International Journal of Research Instinct
(Peer-reviewed Journal)

ISSN ONLINE 2348-2095
Research Article

Study on Antimicrobial,Anti-inflammatory,Antitumor Activity of Some medicinal Orchids – A Review

T. Ramesh and P. Renganathan

[1] *Department of Botany, Srimad Andavan Arts and Science College (Autonomous), Trichy – 5.*
[2] *Department of Botany,(DDE)Anamalai University, Anamalai Nagar, 608 002.*

ABSTRACT

Plants have been used for medical purposes since the beginning of human history and are the basis of modern medicine. Most chemotherapeutic drugs for cancer treatment are molecules identified and isolated from plants or their synthetic derivatives. Our hypothesis was that whole plant extracts selected according to ethnobotanical sources of historical use might contain multiple molecules with antitumor activities that could be very effective in killing human cancer cells. This study examined the effects of three whole plant extracts (ethanol extraction) on human tumor cells. The extracts were from *Urtica membranacea* (Urticaceae), *Artemesia monosperma* (Asteraceae), and *Origanum dayi post* (Labiatae). All three plant extracts exhibited dose- and timedependent killing capabilities in various human derived tumor cell lines and primary cultures established from patients' biopsies. The killing activity was specific toward tumor cells, as the plant extracts had no effect on primary cultures of healthy human cells.Cell death caused by the whole plant extracts is via apoptosis. Plant extract 5 (*Urtica membranacea*) showed particularly strong anticancer capabilities since it inhibited actual tumor progression in a breast adenocarcinoma mouse model. Our results suggest that whole plant extracts are promising anticancer reagents

Key words

Antimicrobial, Anti-inflammatory, Antitumor, and Antioxidative activity

1. INTRODUCTION

In recent times, medicinal plants occupy an important position for being the paramount sources of drug discovery, irrespective of its categorized groups-herb, shrub or tree. Plants have been indispensable in treating diverse forms of diseases including cancer. According to World Health

Organisation, 80% of the people living in the rural areas depend on medicinal plants as primary health care system. These practices are solely based on the knowledge of traditional use of medicinal plants. Natural products are formulated to generate different types of effective drugs to enhance anticancer activities. Proper understanding of the complex synergistic interaction of various constituents of anticancer herbs, would help in formulating the design to attack the cancerous cells without harming the normal cells of the body. Orchids have been widely used in traditional Chinese medicine and some them have been subjected for phytochemical and pharmacological studies. India is one of the richest habitats of orchid. India comprise of about 2500 species in 167 genera. In India, some orchids like *Eulophia campestris, Orchis latifolia, Vanda roxburgii* have drawn the attention of scientific community because of their medicinal properties [3, 4]. Medicinal orchids mainly belong to genera: *Calanthe, Coelogyne, Cymbidium, Cypipedium, Dendrobium, Ephemerantha, Eria, Galeola, Gastrodia, Gymnadenia, Habenaria, Ludisia, Luisia, Nevilia* and *Thunia* [2, 5]. Certain constituent of orchids such as alkaloids, flavonoids etc. suggest medicinal properties. The present review deals with the phytochemistry and medicinal uses of orchids.

Antimicrobial Activity

A number of members of orchid family are used as potent inhibitor against gram positive and gram negative bacteria and also proved to be a potent antimicrobial agent. Gastrodia nin, a protein isolated from orchid Gastrodia elata have shown invitro activity against plant pathogenic fungi [2]. Gastrodianin is homologus to mannose binding proteins of other orchids some of which also displayed invitro antifungal activity [22]. The methanolic extract from different parts of orchids ha s shown antimicrobial activity. The methanolic extract derived from the leaves of Spiranthus mauritianum have shown inhibitory effect against gram positive bacteria and also showed anti-inflammatory activity [23]. The methylene chloride extract from the leaves and stem bark of Galeola foliate have shown a broad spectrum antibacterial activity against gram positive and gram negative bacteria, however the extract was found to be inactive against moulds [24]. Vanillin, the major flavoring component of vanilla is a membrane active compound which results in dissipation of ion gradients and the inhibition of respiration [25]. Vanillin has shown antimicrobial activity against Escherichia coli, Lactobacillus plantarum and Listeria innocua [25]. Antimicrobial activity of vanillin and vanillic isolated from Vanilla planifolia have been studied against several strains of Listeria monocytogenes, Listeria innocua,Listeria grayi and Listeria seeligeri and it was found that mixture of vanillin and vanillic acid exhibited additive inhibitory effects particularly at low pH [26]. The herb extract from Bletilla striata have shown to possess antioxidant and antimicrobial capacity

