- and 11-positions (i.e., the vanillin positions) it follows that aporphines can have the substituents only in the 2-, 3-, 4-, 5-, or 6-positions (Manske, 1954). A methyl group is usually attached to the nitrogen and found tertiary nitrogen atom. If the nitrogen is secondary, the alkaloid is called noraporphines.

Position 1 and 2 are always substituted with hydroxyl, methoxyl or methylenedioxy. Other substitution may be found on the position 9, 10 and 11 and less often 3 and 8. In a few cases, a hydroxyl may locate at position 7 (Shamma, 1972 d).

Aporphine type is the majority of alkaloids occurring in the Lauraceae and *Neolitsea* species. The structures of this alkaloid group are summarized and shown as the following :



Alkaloid	Substituent positions								
	1	2	3	6	8	9	10	11	
actinodaphnine	-OCH ₂ O-	-	-	-	-	OH	OCH ₃	-	
anonaine	-OCH ₂ O-	-	-	-	-	-	-	-	
apoglaziovine	OH	OCH ₃	-	CH ₃	-	-	OH	-	
asimilobine	OCH ₃	OH	-	-	-	-	-	-	
boldine	OCH ₃	OH	-	CH ₃	-	OH	OCH ₃	-	
bulbocapnine	-OCH ₂ O-	-	-	CH ₃	-	-	OCH ₃	OH	
caaverine	OH	OCH ₃	-	-	-	-	-	-	
cassyfiline (cassythine)	-OCH ₂ O-	-	OCH ₃	-	-	OH	OCH ₃	-	
cassythicine	-OCH ₂ O-	-	-	CH ₃	-	OH	OCH ₃	-	
cassythidine	-OCH ₂ O-	-	OCH ₃	-	-	-OCH ₂ O-	-	-	
corydine	OH	OCH ₃	-	CH ₃	-	-	OCH ₃	OCH ₃	
cryptodorine (norneolitsine)	-OCH ₂ O-	-	-	-	-	-	-OCH ₂ O-	-	
dicentrine	-OCH ₂ O-	-	-	CH ₃	-	OCH ₃	OCH ₃	-	
2, 11-dihydroxy-1, 10-dimethoxyaporphine	OCH ₃	OH	-	CH ₃	-	-	OCH ₃	OH	
1, 10-dihydroxy-2-methoxyaporphine	OH	OCH ₃	-	CH ₃	-	-	OH	-	
domesticine	OH	OCH ₃	-	CH ₃	-	-OCH ₂ O-	-	-	
glaucine (O-methylthalicmidine)	OCH ₃	OCH ₃	-	CH ₃	-	OCH ₃	OCH ₃	-	
hernovine	OCH ₃	OH	-	-	-	-	OH	OCH ₃	
4-hydroxydicentrine	-OCH ₂ O-	-	-	CH ₃	-	OCH ₃	OCH ₃	-	
								(OH group at 3a')	
3-hydroxyglaucine	OCH ₃	OCH ₃	OH	CH ₃	-	OCH ₃	OCH ₃	-	
(±)-1-hydroxy-2-methoxyaporphine	OH	OCH ₃	-	CH ₃	-	-	-	-	
10-hydroxy-1, 2-methylenedioxyaporphine	-OCH ₂ O-	-	-	CH ₃	-	-	OH	-	
2-hydroxy-1, 9, 10-trimethoxynoraporphine	OCH ₃	OH	-	-	-	OCH ₃	OCH ₃	-	
1, 2, 9-trimethoxy-10-hydroxynoraporphine (norlirioferine)	OCH ₃	OCH ₃	-	-	-	OCH ₃	OH	-	
1, 2, 3-trimethoxy-9, 10-methylenedioxy- noraporphine	OCH ₃	OCH ₃	OCH ₃	-	-	-OCH ₂ O-	-	-	
isoboldine	OH	OCH ₃	-	CH ₃	-	OH	OCH ₃	-	
(+)-isocorydine	OCH ₃	OCH ₃	-	CH ₃	-	-	OCH ₃	OH	
isooconovine	OH	OCH ₃	OCH ₃	CH ₃	-	-	OCH ₃	OCH ₃	
laetanine	OCH ₃	OH	-	-	-	OCH ₃	OH	-	

Alkaloid	Substituent positions								
	1	2	3	6	8	9	10	11	
laetine	OCH ₃	OH	-	-	-	-	-OCH ₂ O-		
launobine	-OCH ₂ O-		-	-	-	-	OCH ₃	OH	
laurelliptine (norisoboldine)	OH	OCH ₃	-	-	-	OH	OCH ₃	-	
laurolitsine (norboldine)	OCH ₃	OH	-	-	-	OH	OCH ₃	-	
laurotetanine	OCH ₃	OCH ₃	-	-	-	OH	OCH ₃	-	
leucoxine	-OCH ₂ O-		-	CH ₃	OH	OCH ₃	OCH ₃	-	
leucoxylinone	-OCH ₂ O-		OCH ₃	CH ₃	OCH ₃	OCH ₃	OCH ₃	-	
lindcarpine	OCH ₃	OH	-	-	-	-	OCH ₃	OH	
lirinidine	OCH ₃	OH	OCH ₃	CH ₃	-	-	-	-	
litsedine	-OCH ₂ O-		-	-	-	-	OCH ₃	OCH ₃	
litseferine	-OCH ₂ O-		-	-	-	OCH ₃	OH	-	
(-)-mecambroline	-OCH ₂ O-		-	CH ₃	-	-	OH	-	
N-methylactinodaphnine	-OCH ₂ O-		-	CH ₃	-	OH	OCH ₃	-	
O-methylbulbocarpine	-OCH ₂ O-		-	CH ₃	-	-	OCH ₃	OCH ₃	
O-methylcassyfiline (O-methylcassythine)	-OCH ₂ O-		OCH ₃	-	-	OCH ₃	OCH ₃	-	
N-methylhernangerine (N-methylnandigerine)	-OCH ₂ O-		-	CH ₃	-	-	OH	OCH ₃	
N, 0-dimethylhernovine	OCH ₃	OH	-	CH ₃	-	-	OCH ₃	OCH ₃	
N-methylhernovine (N-methylovigerine)	-OCH ₂ O-		-	CH ₃	-	-	-OCH ₂ O-		
N-methylisocorydine	OCH ₃	OCH ₃	-	CH ₃ ; CH ₃	-	-	OCH ₃	OH	
N-methyl-laurotetanine	OCH ₃	OCH ₃	-	CH ₃	-	OH	OCH ₃	-	
N-methyl-lindcarpine	OCH ₃	OH	-	CH ₃	-	-	OCH ₃	OH	
nandigerine	-OCH ₂ O-		-	-	-	-	OH	OCH ₃	
nantenine	OCH ₃	OCH ₃	-	CH ₃	-	-	-OCH ₂ O-	-	
neolitsine	-OCH ₂ O-		-	CH ₃	-	-	-OCH ₂ O-	-	
norcorydine	OH	OCH ₃	-	H	-	-	OCH ₃	OCH ₃	
nordicentrine	-OCH ₂ O-		-	H	-	-	OCH ₃	OCH ₃	
nordomesticine	OH	OCH ₃	-	-	-	-	-OCH ₂ O-	-	
norleucoxylinone	-OCH ₂ O-		OCH ₃	CH ₃	OCH ₃	OCH ₃	OCH ₃	-	
nornantenine	OCH ₃	OCH ₃	-	-	-	-	-OCH ₂ O-	-	

