International Journal of Recent Research and Review, Vol. XI, Issue 3, September 2018
ISSN 2277 – 8322

A Review on Bioactive Constituents of Medicinal Plants

Satya Pal Singh[1], Manu Sikarwar[1], Rajendra K. Gunsaria[1], Ashutosh Sharma[2], M. P. Dobhal[3]
[1]Department of Chemistry, Government College, Tonk, Rajasthan, India
[2]*Department of Chemistry, Yagyavalkya Institute of Technology, Jaipur, India*
[3]*Department of Chemistry, University of Rajasthan, Jaipur*
E-Mail - *spsingh261069@gmail.com,* ashutoshs_912@rediffmail.com

***Abstract*- Medical plants form the backbone of traditional systems of medicine and are being used as one of the gift of nature to cure a number of human diseases. The knowledge of Ayurveda has led to the discovery of many potent bioactive agents in the history of modern drug development. Herbal drugs constitute a major share of all the officially recognized systems of health in India viz Ayurveda, Yoga, Siddha, Unani, Homeopathy and Naturopathy. The use of plants for cure is also discussed in Rig-Vedas. Medicinal plants are occupy an important role in modern medicines e.g. taxol, vincristicin, vinblastine, artemesin etc. Secondary metabolites show an intense physiological effect on mammalian system. In the present communication, chemical constituents and biological activity of plants has been given.**

***Keywords*- Medicinal plants, Biological Activity, Natural Compounds, Secondary Metabolites**

I. INTRODUCTION

Since time immemorial, medicinal plants are being used as one of the gift of nature to cure a number of diseases of human beings. The knowledge of Ayurveda has led to the discovery of many potent bioactive agents in the history of modern drug development. Even today seventy five percent of the population in our country is very much depends on the medicinal plants as population in the rural and remote areas mostly adopts the traditional Indian system of medicine. India's richness in plant diversity and related indigenous knowledge is well recognized. This diversity offers the means for meeting the basic requirements of the Ayurvedic, Unani and Siddha system of medicine.

Plants of medicinal importance are the treasure houses from which future needs will be met with and where new chemical entity may found which forms the basis of new knowledge and technology. Moreover, the global herbal market worth $120 billion a year. By recognizing the value of medicinal plants and integrating it with frontier science and technology, we can conserve both the dying wisdom and the plant genetic resources thus ensuring a better future of our homeland.

Plants play an important role as a backbone in the healthy life style and provide health food and phytotherapeutics. Nearly 8000 plants are recognised with medicinal value that are being used by various traditional systems of medicine in India. It is well established that about 346 plants products have fungicidal properties, 92 have bactericidal and 90 have antiviral properties [1]. However, they are constantly under threat due to the growth of economic development, population explosion and new human settlements.

Most of the medicinal plants extensively used in traditional systems of medicines are obtained from wild sources leading to the problems of dwindling population of numerous plants and insufficient quantity for manufacturing genuine medicine. Under such circumstances measures have been taken on war footing to promote the commercial cultivation of medicinal plants.

The medicinal importance of the plants has attracted the attention of the chemists who successfully isolated the active principle and established their

structures using modern techniques. Attempts were made to correlate the activity of particular skeleton in its structure. This led to the development of synthetic routes for a number of drugs. In fact, the development of many synthetic therapeutic agents can be traced to their initial isolation from the natural source. Thus, the chemists working in the field of natural products have contributed to the development of the modern therapeutic system in their own way.

Realising the medicinal importance of the plant or plant materials, chemists have been successfully analysed various plants, resulting in the isolation of various organic constituents which have been characterized and classified in different classes viz., alkaloids, steroids, terpenoids, flavonoids, etc., heralding a new branch of studies known as "phytochemistry". It involves the systematic chemical investigation of the plant i.e isolation, purification and characterization of the organic constituents.

The chemistry of natural products has been developed as a major field of scientific endeavour during the last few decades. The systematic work in phytochemistry began with the development of physical and biochemical methods. The discovery of chromatographic techniques e.g., column, thin layer, paper, HPLC, HPTLC has given a big impetus to the phytochemical methods. The phytochemists are provided with indispensable tool for the investigation of structure of compounds available even in small quantities with the discovery of modern spectroscopic techniques like UV, IR, 1H NMR, 13C NMR, 2-DNMR and MS.

The medicinal properties of the plants depend upon the presence of one or more physiologically active compounds. Some plant extracts may be toxic in higher doses, so they might be useful as medicine in lower doses. Research in the field of natural products contributes to the discovery of new drugs and drug development program by providing important structural units to pharmaceutical chemists. The results of these investigations have not only enriched the academic outlook of organic chemist but also equipped modern medicinal system with a wide range of therapeutic agents. Despite the various advances made in the field of drug synthesis, the use of plant extracts for treatment is still invariably recommended.

Plants and plant products are part of the vegetarian diet and a number of them exhibit medicinal properties. The medicinal properties of several Indian plants have been documented in ancient Indian texts and the preparations have been found to be effective in the treatment of diseases [2,3]. Recent reports indicated that there is an inverse relationship between the dietary intake of antioxidant rich foods and the incidence of human diseases [4-5]. There are many reports which suggest that botanical antioxidants work synergistically if used in combination. Now a days, consumers are frightened of using synthetic antioxidants and therefore industries prefer to use natural antioxidants in their products. Hence search for new natural antioxidants has become essential. Although investigations focused on isolation of pure compounds as an antioxidant agent [6,7]. It has been found that compounds in their natural formulations are more active than isolated form [8]. An attempt has been made to review the antioxidant activity of some plant extracts commonly used in Ayurvedic medicines [9-19].