[27]. The ethanolic extract of seedlings of Cypripedium macranthos var. rebunense was found to contain antifungal compounds lusianthrin and chrysin. Lusianthrin maintains the perilous symbiotic association for germination was found to be more potent antifungal compound than chrysin which helps to protect adult plants [28]. The methanolic extract from the leaves of Acanthephippium bicolor Lindley was found to have antimicrobial activity against Staphylococcus aureus, Streptococcus foecalis, Bacillus cereus, Proteus vulgaris, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumonia, Shigella dysenteriae, Escherichia coli, Microsporum audouinii, Microsporum fulvum, Candida albicans and Trichophyton rubrum[29]. The gram positive bacteria are found to be more sensitive than gram negative bacteria and fungi [29]

Anti-inflammatory Activity

Several members of orchid family were found to have anti-inflammatory activity. Marked anti-inflammatory activity in carrageenan induced oedema in rats and mice is shown by Vanda roxburghii. The anti anrthritic activity was found to be superior to that of phenyl butazone [30]. Heptacosane and octacosanol isolated from Vanda roxburghii root was found to have anti-inflammatory activity [31]. The anti-inflammat ory activity is due to long chain alkanes and alkanols (ranging C-27 to C-32) which are ubiquitous in plants [31]. The ethanolic extract from the leaves of Anoectochilus formosanus have showed delayed onset of anti-inflammatory activity starting from 4 hours post carrageenan administration.Anoectochilus formosanus have also produced histological changes. Improvement in inflammatory infiltration of lymphocytes and kupffer cells around the central vein was achieved by the use of this orchid [32]. Several compounds with anti-inflammatory activity were isolated from Dendrobium monoliforme [33, 34]. 7-hydroxy-5,6-dimethoxy-1,4-phenanthrenequinone isolated from Dendrobium moniliforme have shown inhibitory effect on VHR dual specificity protein tyrosine phosphatase activity[34], whereas Dendroside A, C and vanilloside from the same sourcehave shown stimulatory effect on proliferation of B cells and inhibitory effect on proliferation of T cells [35]

Antitumor Activity

Several species of orchids have been studied and a number of compounds with antitumorous activity have been isolated.Dendrobium nobile has been a good source of compounds with anti-tumor activity. Denbinobin and 4, 7-Dihydroxy-2-methoxy-9, 10-dihydrophenanthrene from Dendrobium nobile showed cytotoxicity against human lung carcinoma, human ovary adenocarcinoma and humanpromyelocytic leukemia cell lines [39]. Dendroside A and dendronobiloside A obtained from the stem of Dendrobium nobile showed stimulatory effect on