Alkaloid	Substituent positions								
	1	2	3	6	8	9	10	11	
norpredicentrine	OCH ₃	OH	-	-	-	OCH ₃	OCH ₃	-	
norpreocoteine	OH	OCH ₃	OCH ₃	-	-	OCH ₃	OCH ₃	-	
ncrpurpureine	OCH ₃	OCH ₃	OCH ₃	-	-	OCH ₃	OCH ₃	-	
nuciferine	OCH ₃	OCH ₃	-	CH ₃	-	-	-	-	
ocokryptine	OCH ₃	-OCH ₂ O-	-	CH ₃	-	-	OCH ₃	OH	
ocominarine	-OCH ₂ O-	-	-	CH ₃	-OCH ₂ O-	-	OCH ₃	-	
oconovine	OCH ₃	OCH ₃	OCH ₃	CH ₃	-	-	OCH ₃	OH	
ocopodine	-OCH ₂ O-	-	-	CH ₃	OCH ₃	OCH ₃	OCH ₃	-	
ocoteine (O, N-dimethylcassy- filine, thalicmine)	-OCH ₂ O-	-	OCH ₃	CH ₃	-	OCH ₃	OCH ₃	-	
ocotominarine	-OCH ₂ O-	-	-	CH ₃	-OCH ₂ O-	-	OCH ₃	-	
ocoxylopine	-OCH ₂ O-	-	OCH ₃	CH ₃	OH	OCH ₃	OCH ₃	-	
praecoxine (+)-1, 2, 11- trimethoxy-10-hydroxyaporphine, N-methylhermagine)	OCH ₃	OCH ₃	-	CH ₃	CH ₃	-	OH	OCH ₃	
predicentrine	OCH ₃	OH	-	CH ₃	-	OCH ₃	OCH ₃	-	
preocoteine	OH	OCH ₃	OCH ₃	CH ₃	-	OCH ₃	OCH ₃	-	
pulchine (N-methylzenkerine)	OH	OCH ₃	-	CH ₃	-	OCH ₃	-	-	
purpureine (thalicmidine)	OCH ₃	OCH ₃	OCH ₃	CH ₃	-	OCH ₃	OCH ₃	-	
roemerine	-OCH ₂ O-	-	-	CH ₃	-	-	-	-	
thalicmine	-OCH ₂ O-	-	OCH ₃	CH ₃	-	OCH ₃	OCH ₃	-	
thaliporphine (O-methylisoboldine)	OH	OCH ₃	-	CH ₃	-	OCH ₃	OCH ₃	-	
srilankine	OCH ₃	OH	-	CH ₃	-	OCH ₃	OCH ₃	-	
ushinsunine	-OCH ₂ O-	-	-	CH ₃	-	-	-	-	
variabiline	OCH ₃	OCH ₃	-	CH ₃	-	-N(CH ₂ Ph) ₂ -	-	-	
wilsonirine	OH	-OCH ₂ O-	-	-	-	OCH ₃	OCH ₃	-	

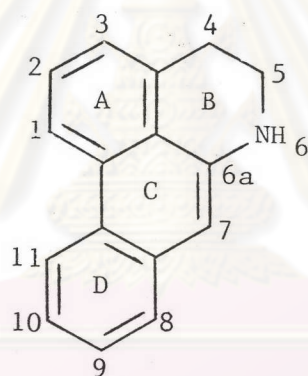
(OH group at 4)

(OH group at 7)

4. Dehydroaporphines

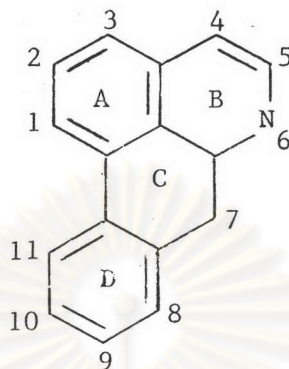
The dehydroaporphines are optically inactive and classified as a subgroup of the aporphine alkaloid (Shamma, 1972e). From the basic structure, there are two types of this subgroup.

4.1 6a,7-Dehydroaporphine The unsaturation is on the C-6a,7. In this subgroup, dehydrodicentrine was first reported to be isolated from natural sources. In Lauraceous plants, they are obtained in *Ocotea* sp. The details of their structures are shown below :-



Alkaloid	Substituent positions					
	1	2	3	8	9	10
dehydrodicentrine	-OCH ₂ O-	-	-	-	OCH ₃	OCH ₃
dehydronantenine	OCH ₃	OCH ₃	-	-	-OCH ₂ O-	-
dehydroocopodine	-OCH ₂ O-	-	-	OCH ₃	OCH ₃	OCH ₃
dehydroocoteine	-OCH ₂ O-	-	OCH ₃	-	OCH ₃	OCH ₃

4.2 4,5-Dehydroaporphines The unsaturation is on C 4, 5. Only one alkaloid of this subgroup in Lauraceous plants is didehydrocoteine.



Alkaloid	Substituent positions					
	1	2	3	6	9	10
didehydrocoteine	-OCH ₂ O-		OCH ₃	CH ₃	OCH ₃	OCH ₃

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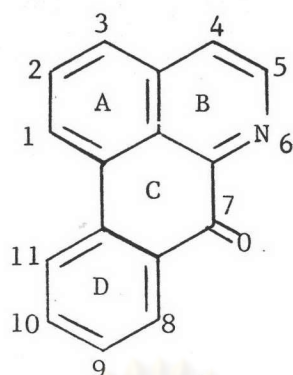
5. Oxoaporphines

Oxoaporphine alkaloids are probably derived in plant by oxidation of the corresponding aporphine alkaloids (Shamma, 1972 f). They are widely distributed (at least nine plant families) and commonly co-occur with aporphine alkaloids. Oxoaporphine like the aporphines, beyond the perennial 1, 2-dioxygenation, they exhibit a variety of oxygen substitution patterns. In the series, however, there is a tendency toward 3-substitution but not 11-substitution (Cordell, 1981d).

The first oxoaporphine to be isolated (1960) was liriodenine a bright yellow constituent of the heartwood of the tulip tree *Liriodendron tulipifera* L. (Magnoliaceae) (Cordell, 1981d).

The occurrence of oxoaporphine alkaloids in Lauraceous plants are summarized and shown below. For *Neolitsea* sp.; this group of alkaloid was only isolated from *N. sericea* (Blume) Koidzumi as liriodenine (Nakasato, Asada and Kaezuka, 1966).

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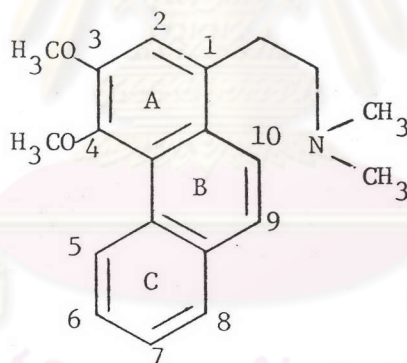


Alkaloid	Substituent positions					
	1	2	3	9	10	11
cassamedine	-OCH ₂ O-		CCH ₃	-OCH ₂ O-		-
cassameridine	-OCH ₂ O-		-	-OCH ₂ O-		-
dicentrinone	-OCH ₂ O-		-	OCH ₃	OCH ₃	-
1, 2-dimethoxy-9, 10-methylenedioxy-7-oxodibenzoquinoline	OCH ₃	OCH ₃	-	-OCH ₂ O-		-
hernandenine	-OCH ₂ O-		-	-	-OCH ₂ O-	
liriodenine (oxoushinsunine)	-OCH ₂ O-		-	-	-	-
machigline	-OCH ₂ O-		-	OH	OCH ₃	-
ocominarone	-OCH ₂ O-		-	OCH ₃	OCH ₃	-
						(OCH ₃ group at 8)
oxonantenine	OCH ₃	OCH ₃	-	-OCH ₂ O-		-
thalicminine	-OCH ₂ O-		OCH ₃	OCH ₃	OCH ₃	-

6. Phenanthrenes

The phenanthrene alkaloids are a small group of optically inactive tertiary bases probably derived biogenetically from the Hoffmann elimination of quaternary aporphine salts. They are always substituted at C-3, 4 since their precursor, the aporphines, are found with substitutions at these two positions corresponding to C-1, 2 of the aporphine skeleton (Shamma, 1972g).