Flavonoids represent the largest group of plant polyphenols. Their dietary intake through fruits and vegetables has been associated with a lower incidence of cardiovascular disease [20]. Further study suggests that dietary flavonoids may have beneficial effects on human health and disease prevention, which is primarily attributed to their antioxidant properties. Commonly occurring flavonols have received much attention as natural antioxidants and only a few studies have reported on the antioxidant effects of prenylated flavonoids, probably because of their low dietary intake compared to flavonols and anthocyanins [21].

It was suggested recently that generation of free radicals play a major role in the progression of a wide range of pathological disturbances such as brain dysfunction, cancer, cardiovascular disease and inflammation [22,23]. In food industries free radicals

are found to be responsible for lipid oxidation that is a major determinant in the deterioration of foods during processing and storage [24-26]. Due to this fact considerable interest has been given to the addition of antioxidants in food and biological systems to scavenge free radicals. A lot of natural compounds have been found to be antioxidants, including vitamin E, phenolic acid, chlorophyll, carotenoids and flavonoids [27]. Polyphenols from grapes, epigallacto catachin (EGC) from tea leaves, curcumin from turmeric and rosmary extract are used as antioxidants for herbal preparations and cosmetics.

Recently, resveratrol a natural product derived from grapes was found to be antioxidative, antimutagenic and an inducer of phase II drug-metabolizing enzymes [28]. Resveratrol belongs to a class of compounds called stilbenes are widely distributed in nature. Interest in the synthesis of stilbene compounds similar to that of natural stilbenes is increasing due to their antioxidant, antifungal, ichthyotoxic and antileukemic properties [29-31].

Since people are particularly concerned about the quality and the safety of their food. Only selected food additives are added for protecting them from off-flavour. Antioxidants are often used in oils and fatty foods to retard their autoxidation. The synthetic antioxidants were widely used, are now avoided due to their possible toxic effects [32]. So industry have focussed on the use of natural antioxidants [33,34]. In Indian system of medicine, herbs and spices are a major source of natural antioxidants. Approximately 700 species of herbs have been screened for natural antioxidants. Among them, 64 have been found to possess significant antioxidant activities, and 24 showed strong antioxidant activities [35-37].

Everybody knows that food spoils by oxidation reaction due to the presence of atmospheric oxygen. Thus the food which contains antioxidant in good amount spoils later. Benzoic acid, ascorbic acid are also good example of antioxidant compounds. Fruits and vegetables contains many chemical substances having antioxidant properties. Thus the natural food antioxidants have anticancer properties or they protected against cancer. Some of the examples of antioxidants are being given below.

1.	Lycopene	-	red colour of tomatoes.
2.	β - Carotene	-	the pigment in carrots
3.	Resveratrol	-	red wine pigment
4.	Flavonoids	-	tea leaves
5.	Quercetin	-	red onions, apples
6.	Proanthocyanidins	-	colouring matter of many fruits
7.	Catechins	-	oak tree (stem bark)

Recent studies showed that antioxidants are useful in lowering the incidence of cadiovascular diseases and are good anticancer agents. They also prevent aging and are used to prevent and treat atherosclerosis and coronary artery diseases. Antioxidants are beneficial for better living and thus average human life span would be extended to more active years. The list of some plants possessing antioxidant activity and their active constituents are given in Table I.

II. CONCLUSIONS

Plants are still to retain the significance as an important source of new drugs/lead compounds. The structural modification on lead compounds may be done to get better chemical entity for pharmaceutical chemist.

III. REFERENCES

[1] Bai SC, Cheellathurai N (2004). *Indian Medicinal and Aromatic Plants Today* pp. 24.

[2] Chopra RN, Nayar SL, Chopra IC (1956). "*Glossary of Indian Medicinal Plants*" Council of Scientific and Industrial Research, New Delhi.

[3] Gupta BC (1908). The Vanausadhi-darpana. S.C. Auddy & Co, Calcutta.

[4] Sies H (1993). *European J Biochem*. 215 : 213.

[5] Halliwell B (1997). *Advances in Pharmacology*. Academic Press, 38 : 3.

[6] Hagerman AE, Reidl KM, Jones GA, Sovik KN, Ritchard NT, Hartzfeld, PW, Riechel T (1998). *J Agric Food Chem*. 46 : 1887.