proliferation of murine T and B lymphocytes [40]. Erianin obtained from the stem of Dendrobium chrysanthum was found to be a potent inhibitor of proliferation of HL-60 cells and the inhibition might be due to erianin induced apoptosis and alter ed expression of bcl-2 and bax genes in HL-60 cells [41]. Inanother study erianin leads to extensive tumor necrosis, growth delay and rapid vascular shutdown in hepatoma Bel7402 and melanoma A375 [42]. Dendrochrysanene isolated from stems of Dendrobium chrysanthum was found to suppress the mRNA level of TNF-alpha, IL8, IL10 and iNOS in murine peritoneal macrophages [43]. Fimbriatone isolated from Dendrobium fimbriatum was found to be potent inhibitor of BGC cell line [44]. A number of compounds such as7,8-dihydro -4-hydroxy-12,13- methylenedioxy-11methoxyldibenz[bf]oxepin,7,8dihydro-4-hydroxy-12,13 methylenedioxy11methoxyldibenz[bf]oxepin,7,8-Dihydro5 hydroxy-12,13-methylenedioxy-11-methoxyldibenz[bf]oxepin, cumulating, densiflorol A and plicatol B isolated from Bulbophyllum kwangtungense have shown anti tumor activities against Hela and K562 human tumor cell lines [18]. The methanolic extract obtained from Anoectochilus Formosan us have shown to induce apoptosis of MCF-7 cells [45]. However, the water extract from the same source was found to have potent tumor inhibitor which might is due to its potent immunostimulating effect [46]. It has shown inhibitory effect in BALB/c mice after subcutaneous transplantation of CT-26 murine colon cancer cells by stimulating proliferation of lymphoid tissues and activating the phagocytosis of peritoneal macrophages against Staphylococcus aureus [46]. The tuber of Cremastra appendiculata yield cirrohopetalanthrin and 2,7,2',7',2''-pentahydroxy-4,4'4''7''-tetramethoxy-1,8,1',1''-triphenanthrene which were found to have moderate cytotoxicity against human colon cancer, human stomach cancer, human hepatoma, human breast cancer, human lung adenocarcinoma and human ovarian cancer cell lines [17,47]. The homoisoflavanone5,7-dihydroxy-3-(3-hydroxy-4 methoxybenzyl)-6-methoxychroman isolated from Cremastra appendiculata was found to be a potent inhibitor of angiogenesis [17]. Lonchophylloids A and Lonchophylloids B obtained from the stems of Ephemerantha lonchophylla were found to sensitize those cells which have expressed the multidrug resistance phenotype to the toxicity of the anticancer drug doxorubicin [48]. Denbinobin isolated from the same source displayed anticancerous effects in K562 cells by increasing polymeri zation of tubulin and degranulation of Bcr-Abl signaling [49]. Methanolic extract of Gastrodia elata prevents serum deprived apoptosis through activation of serine/threonine kinase-dependent pathway and suppression of JNK activity [50], whereas the ethanolic extract from the rhizomes have shown potent anti tumor activity invitroin a dose dependent manner [51]. (2S)-5, 2',6'-trihydroxy-6-lavandulyl-4''-(γ,γ-dimethylallyl)-2'',2''-dimethylpyrano-[5'',6'',7,8]-flavanone, a dihydroflavanoid

isolated from Spiranthes australis (R. Brown) Lindl inhibits human cancer cells growth including A498, A549, BEL-7402,SGC-7901,MCF-7, HT-29 and K562 cell lines [52]. A phenanthrene derivative 3,7-dihydroxy-2,4,6-trimethoxyphenanthrene from Bulbophyllum odoratissimum was found to have cytotoxicity against the human cancer cell lines such as human leukemia cell lines K562 and HL-60, human hepatoma BEL-7402, human lung adenocarcinma A549 and human stomach cancer cell lines SGC-7901[53]

Antioxidative Property

Several compounds from orchid family were found to have strong antioxidative property. Ephemeranthone,a dihydrostilbene obtained from the leaf ethanolic extract of Ephemerantha lonchophylla was found to have strong antioxidative property for invitro inhibition of human low density lipoprotein[54]. Another dihydrostilbene isoamoenylin obtained from the roots of Dendrobium amoenum var. denneanum showed moderate antioxidative property [55]. Cismelilotoside,dihydromelilotoside and trans-melilotoside obtained from stems of Dendrobium aurantiacum were found to be potent antioxidants [16]. Antioxidative compounds like alkyl ferulates and quercetin were also isolated from Dendrobium monoliforme and Dendrobium tosaense [15]. The ethanolic extract of Dendrobium nobile was found to exhibit antioxidative property equivalent or higher to ascorbic acid [56].Kinsenone from Anoectochilus Formosan us was reported to have antioxidative property [57].The aqueous leaf extract from Anoectochilus Formosan us shows inhibitory effect on proteolytic cleavage of poly(ADP-ribose) polymerase during apoptosis [58]. Several phenolic compounds such as kaempferol-3-O-β-glucopyranoside (59), kaempferol-7β-D -glucopyranoside (60), isorhamnetin-3-β-D-rutinoside (61), 8-droxybenzylquercetin (62), 5- hydroxy-3',4',7-trimethoxyflavonol-3-β-D-rutinoside (63), and, and quercetin-7-O-β-D-[6"-O-(trans-feruloyl)]-glucopyranoside were isolated from Anoectochilus roxburghii (Wall.) Lindl that possess scavenging activity of DPPH radicals (64). Hydroxybenzyl alcohol, hydroxybenzaldehyde, vanillin and vanillyl alcohol obtained from leaf methanolic extract Gastrodia elata were reported to possess antioxidative property [65]. Several phenanthrenes isolated from 60% ethanolic extract of air dried plant of Pholidota yunnanensis were found to show the DPPH free radical scavenging activity [66]