In Lauraceous family, it was found only one phenanthrene alkaloid, atherosperminine, isolated from *Cryptocarya angulata* C.T. White (Cooke and Haynes, 1954; Bick and Douglas, 1965). There are no reports on phenanthrenes occurring in *Neolitsea* spp.



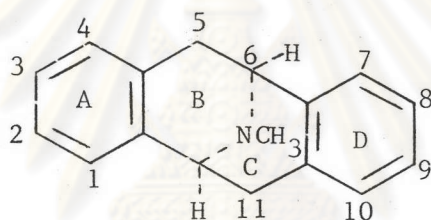
Atherosperminine (3, 4-dimethoxy-1-dimethylaminoethylphenanthrene)

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

7. Pavines

Pavines alkaloids are derived biogenetically from benzylisoquinoline. But several pavines are derived from tetrahydrobenzylisoquinoline, (+)-reticuline (Gozler, Melinda, Lantz and Shamma, 1983). (-)-Argemoneine was first isolated in 1962 from *Argemone mexicana* L. and has subsequently been found in several *Argemone* species of the Papaveraceae (Cordell, 1981e).

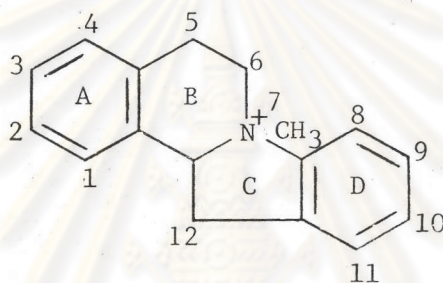
Among the Lauraceae genera, the genus *Cryptocarya* is known to possess pavines (Gozler *et al.*, 1983). There is no report of pavine alkaloids in *Neolitsea* sp.



Alkaloid	Substituent positions			
	2	3	8	9
bisnorargemoneine	OH	OCH ₃	OCH ₃	OH
(+)-caryachine	-OCH ₂ O-		OH	OCH ₃
(-)-caryachine	-OCH ₂ O-		OH	OCH ₃
(+)-eschscholtzidine	-OCH ₂ O-		OCH ₃	OCH ₃
((+)-0-methylcaryachine)				
(-)-eschscholtzine	-OCH ₂ O-			-OCH ₂ O-
((-)-crychine, (-)-californine)				
norargemoneine	OH	OCH ₃	OCH ₃	OCH ₃

8. Dibenzopyrrocolines

The dibenzopyrrocolines have so far been found only in the Lauraceae (Ralph, Bick and Sinchai, 1978). The only two natural dibenzopyrrocolines known are (-) cryptaustoline and (-)-cryptowoline from the bark of *Cryptocarya bowiei* (Hook.) Druce. (Lauraceae) (Cordell, 1981e). The only difference between cryptaustoline and cryptowoline is the latter has a methylenedioxy group in place of two methoxyls in ring D (Shamma, 1972h).



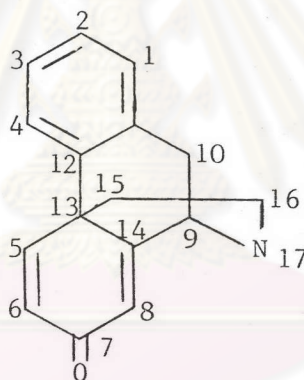
Alkaloid	Substituent positions			
	2	3	9	10
cryptaustoline	OH	OCH ₃	OCH ₃	OCH ₃
cryptowoline	OH	OCH ₃	-OCH ₂ O-	

ศูนย์วิทยุศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย

9. Morphinandienone and Morphinane Alkaloids

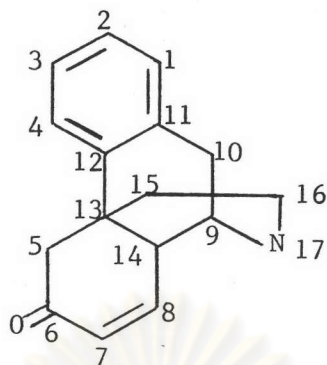
The morphinandienone alkaloids and related alkaloids are more limited in number and distribution. There are fewer than a dozen of them distributed in Family Papaveraceae, the genus *Papaver* and several genera of Menispermaceae (Robinson, 1981).

In family Lauraceae, the morphinandienone and morphinane alkaloids have been obtained from *Beilschmiedia*, *Cassytha*, *Litsea* and *Ocotea* sp. The basic structure of these alkaloids are occurred in four formulae; A, B, C and D. The summerization of the structures and their substitutions are shown in the following tables.



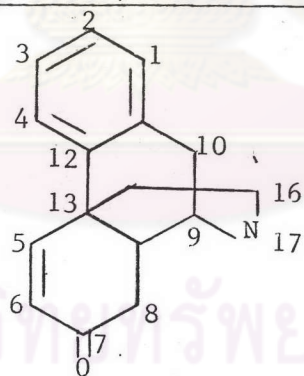
Formula A

Alkaloid	Substituent positions				
	2	3	4	6	17
(S)-pallidine	OH	OCH ₃	-	OCH ₃	CH ₃
(S)-(-)-O-methylpallidine	OCH ₃	OCH ₃	-	OCH ₃	CH ₃
sebiferine	OCH ₃	OCH ₃	-	OCH ₃	CH ₃
sinoacutine	-	OCH ₃	OH	OCH ₃	CH ₃



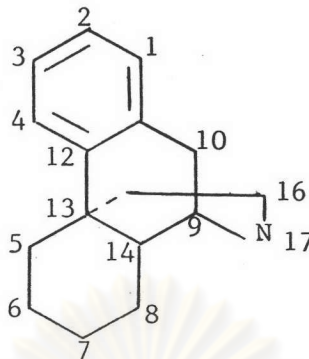
Formula B

Alkaloid	Substituent positions				
	2	3	4	7	17
14-episinomenine	-	OCH ₃	OH	OCH ₃	CH ₃



Formula C

Alkaloid	Substituent positions				
	2	3	4	6	17
ocobotrine	-	OCH ₃	OH	OCH ₃	CH ₃
S-(-)-pallidine	OH	OCH ₃	-	OCH ₃	CH ₃
S-(-)-O-methylpallidine	OCH ₃	OCH ₃	-	OCH ₃	CH ₃



Formula D

Alkaloid	Substituent positions				
	2	3	6	7	17
oreobeiline	OH	OCH ₃	OCH ₃	OH	CH ₃ (OCH ₃ ▯ at 6)
6-epioreobeiline	OH	OCH ₃	OCH ₃	OH	CH ₃ (OCH ₃ ► at 6)

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



10. Bisbenzylisoquinolines

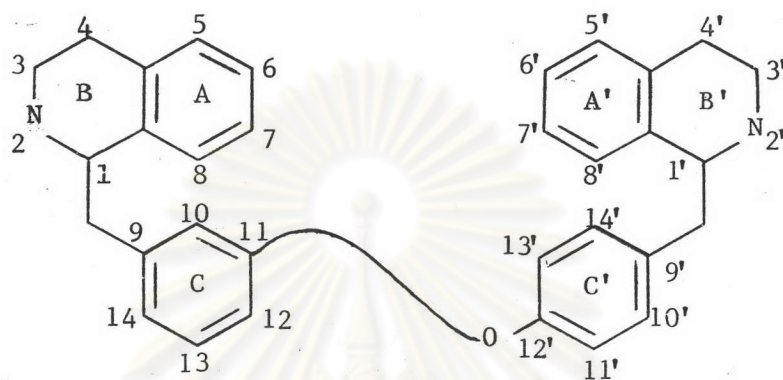
The bisbenzylisoquinolines are the largest of isoquinoline alkaloid (Shamma, 1972 i). They occurred in nature, formed by the linkage of two molecules of a simple benzylisoquinoline alkaloid, the junction being an ether linkage between aromatic nuclei (Bentley, 1957). The aromatic substituents may be hydroxyl, methoxyl or methylenedioxy (Cordell, 1981 f).