[7] Haramaki N, Packer L (1995). *Handbook of antioxidants.* Marcel Decker Inc, New York, pp. 487.
[8] Khopde SM, Priyadarsini KI, Mohan H, Gawandi VB, Satav JG, Yakhmi. JV, Banavaliker MM, Biyani MK, Mittal JP (2001). *Current Science* 81 : 185.
[9] Polva GM, Foo LY (1994) *Phytochemistry* 6 : 1399.
[10] Sham JS, Chiu KW, Pang PK (1984). *Planta Med*. 50 :177.
[11] Singh KN, Mittal RK, Barthwal KC (1976). *Indian J Med Res*. 64 : 754.
[12] Khavyal MT, El-Ghazaly MA, Kenawy SA, Seif-El-Nasr M, Mahran IG, Kafafi A, Okpanvi SN (2001). *Arzneimittelforschung* 51 : 545.
[13] Konovalova GG, Tikhaze AK, Lankin VZ (2000). *Bull Exp Bio Med.* 130 : 658.
[14] Ji W, Asada Y, Yoshikawa T (1998). *Planta Med*. 64 : 746.
[15] Vaya J, Belinky PA, Aviram M (1997). *Biol Med*. 23 : 302.
[16] Grover JK, Vats V, Rathi SS, Dawar R (2001). *J Ethnopharmacol.* 76 : 233.
[17] Scartezzini P, Speroni E (2000). *J Ethnopharmacol.* 71 : 23.
[18] Jagtap AG, Karkera SG (1999). *J Ethnopharmacol*. 68 : 299.
[19] Kaur S, Grover IS, Singh M, Kaur S (1995). *Mut Res*. 419 :169.
[20] Hertog MG, Feskens EJ, Hollman PC, Katan MB, Kromhout D (1993). *Lancet* 342 : 1007.
[21] Miranda CL, Stenvens JF, Ivanov V, McCall M, Frei B, Deinzer ML, Buhler DR (2000). *J Agric Food Chem* 48. 3876.
[22] Huong NTT, Matsumoto K, Karai R, Yamasaki K, Watanabe W (1998). *Biol Pharm Bull*. 21 : 978.
[23] Haraguchi H, Ishikawa H, Kubo I (1997). *Planta Med*. 63 : 213.
[24] Nunez-Delicado E, Sanchez-Ferrer A, Garcia-Carmona F (1997). *J Agric Food Chem* 45 : 2830.
[25] Chen JH, Ho C-T (1997). *J Agric Food Chem*. 45 : 2374.
[26] Dziedzi SZ, Hudson BJF, Barnes G (1985). *J Agric Food Chem*. 33 : 244.
[27] Larson RA (1988). *Phytochemistry*, 27 : 967.
[28] Jang M, Cai L, Udeani GO, Slowing KV, Thomas CF, Beecher CWW, Fong HHS, Farnsworth NR, Kinghorn AD, Mehta RG, Moon RC, Pezzuto JM (1997). *J Chem Soc Chem Commun*. 208.
[29] Pettit GR, Singh SB, Boyd MR, Hamel E, Pettit RK, Schmidt JM, Hogan F (1995). *J Med Chem*. 38 : 1666.
[30] Cushman M, Nagarthnam D, Gopal D, Chakraborti AK, Lin CM, Hamel E (1991) *J Med Chem.* 34 : 2579.
[31] Hata K, Baba K, Kozawa M (1979). *Chem Pharm Bull*. 27 : 984.
[32] Grice HC (1986). *Food and Chemical Toxicology* 24 : 1127.
[33] Chipault JR et al (1952). *Food Research* 17 : 45.
[34] Su JD et.al (1986). *Agric Biol Chem.* 50 : 199.
[35] Weng XC, Cao GF, Dong XW and Duan S (1998). *Journal of the Chinese Cereals and Oils Association* 13 : 25.
[36] Weng XC, Ren GP, Duan S, Dong XW and Jiang AL (1998). *Journal of the Chinese Cereals and Oils Association* 13 : 46.
[37] Weng XC, Gu LW, Dong XW, Duan S, Liu YP, Li HP and Jing JR (1997). *J Yantai University* 10 : 304.
[38] Naik GH, Priyadarsini KI, Satav JG, Banavalikas MM, Sohoni DP, Biyani MK, Mohan H (2003). *Phytochemistry* 63 : 97.
[39] Carton E, Carbonneau MA, Fouret G, Descomps B, Leger CL (2001). *J Nat Prod* 64 : 480.
[40] Lamarque AL, Fortunato RH, Guzman CA (1998). *Phytochemistry* 49 : 731.
[41] Piao XL, Park HI, Baek SH, Kim HY, Park MK, Park JH (2004). *J Ethnopharmacol* 93 : 243.
[42] Mehrotra S, Pushpangadan P (2004). *Biol Pharm Bull* 27 : 1266.
[43] Kamat JP, Boloor KK, Devasagayam TPA, Venkatachalam SK (2000). *J Ethnopharmacol* 71 : 425.
[44] Couladis M, Tzakou O, Verykokidou E, Harvala C (2003). *Phytother Res.* 17 : 194.
[45] deSousa E, Zanatta L, Seifriz I, Creczynski TB, Pizzolatti MG, Szpoganicz B, Silva FR (2004). *J Nat Prod* 67 : 829.
[46] Kondo S, Kittikosn M, Kanalayanarat S (2005). *Postharvest Biology and Technology* 36 : 309.
[47] Reanmongkol W, Subhadhirasakul S, Panichayupakaranant P, Kim KM (2003).

Pharmaceutical Biology 41 : 592.

[48] Song LC, Chen KZ, Zhu JY (1992). *Zhongguo Zhong Xi Yi Jie He Za Zhi* 12 : 421.

[49] Wang S, Fon M, Bian Z (2001). *Zhonghua Kou Qiang Yi Xue Za Zhi* 36 : 385.

[50] Park IK, Lee HS, Lee SG, Park JD, Ahn YJ (2000). *J Econ Entomol* 93 : 331.

[51] Kim JP, Jung MY, Kim JP, Kim SY (2000). *J Agric Food Chem* 48 : 1058.

[52 Clark EP (1943). *J Org Chem* 8 : 489.

[53] Falshaw CP, Harmer RA, Ollis WD, Wheeler RE, Lalith VR, Rao NVS (1969). *J Chem Soc (London)* 374.

[54] Johnson AP, Pelter A, Stainton P (1966). *J Chem Soc* 192.

[55] Pelter A, Johnson AP (1964). *Tetrahedron Lett*. 2817.

[56] Agaghinikhnam M, Chung S, Nelson White T, Eskelson C, Watson RR (1996). *Life Science* 59 : 147.

[57] Hou WC Lee MH, Chen HJ, Liang WL, Han CH, Liu YW, Lin YH (2001). *J Agric Food Chem*. 49 : 4956.