2. CONCLUSION

Orchids are generally known for its beautiful flowers and very less known for its medicinal uses. However, a number of compounds have been isolated from the different parts of the plant which possess medicinal properties. Compounds with antimicrobial, antitumor, anti-inflammatory, antioxidative, antidiabetic, neuroprotective, antiallergic properties have beenisolated and tested on

animal models but clinical trials with orchid plant parts have not been a regular practice. Emphasis on the clinical trials will provide a new gateway for treatment of diseases with herbal medicines. The orchid components still requires proper study with full experimental trials which will lead to its acceptance as medical recommendations.

REFERENCES

[1] **Stewart, J & M.,Griffith (1995**). Manual of Orchids.Timber Press Portland, Oregon.

[2] **Gutierrez, R M P (2010).** Orchids: A review of uses in traditional medicine, its phytochemistry and pharmacology. Journal of Medicinal Plant Research 4(8):592-638.

[3] Stuart, G A (1984). Chinese Materia Medica Taipei, Southern Materials Centre. A translation of an ancient Chinese herbal.

[4] **Singh, A & Duggal, S (2009).** Medicinal Orchids: An Overview. Ethnobotanical Leaflets 13: 351-363.

[5] Szlachetko D (2001). Genera et species *Orchidalium.* 1.Polish Bot. J. 46: 11-26.

[6] **Hausen BM, Shoji A, Jarchow O (1984).** Orchid allergy. Archives Dermatol. 120: 1206-1208.

[7] Chawla AS, Sharma AK, Handa SS, Dhar KL (1992). Chemical studiesand anti inflammatory activity of *Vanda roxburghii* roots. Indian J. Pharm. Sci. 54: 159-161.

[8] Suresh PK, Subramoniam A, Pushpangadan P (2000).Aphodisiac activity of *Vanda tessellata.* Indian J. Pharmacol. 32:300-304.

[9] Yoshikawa M, Murakami T, Kishi A, Sakurama T, MatsudaH, Nomura M, Matsuda H, Kubo M (1998). Novel indole S,Obisdesmoside,calanthoside, the precursor glycoside of tryptanthrin, indirubin, and isatin, with increasing skin blood flow promoting effects, from two Calanthe species (Orchidaceae). Chem. Pharm. Bull. 46: 886-888.

[10] **Johnson MK, Alexander KE, Lindquist N, Loo G (1999).** A phenolic antioxidant from the freshwater orchid, *Habenaria repens.* Comparative Biochememistry Physiology part C: Pharmacol. Toxicol. Endocrinol. 122: **211-214.**

[11] Fan C, Wang W, Wang Y, Qin G, Zhao W (2001). Chemical constituents from *Dendrobiu*m *densiflorum.*Phytochemistry 57: 1255-1258.

[12] **Hayashi J, Sekine T, Deguchi S, Lin Q, Horie S, Tsuchiya S, Yano S, Watanabe K, Ikegami F (2002).** Phenolic compounds from *Gastrodia* rhizome and relaxant effects of related compounds on isolated smooth muscle preparation. Phytochemistry 59: 513-519.

[13] Estrada S, Acevedo L, Rodríguez M, Toscazo RA, Mata R (2002). New triterpenoids from orchids *Scaphyglottis livida* and *Nidema boothii*. Nat. Prod. Lett. 16: 81-86.

[14] **Majumder PL, Sen S, Majumder S (2003).** Triterpenoids from orchids *Agrostophyllum brevipes* and *Agrostophyllum callosum.* Phytochemistry 62: 591-596.

[15] Lo SF, Mulabagal V, Chen CL, Kuo CL, Tsay HS (2004). Bioguided fractionation and isolation of free radical scavenging components from in vitro propagated chinese medicinal plants *Dendrobium tosaense* Makino and *Dendrobium moniliforme* SW. J. Agric. Food Chem. 52: 6916-6919.

[16] Yang L, Han H, Nakamura N, Hattori M, Wang Z, Xu L (2007). Bioguided isolation of antioxidants from the stems of *Dendrobium aurantiacum* var. denneanum. Phytotherapy Res. 21: 696-698.