Bisbenzylisoquinolines alkaloids have been classified into 28 types. An asterisk (*) or dagger (†) symbol on the upper right of numbers indicated the diarylether terminals. Numbers in parentheses are used to indicated aryl-aryl bonds. Square brackets are used to indicate the terminals of methylenedioxy bridge (Shamma and Moniot, 1978 b).

In the Lauraceous plants, the bisbenzylisoquinoline alkaloids are confined to *Nectandra* and *Ocotea* sp. and 5 types in 28 types of these bases which distributed in Lauraceous plants are shown below (Guha and Mukherjee, 1979).

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

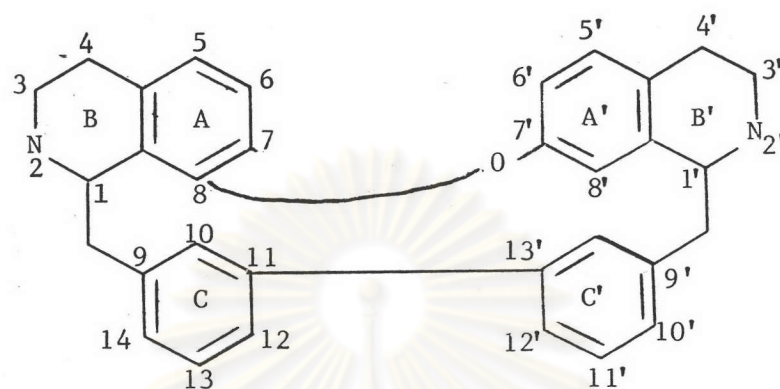
10.1 Bisbenzylisoquinolines; Thalibrine type 6, 7, 11*,
12-6, 7, 12*



Alkaloid	Substituent position						
	2	6	7	12	2'	6'	7'
Lindoldhamine	H	OCH ₃	OH	OH	H	OCH ₃	OH

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

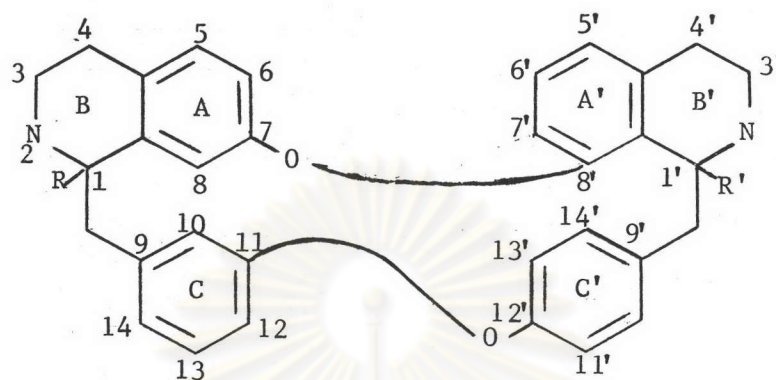
10.2 Bisbenzylisoquinolines; Rodiasine type 6, 7, 8*,
12-6, 7*, 12(11-11)



Alkaloid	Substituent positions			
	2	12	2'	12'
norrodiasine	H(CH ₃)	OCH ₃	CH ₃ (H)	OH
ocoteine	CH ₃	OCH ₃	H	OH
ocotosine	CH ₃	OCH ₃	-	OH
rodiasine	CH ₃	OCH ₃	CH ₃	OH

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

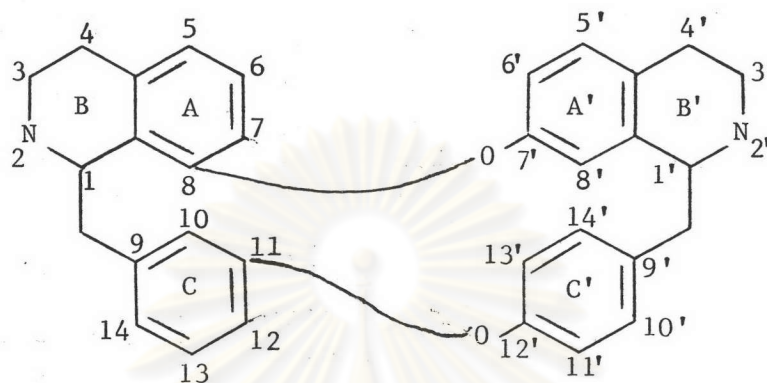
10.3 Bisbenzylisoquinolines; Oxycanthine type; 6, 7*,
11†, 12-6, 7, 8*, 12†



Alkaloid	Substituent positions					
	2	6	12	2'	6'	7'
demerarine (Epimer of sepeerine; ($R_1 = R'_1 = H$ ''')	-	OCH ₃	OH	CH ₃	OCH ₃	OCH ₃
sepeerine ($R_1 = H$ ▶, $R'_1 = H$ ''')	-	OCH ₃	OH	CH ₃	OCH ₃	OCH ₃

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

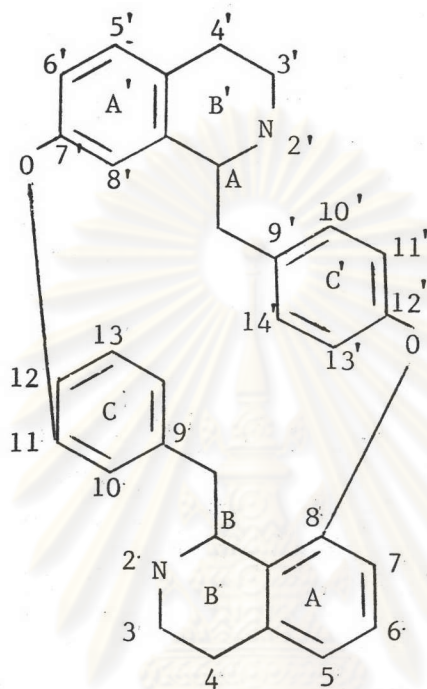
10.4 Bisbenzylisoquinolines; Berberine type, 6, 7, 8*,
11†, 12-6, 7*, 12†



Alkaloid	Substituent positions					
	2	6	7	12	2'	6'
2-nor-(+)-tetrandrine	-	OCH ₃	OCH ₃	OCH ₃	CH ₃	OCH ₃

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

10.5 Bisbenzylisoquinolines, curine type; 6, 7, 8*,
11†, 12-6, 7†, 12*

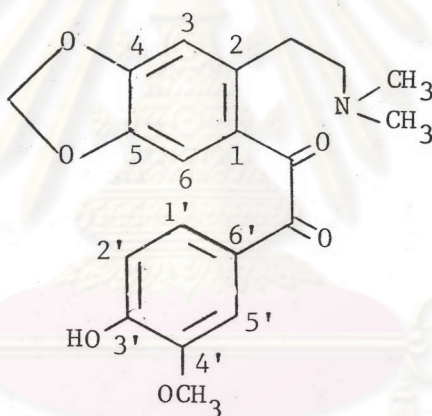


Alkaloid	Substituent positions					
	2	6	7	2'	6'	13'
(+)-curine	CH ₃	OCH ₃	OH	CH ₃	OCH ₃	OH

11. Cryptopleurospermines

Cryptopleurospermines is the sole representative of a type with fewer rings, and it would seem to have been formed by oxidative ring opening of a tetrahydroisoquinoline structure (Ralph, Bick and Sinchai, 1978).

In Lauraceous plants, cryptopleurospermine was isolated from *Cryptocarya pleurosperma* White & Francis (Johns, Lamberton, Sioumis and Willing, 1970).



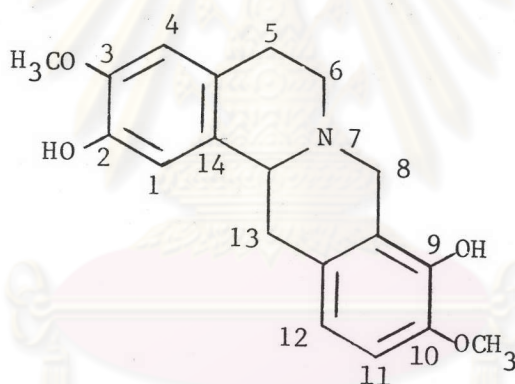
Cryptopleurospermine

ศูนย์วิจัยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

12. Protoberberines

Most of protoberberine alkaloids exist in nature as tetrahydroprotoberberine and quaternary protoberberine salts, but some dihydroprotoberberines are also known. Substitution are usually present at C-2 and C-3, C-9 and C-10 or C-10 and C-11. In some instances a hydroxyl or methoxyl substitution may be present at C-1 (Shamma, 1972 j).