[58] Liu HW, Hu K, Zhao QC, Cui CB, Kobayashi H, Yao XS (2002). *Pharmazie* 57 : 570.

[59] Dong M, Feng XZ, Wu LJ, Wang BX, Ikejima T (2001). *Planta Med*. 67 : 853.

[60] Chacha M, Bojase-Moleta G, Majinda RRT (2005). *Phytochemistry* 66 : 99.

[61] Benard FJ, Runner RT (2004). *Phytochemistry* 65 : 1397.

[62] Park SS, Abe K, Kimura M, Urisu A, Yamasaki N (1997). *FEBS Lett*. 400 : 103.

[63] Quettier-Deleu C, Gressier B, Vasseur J, Dine T, Brunet C, Luyckx M, Cazin M, Cazin JC, Bailleul F, Trotin F (2000). [*J Ethnopharmacol* 72 : 35.

[64] Duke JA (1990). *Advances in New Crops,* Timber Press, Portland, p. 491.

[65] Huang YL, Yeh PY, Shen CC, Chen CC (2003). *Phytochemistry* 64 : 1277.

[66] Souri E, Farsam H, Sarkheil P, Ebadi F (2004). *Pharmaceutical Biology* 42 : 396.

[67] Seazzocchio F, Cometa MF, Tomassini L, Palmery M (2001). *Planta Med*. 67 : 561.

[68] Gentry EJ, Jampani HB, Keshavarz-Shokri A, Morton MD, Velde DV, Telikepalli H, Mitscher LA, Shawar R, Humble D, Baker W (1998). *J Nat Prod* 61 : 1187.

[69] Periera de Silva A, Rocha R, Silva CM, Mira L, Duarte MF, Florencio MH (2000). *Phytother Res.* 14 : 612.

[70] Lau CW, Yao XQ, Chen ZY, Ko WH, Huang Y (2001). *Cardiovasc Drug Rev*. 19 : 234.

[71] Silvaa BA, Forreresb F, Malvac JO Dias ACP (2005). *Food Chemistry* 90 : 157.

[72] Silva DHS, Pereira FC, Zanoni MVB, Yoshida M (2001). *Phytochemistry* 57 : 437.

[73] Singh RP, Padmavathi B, Rao AR (2002). *Mol Cell Biochem.,* 213 : 99.

[74] Anesini C, Genaro A,Cremaschi G, stterin Borda L, Borda E (1999). *Comp Biochem Physiol C Pharmacol Toxicol Endocrinol* 122 : 245.

[75] Anesini C, Genaro A, Cremaschi G, Zubillaga M, Boccio J, Sterin- Borda L, Borda E (1996). *Acta Physiol Pharmacol The Latinoam* 46 : 33.

[76] Quiroga EN, Sampietro AR, Vattuone MA (2001). *J Ethnopharmacol* 74 : 89.

[77] Mc Donald RW, Bunjobpon W, Liu T, Fessler S, Pardo OE, Freer IK, Glaser M, Seckl MJ, Robins DJ (2001). *Anticancer Drug Res* 16 : 261.

[78] Scartezzini P, Speroni E (2000). *J Ethnopharmacol* 71 : 23.

[79] Larrondo JV, Agut M, Calvo-Torras MA (1995). *Microbios* 82 : 171.

[80] Lamaison JL, Petitjean-Freylet C, Carnat A (1991). *Pharm Acta Helv* 66 : 185.

[81] Dimitrova Z, Dimov B, Manolova N, Pancheva S, Ilieva D, Shishkov S (1993). *Acta Microbiol Bulg* 29 : 65.

[82] Akhtar MS, Qureshi AQ, Iqbal J (1990). *J Pakistan Med Assoc* 40 : 147.

[83] Tripathi YB, Upadhyay AK (2002). *Phytother Res* 16 : 534.

[84] Pras N, Woesdenbag HJ, Batterman S, Visser JF, Van Uden W, (1993). *Pharm World Sci* 15 : 263.

[85] Jong TT, Chau SW (1998). *Phytochemistry* 49 : 2145.

[86] Mattei R, Dias RF, Espinola EB, Carlini EA, Barros SB (1998). *J Ethnopharmacol* 60 : 111.

[87] Lanhers MC, Joyeux M, Soulimani R, Fleurentin J, Sayag M, Mortier F, Younos C, Pelt JM (1991),

Planta Med 57 : 110.

[88] Vila R, Valenzuela L, Bello H, Canigueral S, Montes M, Adzet T (1999). *Planta Med* 65 : 178.

[89] Backhouse N, Delporte C, Givernau M, Cassels BK, Valenzuela A, Speisky H (1994). *Agents Actions* 42 : 114.

[90] Suga A, Takaishi Y, Goto S, Munakata T, Yamauchi I, Kogure K (2003). *Phytochemistry* 64 : 991.

[91] Tegischer K, Tausz M, Wieser G, Grill D (2002). *Tree Physiol* 22 : 591.

[92] Lee JP, Min BS, An RB, Na MK, Lee SM, Lee HK, Kim JG, Bae KH, Kang SS (2003). *Phytochemistry* 64 : 759.

[93] Peng ZF, Strack D, Baumert A, Subramaniam R, Goh NK, Chia TF, Tan SN, Chia LS (2003). *Phytochemistry* 62 : 219.

[94] Jung HA, Kim AR, Chung HY, Choi JS (2002). *Arch Pharm Res* 25 : 865.

[95] Cho H, Jun JY, Song FK, Kang KH, Back HY, Ko YS, Kim YC, (2001). *Planta Med* 67 : 750.

[96] Haraguchi H, Inoue J, Tamura Y, Mizutani K (2002). *Phytother Res* 16 : 539.