[17] Xia WB, Xue Z, Li S, Wang SJ, Yang YC, He DX, Ran GL, Kong LZ, Shi JG (2005). Chemical constituents from tuber of *Cremastra appendiculata.* Zhongguo Zhong Yao Za Zhi. 30: 1827-1830.

[18] **Wu, B, He, S., Pan, Y.J. (2006).** New dihydrodibenzoxepins from *Bulbophyllum kwangtungense*. Planta Medica 72: 1244- 1247.

[19] **Watanabe K, Tanaka R, Sakurai H, Iguchi K, Yamada Y, Hsu CS, Sakuma C, Kikuchi H, Shibayama H, Kawai T (2007).** Structure of cymbidine A, a monomeric peptidoglycan-related compound with hypotensive and diuretic activities, isolated from a higher plant, *Cymbidium goeringii* (Orchidaceae). Chemical Pharmaceutic Bulletin 55: 780-783

[20] Déciga-Campos M, Palacios-Espinosa JF, Reyes-Ramírez A, Mata R (2007). Antinociceptive and anti-inflammatory effects of compounds isolated from *Scaphyglottis livida* and *Maxillaria densa* . J. Ethnopharmacol. 114(2):161-168.

[21] Wu JB, Lin WL, Hsieh CC, Ho HY, Tsay HS, Lin WC (2007). The hepatoprotective activity of kinsenoside from *Anoectochilus formosanus*. Phytotherapy Res. 21: 58-61.

[22] Wang X, Bauw G, Van Damme EJ, Peumans WJ, Chen ZL, Van Montagu M, Angenon G, Dillen W (2001). Gastrodianinlike mannose-binding proteins: a novel class of plant proteins with antifungal properties. Plant J. 25: 651-661.

[23] **Matu EN, van Staden J (2003).** Antibacterial and anti-inflammatory activities of some plants used for medicinal purposes in Kenya. J. Ethnopharmacol. 87: 35-41.

[24] **Khan MR, Omoloso AD (2004).** Antibacterial activity of *Galeola foliata.* Fitoterapia. 75: 494-486.

[25] Fitzgerald DJ, Stratford M, Gasson MJ, Ueckert J, Bos A, Narbad A (2004). Mode of antimicrobial action of vanillin against *Escherichia coli, Lactobacillus plantarum and Listeria innocua*. J. Appl. Microbiol. 97. 104-113.

[26] **Delaquis P, Stanich K, Toivonen P (2005**). Effect of pH on the inhibition of *Listeria* spp. by vanillin and vanillic acid. J. Food Protection 68: 1472-1476.

[27] **Luo H, Lin S, Ren F, Wu L, Chen L, Sun Y (2007**). Antioxidant and antimicrobial capacity of Chinese medicinal herb extracts in raw sheep meat. J. Food Protrection 70: 1440- 1445.

[28] **Shimura H, Matsuura M, Takada N, Koda Y (2007).** An antifungal compound involved in symbiotic germination of *Cypripedium macranthos* var. rebunense (Orchidaceae). Phytochemistry 68:1442-1447.

[29**] Kala S and Senthilkumar S (2010).** Antimicrobial activity of *Acanthephippium bicolour* Lindley. Malaysian Journal of Microbiology. 6(2):140-148.

[30] **Prasad DN, Achari G (1966).** A study of anti-arthritic action of *Vanda roxburghii* in albino rats. J. Indian Med. Assoc. 46:234-237.

[31] **Chawla AS, Sharma AK, Handa SS, Dhar KL (1992).** Chemical studiesand anti inflammatory activity of *Vanda roxburghii* roots. Indian J.Pharm. Sci. 54: 159-161.

[32] **Lin JM, Lin CC, Chiu HF, Yang JJ, Lee SG (1993**).Evaluation of the anti-inflammatory and liver-protective effects of *Anoectochilus formosanus, Ganoderma lucidum* and *Gynostemma pentaphyllum* in rats. Am. J. Chin. Med. 21, 59-69.

[33] **Lin TH, Chang SJ, Chen CC, Wang JP, Tsao LT (2001).** Two phenanthraquinones from *Dendrobium moniliforme*. J. Nat.Prod. 64: 1084-1086.