Scoulerine is the first protoberberine alkaloid isolated from Lauraceous plants, *Cryptocarya longifolia* Kosterm. (Ralph *et al.*, 1981).



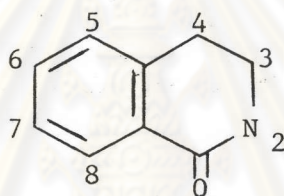
Scoulerine

ศูนย์วิจัยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

13. Isoquinolones

The isoquinolone alkaloids are a small group of alkaloids present in plants only in minor amounts. They can be subdivided into two categories : those with a totally aromatic nucleus such as doryanine, thalactamine and those which incorporate a C-3, 4 single bond (Shamma, 1972 k).

In Lauraceous plants, it was found only one isoquinolone, thalifoline, from *Cryptocarya longifolia* Kostermans (Ralph *et al.*, 1981).

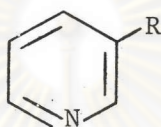


Alkaloid	Substituent positions		
	2	6	7
thalifoline	CH ₃	OCH ₃	OH

ศูนย์วิจัยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

14. Miscellaneous Alkaloids14.1 Pyridines

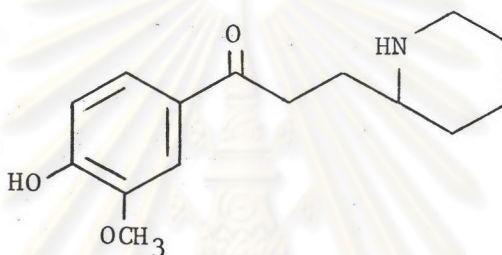
For the Lauraceous plants, the pyridine group was only isolated from genus *Aniba* such as anibine, anabasine and duckyne (Ralph, Bick and Sinchai, 1978).



Alkaloid	Substituent groups
anabasine	R =
anibine	R =
duckeyne	R =

14.2 Sedamine type

Pleurospermine is an alkaloid of sedamine type which isolated from the leaves of *Cryptocarya pleurosperma* C.T. White & Francis (Lauraceae). It is considered to be derived from condensation of two equivalents of dihydroxyphenylalanine and one equivalent of lysine (Johns *et al.*, 1969). The structure of the alkaloid is shown below.



Pleurospermine

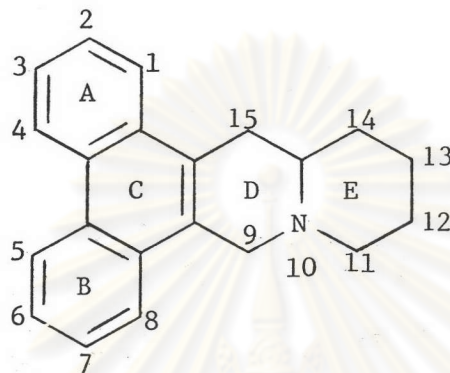
14.3 Phenanthroquinolizidines and Phenanthroindolizidine alkaloids

The phenanthroquinolizidine and the phenanthroindolizidine alkaloids are basic pentacyclic compounds and found in members of the Lauraceae, Asclepiadaceae and Moraceae (Pelletier, 1970).

14.3.1 Phenanthroquinolizidine alkaloids

Cryptopleurine, a phenanthroquinolizidine alkaloid, was first obtained from *Cryptocarya pleurosperma* White & Francis (family Lauraceae) (Cordell, 1981g). Cryptopleurine was biosynthetically related to pleurospermine (sedamine type).

In Lauraceous plants, cryptopleurine and cryptopleuridine are confined to the genus *Cryptocarya* (Ralphs, Bick and Sinchai, 1978). Their substitution are shown as follows.

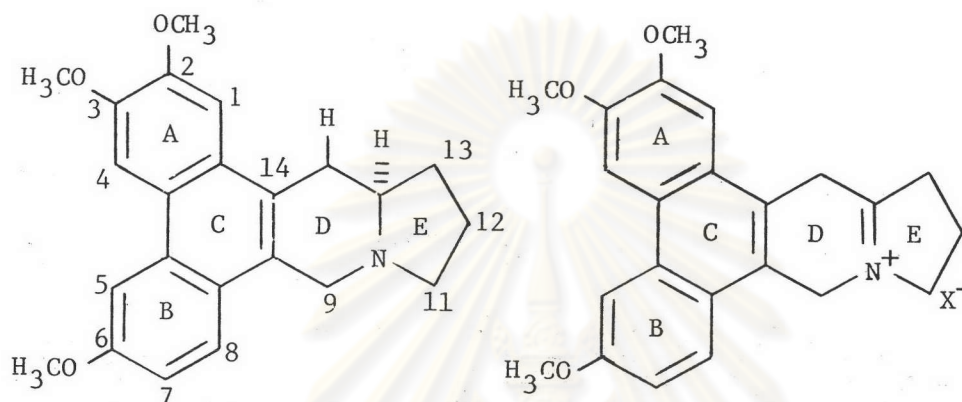


Alkaloid	Substituent positions			
	2	3	6	12
cryptopleuridine	-OCH ₂ O-		OCH ₃	OH
cryptopleurine	OCH ₃	OCH ₃	OCH ₃	-

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

14.3.2 Phenanthroindolizidine alkaloids

In Lauraceous plants, antofine and dehydroantofine are obtained in *Cryptocarya phyllostemon* Kostermans (Bick *et al.*, 1980).



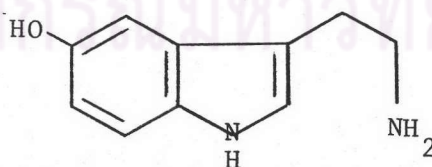
antofine

dehydroantofine

14.4 Indole alkaloid

Serotonin (5-hydroxytryptamine), an indole alkaloid is reported in the Lauraceae, *Persea* spp.

(Ralph, Bick and Sinchai, 1979).