[97] Mar W, Je KH, Seo EK (2001). *Arch Pharm Res* 24 : 211.

[98] Qamaruddin, Parveen N, Khan NU, Singhal KC (2002). *J Ethnopharmacol* 82: 23.

[99] Das AK, Mandal SC, Banerjee SK, Sinha S, Das J, Sana BP, Pal M (1999). *J Ethnopharmacol* 68 : 205.

[100] Khanbabaee K, Ree TV (2001). *Nat Prod Rep* 18 : 641.

[101] Chidambara Murthy KN, Jayaprakasha GK, Singh RP (2002). *J Agric Food Chem* 50 : 4791.

[102] Dormana HJD, Peltoketo A, Hiltunena R, Tikkanenb MJ (2003). *Food Chemistry* 83 : 255.

[103] Wang XC, Weng W (2000). *Food Chemistry* 71 : 489.

[104] Tan MQ, Luo ZY, Wang QR, Jiang DZ (2000). *Hunan Yi Ke Da Xue Bao* 25 : 443.

[105] Tang YP, Li Yf, Hu J, Lou FC (2002). *J Asian Nat Prod Res* 4 : 123.

[106] Yamahara J, Mochizuki M, Chisaka T, Fujimusa H, Tamai Y, (1990). *Chem Pharm Bull* 38 : 1039.

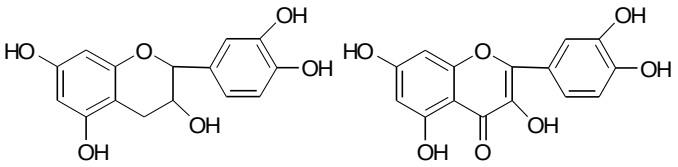
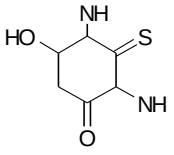
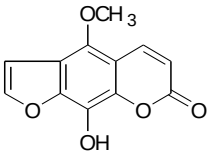
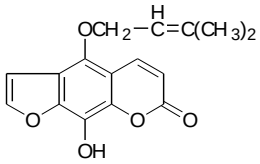
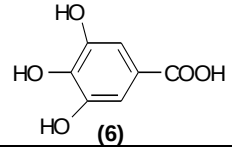
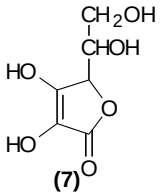
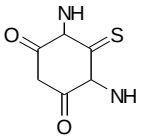
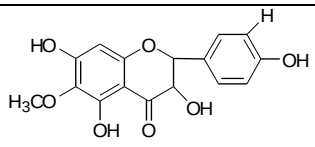
[107] Park BS, Lee KG, Shibamoto T, Lee SE, Takeoka GR (2003). *J Agric Food Chem* 51 : 295.

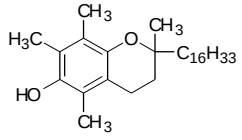
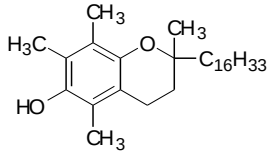
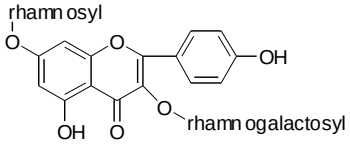
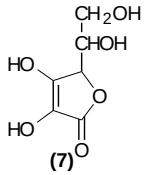
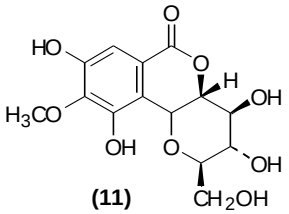
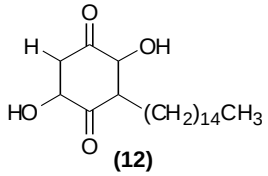
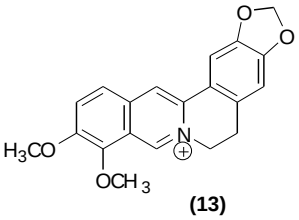
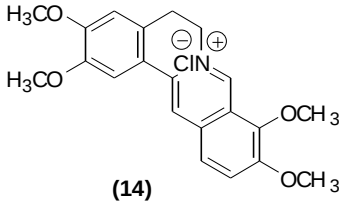
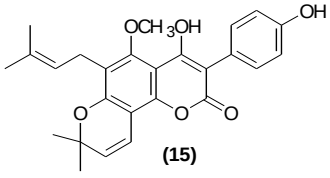
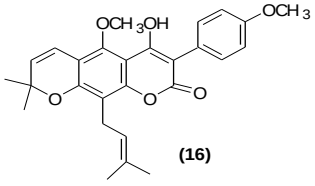
[108] De Santana CF, de Lima O, d Albuquerque IL, Lacerda AL, Martins DG (1968), *Rev Inst Antibiot* 8 : 89.