[34] **Bae EY, Oh H, Oh WK, Kim MS, Kim BS, Kim BY, Sohn CB, Osada H, Ahn JS (2004).** A new VHR dual-specificity protein tyrosine phosphatase inhibitor from *Dendrobium moniliforme*. Planta Medica 70:869-870.

[35] **Zhao C, Liu Q, Halaweish F, Shao B, Ye Y, Zhao W(2003**). Copacamphane, picrotoxane, and alloaromadendrane sesquiterpene glycosides and phenolic glycosides from
Dendrobium moniliforme. J.Nat. Prod. 66: 1140-1143.

[36] Lee JY, Jang YW, Kang HS, Moon H, Sim SS, Kim CJ(2006). Antiinflammatory action of phenolic compounds from*Gastrodia elata* root. Archives Pharm. Res. 29: 849-858.

[37] **Ahn EK, Jeon HJ, Lim EJ, Jung HJ, Park EH (2007**). Antiinflammatory and anti-angiogenic activities of *Gastrodia elata* Blume. J. Hnopharmacol. 110: 476-482.

[38] **Wang J, Matsuzaki K, Kitanaka S (2006).** Stilbene derivatives from *Pholidota chinensis* and their anti-inflammatory activity. Chem.Pharm. Bulletin. 54: 1216-1218.

[39] **You HL, Park JD, Baek NI, Kim S, Ahn BZ (1995).** *In vitro* and *in vivo* antimural phenanthrenes from the aerial parts of *Dendrobium nobile*. Planta Medica 61: 178-180.

[40] **Zhao W, Ye Q, Tan X, Jiang H, Li X, Chen K, Kinghorn AD (2001**). Three new sesquiterpene glycosides from *Dendrobium nobile* with immunomodulatory activity. Journal Natural Products 64: 1196-2000

[41] **Li YM, Wang HY, Liu GQ (2001).** Erianin induces apoptosis in human leukemia HL-60 cells. Acta Pharmacological Sinica 22: 1018-1022.

[42] Gong YQ, Fan Y, Wu DZ, Yang H, Hu ZB, Wang ZT (2004). *In vivo* and *in vitro* evaluation of erianin, a novel antiangiogenic agent. Eur. J. Cancer 40: 1554-1565.

[43] **Yang L, Qin LH, Bligh SW, Bashall A, Zhang CF, Zhang M, Wang ZT, Xu LS (2006).** A new phenanthrene with a spirolactone from *Dendrobium chrysanthum* and its anti-inflammatory activities. Bioorg. Med. Chem. 14, 3496-3501.

[44] Bi ZM, Wang ZT, Xu LS, Xu GJ (2003). Studies on the chemical constituents of *Dendrobium fimbriatum.* Yao Xue Xue Bao 38: 526-529.

[45] **Shyur LF, Chen CH, Lo CP, Wang SY, Kang PL, Sun SJ, Chang CA, Tzeng CM, Yang NS (2004).** Induction of apoptosis in MCF-7 human breast cancer cells by phytochemicals from *Anoectochilus formosanus*. J. Biomed. Sci. 11: 928-939.

[46] Tseng CC, Shang HF, Wang LF, Su B, Hsu CC, Kao HY, Cheng KT (2006). Antitumor and immunostimulating effects of *Anoectochilus formosanus* Hayata. Phytomedicine 13: 366-370.

[47] **Xue Z, Li S, Wang S, Wang Y, Yang Y, Shi J, He L (2006).** Mono-, Bi-, and triphenanthrenes from the tubers of *Cremastra appendiculata*. J. Nat. Prod. 69: 907-913.

[48] **Na GX, Wang TS, Yin L, Pan Y, Guo YL, LeBlanc GA, Reinecke MG, Watson WH, Krawiec M (1998).** Two pimarane diterpenoids from *Ephemerantha lonchophylla* and their evaluation as modulators of the multidrug resistance phenotype. J. Nat. Prod. 61: 112-115.

[49] Huang Y, Guh J, Teng C (2005). Denbinobin-mediated anticancer effect in human K562 leukemia cells: role in tubulin polymerization and Bcr- Abl activity. J. Biomed. Sci. *elata* prevents rat pheochromocytoma cells from serum-deprived apoptosis: the role of the MAPK family. Life Sci. 75:1649-1657.