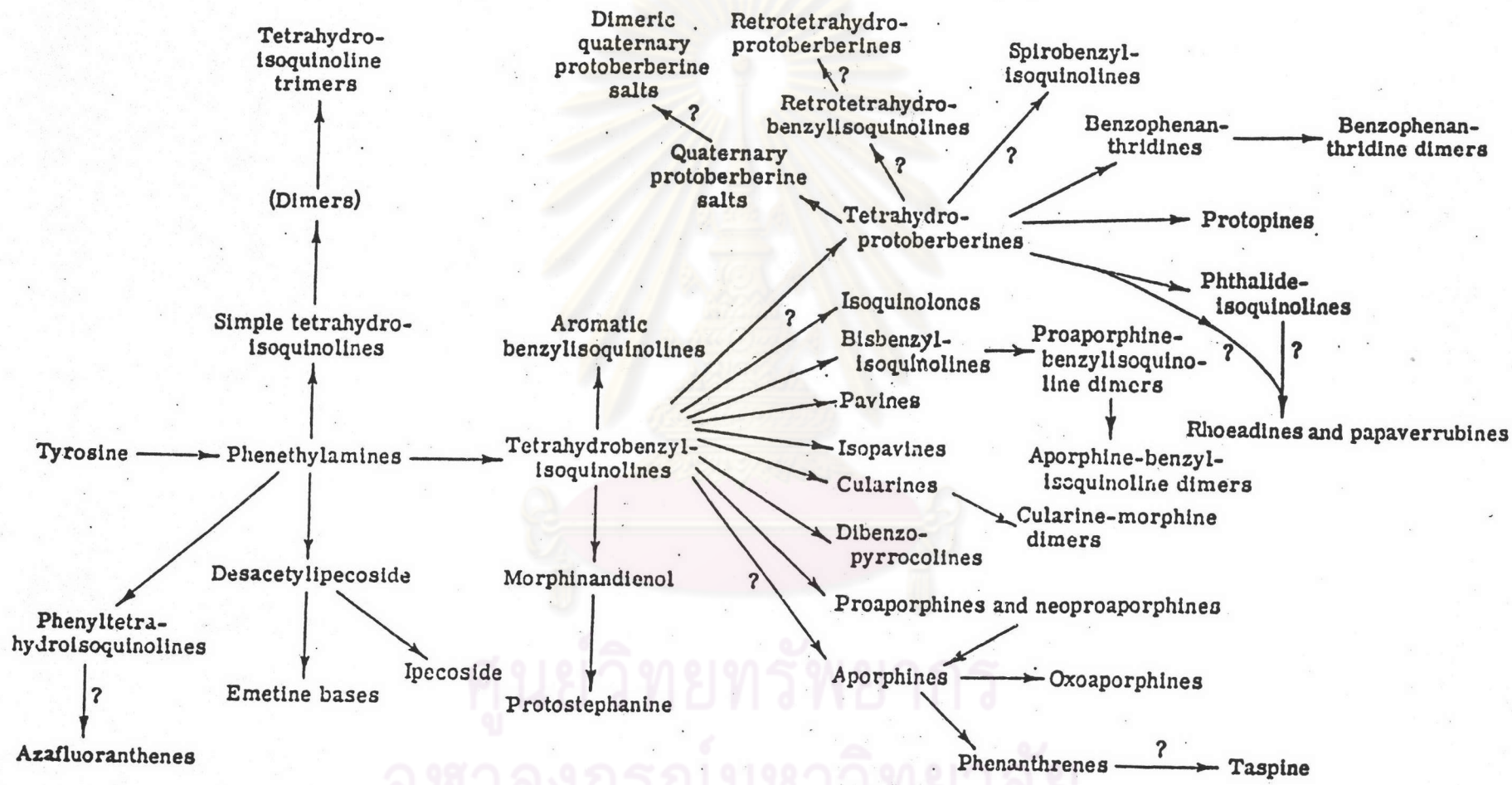


Serotonin (5-hydroxytryptamine)

IV. Biosynthesis

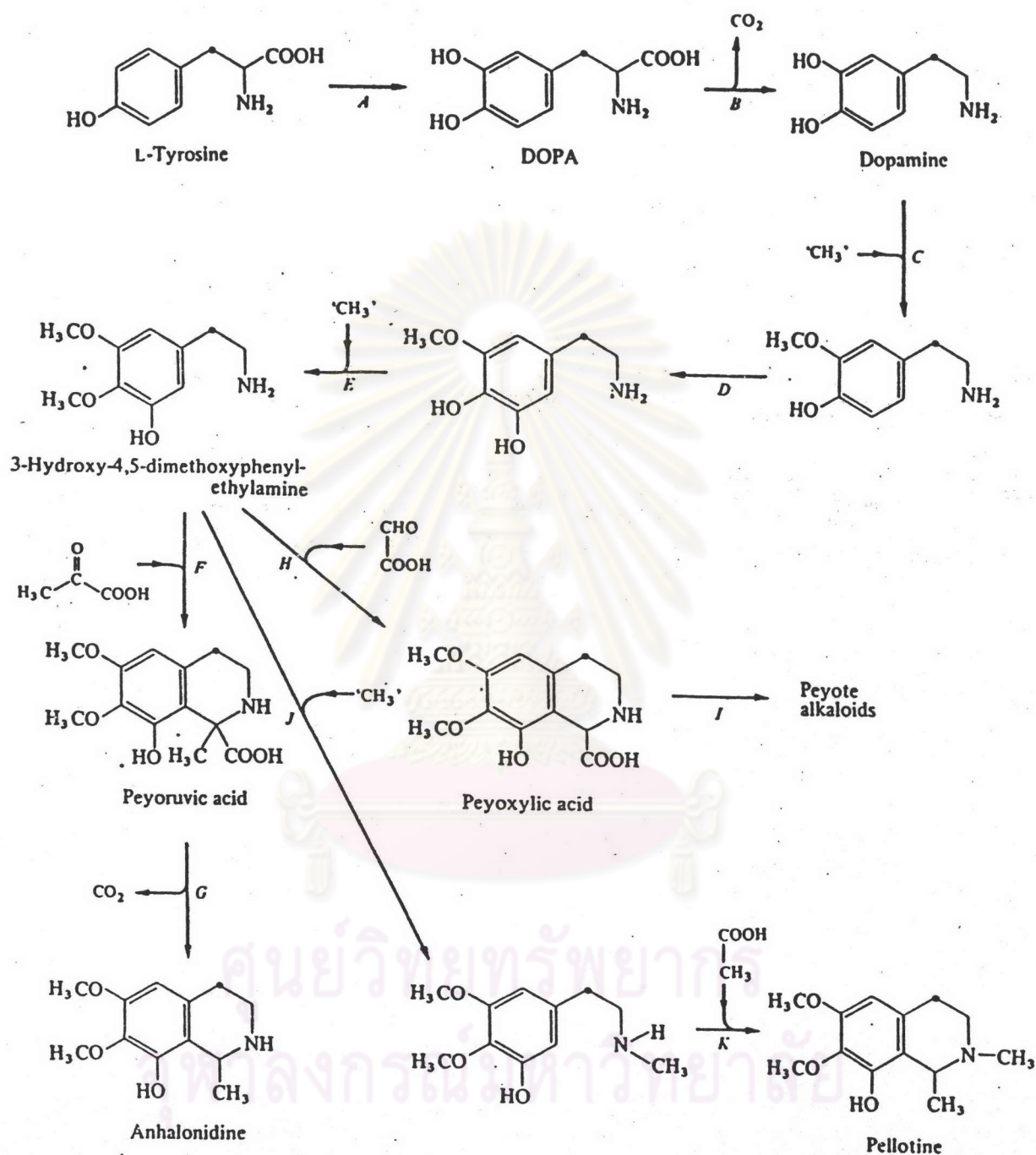
The biosynthetic routes of isoquinoline alkaloid which generally accepted are started from the essential amino acid, tyrosine as shown in Scheme 1 (Shamma, 1972e). It is conveniently treated in two parts, starting with the generation of the isoquinoline structures, then elaborating to more complicated structure (Staunton, 1979).

The formation of the simple tetrahydroisoquinoline alkaloids involves the hydroxylation of the aromatic ring of L-tyrosine followed by decarboxylation and then ring closure with another compound, which provides an additional one or two carbon units, occurs. A typical example of this producer is seen in the formation of anhalonidine by the peyote cactus (Scheme 2). It is assumed that 3, 4-dihydroxy-phenylalanine (DOPA), formed by 3-hydroxylation of L-tyrosine, is converted into 3-hydroxy-4, 5-dimethoxyphenylethylamine, known to be present in the peyote cactus, *Lophophora williamsii* (Lam.) Coulter, by a series of steps (B, C, D and E). The 3-hydroxy 4, 5-dimethoxyphenylethylamine then undergoes ring closure (Step F) with pyruvate to form peyoruvic acid which is then decarboxylated (Step G) to anhalonidine. The proposed intermediate, peyoruvic acid, has been isolated from *L. williamsii* (Lam.) Coulter. The analogue of peyoruvic acid, peyoxylic acid, is formed by the condensation of the precursor amine with glyoxylic acid (Step H), peyoxylic acid can also be incorporated into peyote alkaloids (Step I). The N-methylated



Scheme 1

Proven or Probable Biogenetic Loci for the Formation of the Isoquinoline Alkaloids