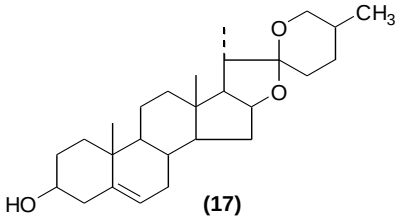
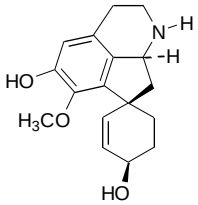
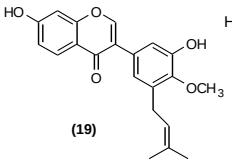
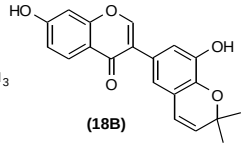
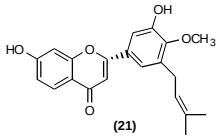
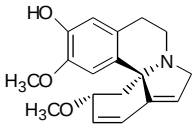
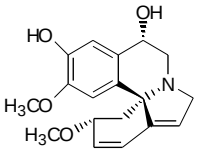
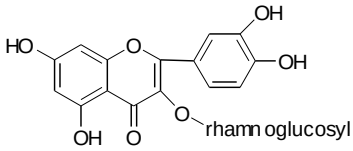
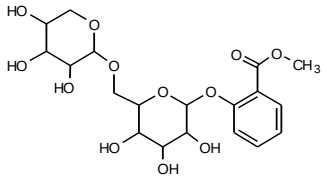
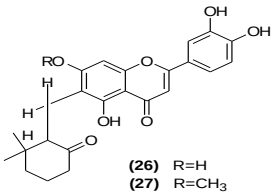
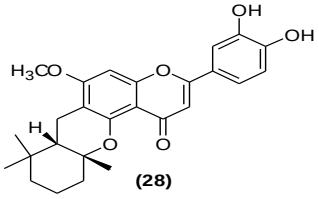
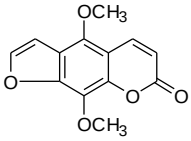
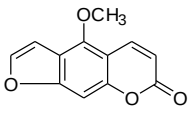
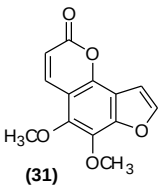
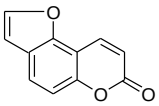
[109] Portillo A, Vila R, Freixa B, Adzet T, Canigueral S (2001). *J Ethnopharmacol* 76 : 93.

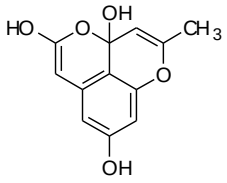
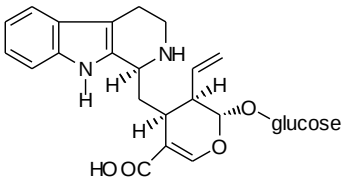
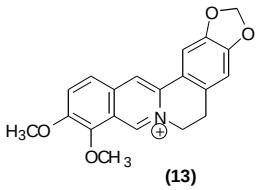
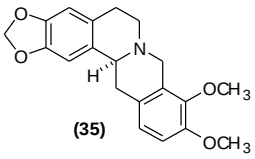
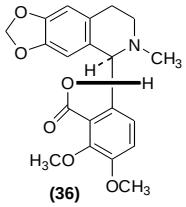
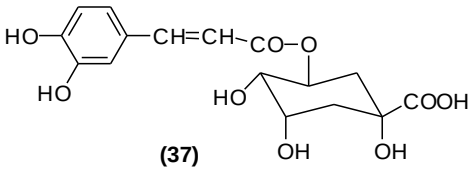
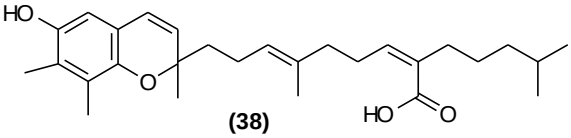
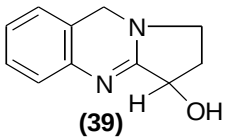
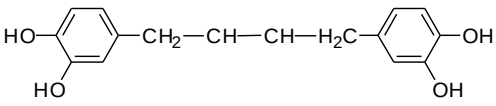
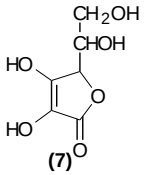
[110] Sara CI, Varel M, Harput US, Nagatsu A (2004). *Phytohemistry* 65 : 237

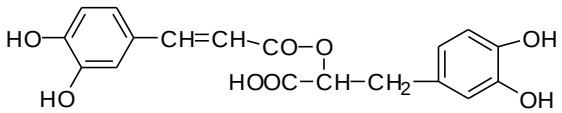
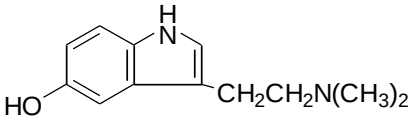
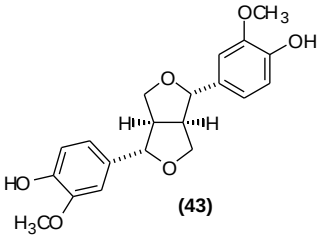
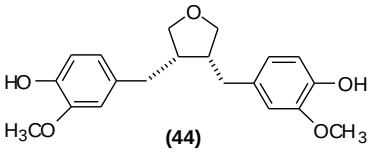
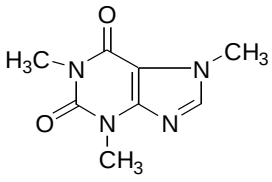
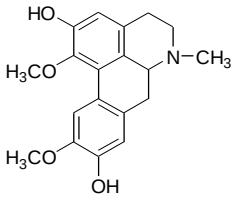
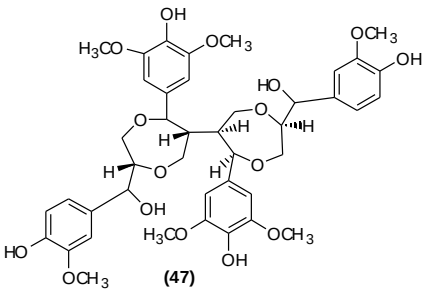
TAB LE