[50] **Miyazawa M, Shimamura H, Nakamura S, Sugiura W, Kosaka H, Kameoka H (1999**). Moscatilin from *Dendrobium nobile*, a naturally occurring bibenzyl compound with potential antimutagenic activity. J. Agric. Food Chem. 47: 2163-2167.

51. **Heo JC, Woo SU, Son M, Park JY, Choi WS, Chang KT, Kim SU, Yoon EK, Kim YH, Shin HM, Lee SH (2007).** Antitumor activity of *Gastrodia elata* Blume is closely associated with a GTP-Ras dependent pathway. Oncol. Reports 8: 849-853.

52. Peng J, Xu Q, Xu Y, Qi Y, Han X, Xu L (2007). A new anticancer dihydroflavanoid from the root of *Spiranthes australis* (R. Brown) Lindl. Nat. Prod. Res. 21: 641-645.

53. **Chen Y, Xu J, Yut H, Qin CW, Zhangt Y, Liu Y, Wang J (2007).** *Bulbophyllum Odoratissimum* 3,7- Dihydroxy-2,4,6- trimethoxyphenanthrene. J. Korean Chem. Soc. 51: 352-355.

54. Chen HY, Shiao MS, Huang YL, Shen CC, Lin YL, Kuo YH, Chen CC (1999). Antioxidant principles from *Ephemerantha Ionchophylla*. J. Nat. Prod. 62: 1225-1227.

55. **Venkateswarlu S, Raju MS, Subbaraju GV (2002).** Synthesis and biological activity of isoamoenylin, a metabolite of *Dendrobium amoenum.* Biosci. Biotechnol. Biochem. 66: 2236-2238

56. Zhang X, Xu JK, Wang J, Wang NL, Kurihara H, Kitanaka S, Yao XS(2007). Bioactive bibenzyl derivatives and fluorenones from *Dendrobium nobile.* J. Nat. Prod. 70: 24-28.

57. **Wang SY, Kuo YH, Chang HN, Kang PL, Tsay HS, Lin KF, Yang NS, Shyur LF (2002).** Profiling and characterization antioxidant activities in *Anoectochilus formosanus* hayata. J.Agric. Food Chemistry 50:1859-1865.

58. Wang LF, Lin CM, Shih CM, Chen HJ, Su B, Tseng CC,Gau BB, Cheng KT (2005). Prevention of cellular oxidative damage by an aqueous extract of *Anoectochilus formosanus*. Annales. New York Academy of Sciences 1042: 379-386.

59. Markham KR, Ternai B, Stanley R, Geiger H, Mabry TJ (1978). Carbon- 13 NMR studies of flavonosides-III: Naturally occurring flavonoid glycosides and their alylated derivatives. *Tetrahedron* 34: 1389–1397

60. **Gong YH (1986).** 13C Chemical Shift of Natural Organic Compounds, Tomus 1. Yunnan Science and Technology Press, Kunming pp. 356-359.

[61] **Victoire, C., Berrurier, M.H., Guth, A.L. (1988). Isolation 65. Jung TY, Suh SI, Lee H, Kim IS, Kim HJ, Yoo HS, Lee SR (2007).** Protective effects of several components of *Gastrodia elata* on lipid peroxidation in gerbil brain homogenates. Phytother. Res. 21:960

[66] **Guo XY, Wang J, Wang NL, Kitanaka S, Yao XS (2007).** 9, 10- Dihydrophenanthrene derivatives from *Pholidota yunnanensis* and scavenging activity on DPPH free radical. J. Asian Natural Prod. Res.9: 165-174.

67. **Rhee JK, Ki PG, Baek BK, Lee SB, Ahan BZ (1982).** Isolation of anthelmintic substance on *Clonorchis Sinensis* from tuber of *Bletilla Striata*. Kisaengchunghak Chapchi. 20: 142- 146.

[68] **Chen KK, Chen AL (1935).** The alkaloid of Chin-Shih-Hu. J. Biol. Chem. pp. 653-658.

[69] **Li MF, Hirata Y, Xu GJ, Niwa M, Wu HM (1991).** Studies on the chemical constituents of *Dendrobium loddigesii* rolfe. Yao Xue Xue Bao. 26: 307-310

[70] **Ye Q, Qin G, Zhao W (2002).** Immunomodulatory sesquiterpene glycosides from *Dendrobium nobile*.Phytochemistry. 61: 885-890.