Scheme 2

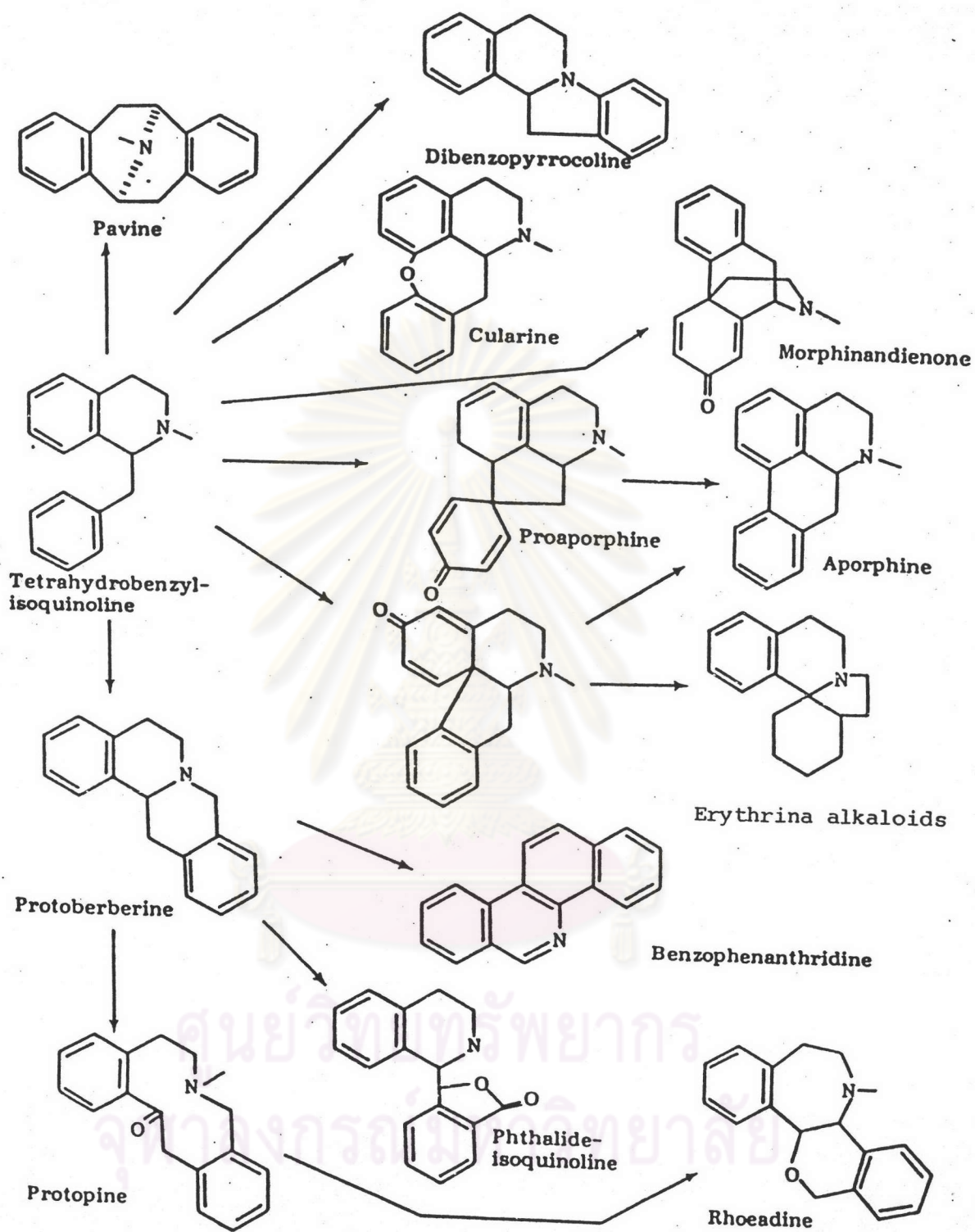
The formation of peyote alkaloids from L-tyrosine

isoquinoline alkaloids are formed by N-methylation of a precursor amine (Step J, K) (Goodwin and Mercer, 1983).

The benzyloisoquinoline alkaloids are the precursors of a large array of polynuclear structures including simple benzyloisoquinolines, bisbenzyloisoquinolines, proaporphines, aporphines, aporphine-benzyloisoquinoline dimers, oxoaporphines, protoberberines, benzophenanthridines, protopines, phthalide isoquinolines and hasubanan derivatives. Some biogenetic relationships of these alkaloid groups are shown in Scheme 3. (Cordell, 1981h).

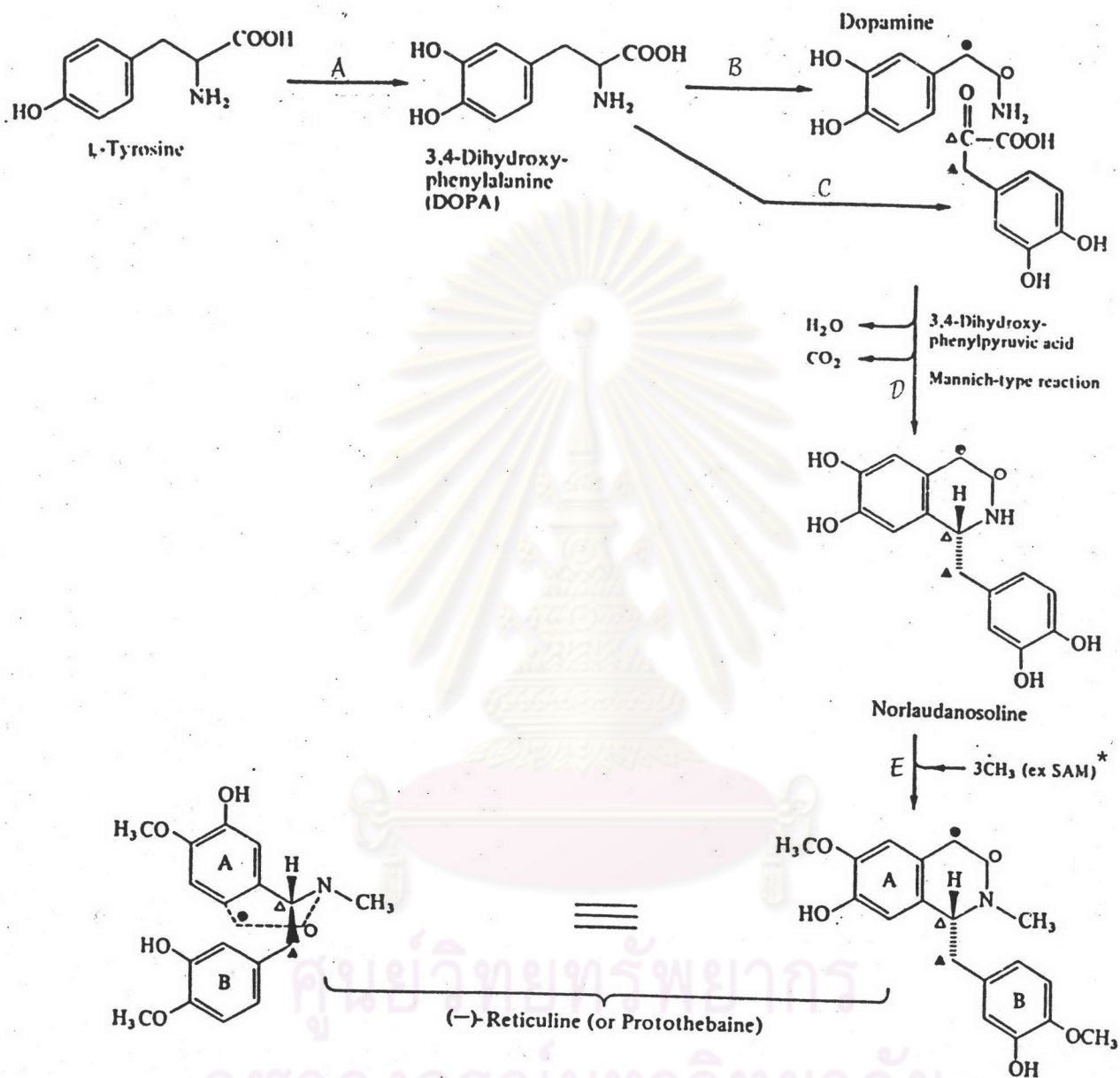
The benzyloisoquinolines are biosynthesised from L-tyrosine by way of DOPA. From Scheme 4 the first step (Step A) involves the conversion of two molecules of L-tyrosine into two molecules of DOPA. One molecule of DOPA is converted into dopamine (Step B) whilst the other is converted into 3, 4-dihydroxyphenylpyruvate (Step C). These two compounds then combine with the elimination of water and carbon dioxide in a Mannich-type reaction to yield a molecule of norlaudanosoline (Step D) O- and N-methylation (Step E) and lead to (-)-reticuline (sometimes called protothebaine) (Goodwin and Mercer, 1983).