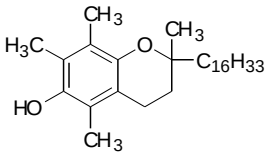
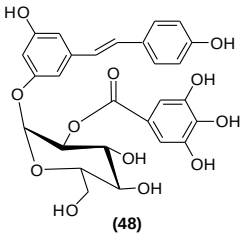
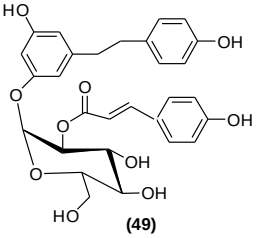
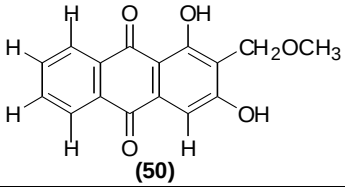
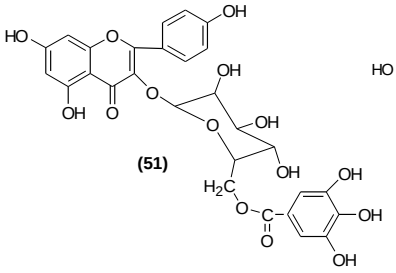
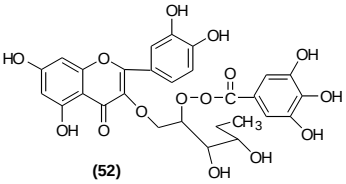
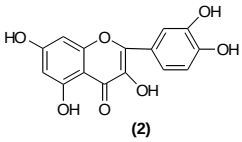
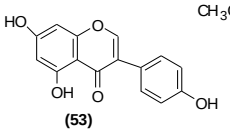
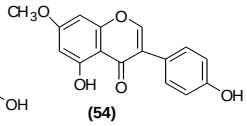
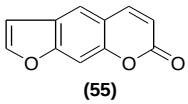
S. No.	Name of plant	Part of Plant	Active principle	Structure of active principle	Ref.
1.	Acacia catechu	Whole plant	Catechin (1) Quercetrin (2)	 (1) (2)	39
2.	Anadenanthera macrocarpa	Bark	Thiobarbituric acid (3)	 (3)	40
3.	Angelica dahurica	Root	9-Hydroxy-4-methoxy psorlen (4) Alloisoimperatorin (5)	 (4)  (5)	41
4.	Anogeissus latifolia	-	Gallic acid (6)	 (6)	39,42
5.	Asparagus racemosus	-	Ascorbic acid (7)	 (7)	43
6.	Astronium urundeuva	Bark	Thiobarbituric acid (3)	 (3)	40
7.	Baccharis grisebachii (Asteraceae)	Aerial parts	5,7,4´-Trihydroxy-6-methoxy flavone quercetrin (8)	 (8)	44

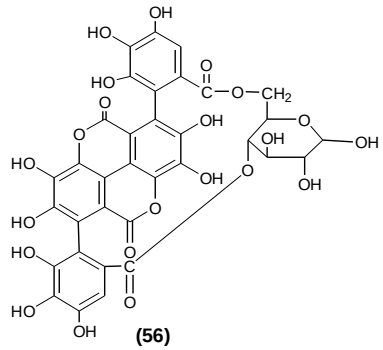
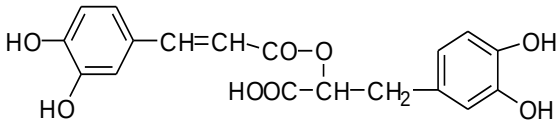
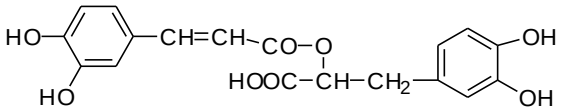
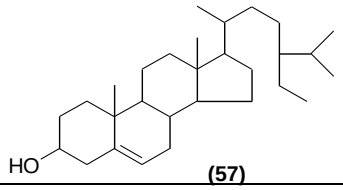
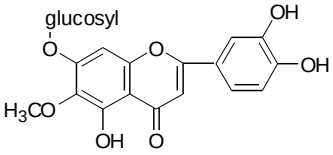
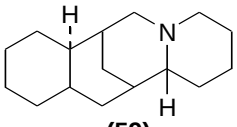
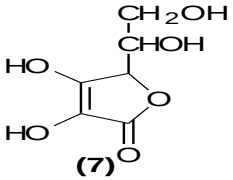
8.	Ballota acetabulosa (Lamiacea)	-	α-Tochopherol (9)	 **(9)**	44
9.	Ballota pseuodictamnus (Lamiacea)	-	α -tochopherol (9)	 **(9)**	44
10.	Bauhinia forticate	Leaves	Kempferol-3,7-O-dirhamnoside (10)	 **(10)**	45
11.	Carica papaya L.	Fruit	Ascorbic acid (7)	 **(7)**	46
12.	Connarus semidecandrus	Stem	Bergenin (11) Homorapanone (12)	 **(11)**  **(12)**	47
13.	Coptis spp.	Root	Berberine (13) Palmatine (14)	 **(13)**  **(14)**	48-51
14.	Derris scandens	-	Scandenin (15) Loncho carpenin (16)	 **(15)**  **(16)**	52-55