The biogenesis of reticuline is of importance because it is regarded as the key intermediate in the biosynthesis of many alkaloids based on the benzyloisoquinoline nucleus (Cordell, 1981h). For example, reticuline is the precursor for isoboldine



Scheme 3

Biogenetic relationships of the major alkaloid groups derived from a tetrahydrobenzylisoquinoline precursor

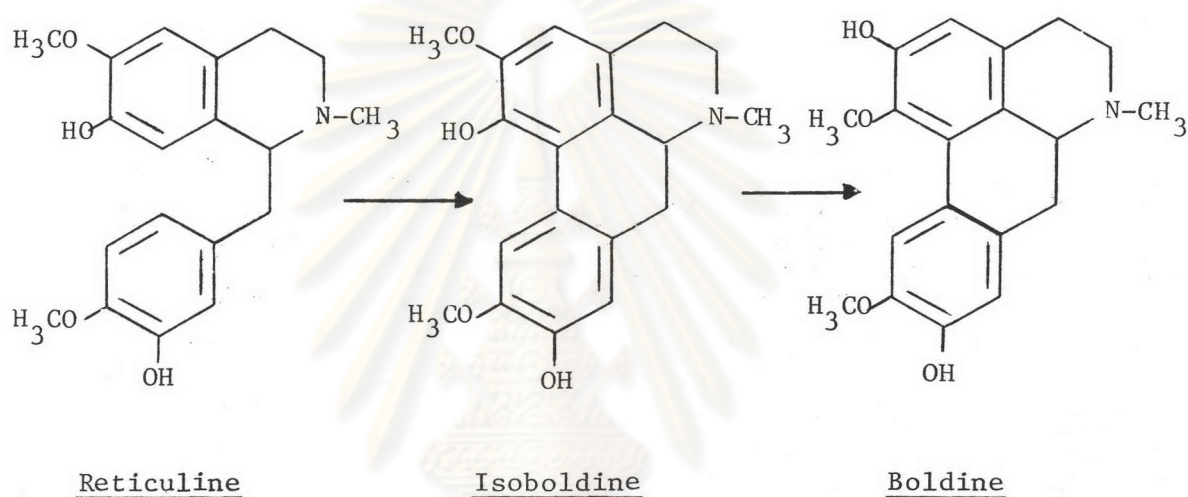


Scheme 4 The formation of 1-benzyl-1,2,3,4-tetrahydroisoquinolines

* SAM = S-adenosylmethionine

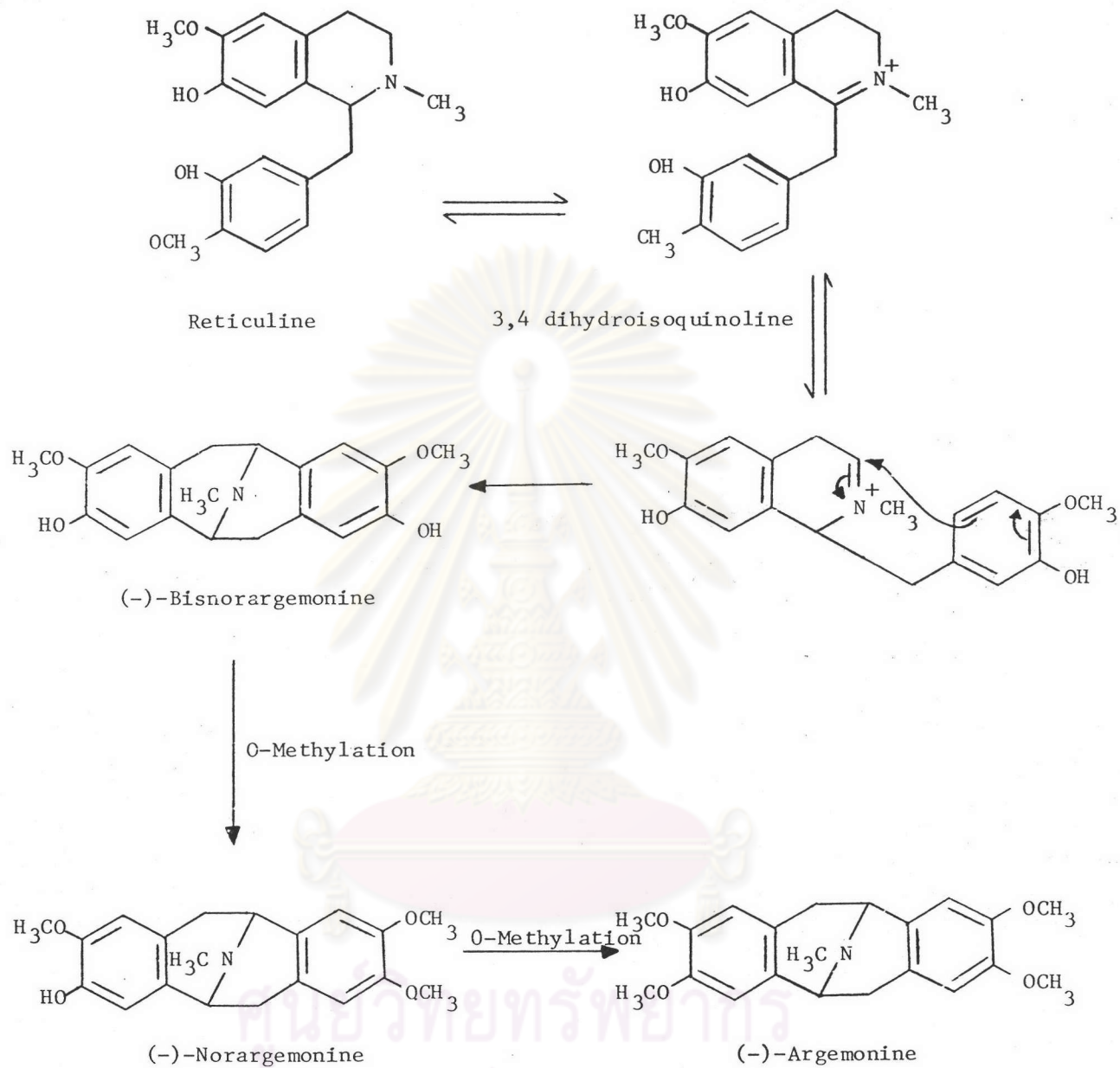


and the isomer, boldine (aporphine alkaloids) in *Papaver somniferum* Linn. (Scheme 5) by a straight forward intramolecular oxidation coupling between the two aryl rings of reticuline. The sites of coupling both bear a hydrogen and therefore the two ring can rearomatised to give the biphenyl system characteristic of the aporphine alkaloids (Staunton, 1979).



Scheme 5

Several of the pavines and isopavines are probably derived biogenetically from the tetrahydroisoquinoline (Gözler, Lantz and Shamma, 1983). It has always been supposed that the pavine alkaloids such as argemonine, are biosynthesised from reticuline (Scheme 6). Reticuline is dehydrogenated to form 3, 4-dihydroisoquinoline which could isomerize and undergo cyclization to the pavine system (Dyke, 1977).



Scheme 6