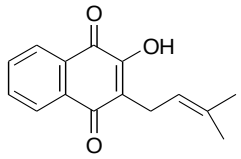
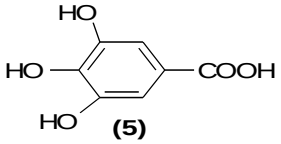
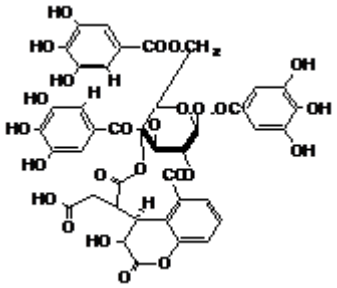
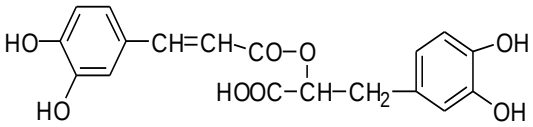
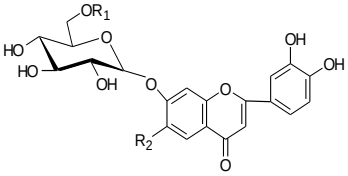
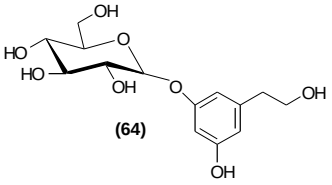
15.	Dioscorea spp.	Rhizomes	Diosgenin (17) Dioscorin (18)	 (17)  (18)	56-59
16.	Erythrina latissima	Stem wood	Erylatissin A (19) Erylatissin B (20) Erylatissin C (21)	 (19)  (18B)  (21)	60
17.	Erythrina lysistemon	Flowers	(+) Erysodine ((22), α-Hydroxy erysodine (23)	 (22)  (23)	61
18.	Fogophyrum esculentum	Seeds	Rutin (24)	 (24)	62,63
19.	Gaultheria procumbens	-	Gaultherin (25)	 (25)	64
20.	Helminthostachys zeylanica	-	Ugonin J (26) ,Ugonin K (27) ,Ugonin L (28)	 (26) R=H (27) R=CH3  (28)	65
21.	Heracleum persicum	-	Isopimpinellin (29) Bergapten (30) Pimpinellin (31) Bakuchicin (32)	 (29)  (30)  (31)  (32)	66

22.	Hunteria zeylanica	Leaves	Barakol (33) Strictosidinic acid (34)	 **(33)**  **(34)**	47
23.	Hydrastic canadensis	-	Berberine (13), Canadine (35), β- Hydrastine (36)	 **(13)**  **(35)**  **(36)**	67-70
24.	Hypericum perforatum	-	Caffeoylquinic acid (37)	 **(37)**	40,71
25.	Iryanthera jurerensis	Fruits	Tocotrienol (38)	 **(38)**	72
26.	Justica adhatoda	Leaves	Vasicine (39)	 **(39)**	73
27.	Larrea divarticata	-	Nordihydro guaiaretic acid (40)	 **(40)**	74-77
28.	Mangifera indica L.	-	Ascorbic acid (7)	 **(7)**	78

29.	Melissa officinalis	-	Rosmarinic acid (41)	 **(41)**	40 79-81
30.	Mucuna prurines	Seeds	Bufotenine (42)	 **(42)**	82-84
31.	Pandanus odoratissimus	Root	Pinoresinol (43) 3,4-bis (4-Hydroxy-3-methoxybenzyl) tetrahydrofuran (44)	 **(43)**  **(44)**	85
32.	Paullinia cupana	-	Caffeine (45)	 **(45)**	86
33.	Peumus boldus	Leaves	Boldine (46)	 **(46)**	87-89
34.	Phyllostachys edulis	Stem	Phyllostadimers A (47)	 **(47)**	90

35.	Picea abies (L)	Leaes	α-Tocopherol (9)	 **(9)**	91
36.	Pleuropterus ciliinervis	-	Pieceid-2´´-O-gallote (48) Pieceid-2´´-O-coumarate (49)	 **(48)**  **(49)**	92
37.	Prismatomeris malayana	Root	Lucidin-β-methylether (50)	 **(50)**	47
38.	Polygonum hytropiper L.	Leaves	Galloyl kaempherol 3-glucoside (51) Galloylquercetrin (52)	 **(51)**  **(52)**	93
39.	Prunues domestics	Leaves	Prunetin (54) Genistein (53) Quercetin (2)	 **(2)**  **(53)**  **(54)**	94
40.	Psorolea corylifolia	Seed & Leaves	Psoralen (55)	 **(55)**	95-98

41.	Punica granatum	Seed	Punicalin (56)	 **(56)**	99-101
42.	Rosmarinus officinalis L. (Lamiaceae)	Herb	Rosmarinic acid (41)	 **(41)**	40,102
43.	Salvia officinalis L. (Lamiaceae)	Herb	Rosmarinic acid (41)	 **(41)**	40,102
44.	Salvia plebeia	Herb	β-Sitosterol (57) , 6-methoxy luteolin-7-O-glucoside (58)	 **(57)**  **(58)**	103
45.	Soppora pachycarpa	-	Pachycarpine (59)	 **(59)**	104-106
46.	Syzygium jambos (Alstron)	Fruit	Ascorbic acid (7)	 **(7)**	46

47.	Tabebuio spp.	Bark	Lapachol (60)	 **(60)**	107-109
48.	Terminalia chebula	Whole plant	Gallic acid (5) Chebulinic acid (61)	 **(5)**  (61)	39
49.	Teucriumpolium (Lamiaceae)	Herb	Rosmarinic acid (41)	 **(41)**	39-102
50.	Vermonia thymoides	-	3´-Hydroxy scutellarein-7-0-(6´´-0-protocatechuoyl) -β-glucopyranoside (62) , 3´-Hydroxy scutellarein-7-0-(6´´-0-trans-feruloyl)-β-glucopyranosie (63) , 3,5-Dihydroxyphenethylalcohol 3-0-β-glucopyranosie (64)	 **(62)** R_1=protocatechuoyl R_2=OH **(63)** R_1=trans-feruloyl R_2=OH  **(64)**	110