# REFERRENCES

# REFERENCES


[1] Russell, D. W. and Wilson, J. D. (1994). Steroid 5α-reductase: two genes/two enzymes. **Annual Reviews of Biochemistry**, 63, 25-61.

[2] Bartsch, G., Rittmaster, R. S. and Klocker, H. (2000). Dihydrotestosterone and the concept of 5α-reductase inhibition in human benign prostatic hyperplasia. **European Urology**, 37(4), 367-380.

[3] Iehle, C., Delos, S., Guirou, O., Tate, R., Raynaud, J. P. and Martin, P. M. (1995). Human prostatic steroid 5α-reductase isoforms-a comparative study of selective inhibitors. **Journal of Steroid Biochemistry and Molecular Biology**, 54(5-6), 273-279.

[4] Gormley, G. (1995). Finasteride: a clinical review. **Biomedicine and Pharmacotherapy**, 49(7-8), 319-324.

[5] Aggarwal, S., Thareja, S., Verma, A., Bhardwaj, T. R. and Kumar, M. (2010). An overview on 5α-reductase inhibitors. **Steroids**, 75(2), 109-153.

[6] Pumthong, G. (2010). **Studies of a 5α-reductase inhibitory activity of *Curcuma aeruginosa* extract**. Doctoral dissertation, Ph.D., Naresuan University, Phitsanulok.

[7] Pumthong, G., Asawanonda, P., Varothai, S., Jariyasethavong, V., Triwongwaranat, D., Suthipinittharm, P., et al. (July 14, 2011). ***Curcuma aeruginosa*, a novel botanically derived 5α-reductase inhibitor in the treatment of male-pattern baldness: a multicenter, randomized, double-blind, placebo-controlled study.** Retrieved August 20, 2011, from http://informahealthcare.com/doi/abs/10.3109/09546634.2011.568470

[8] Thaina, P., Tungcharoen, P., Wongnawa, M., Reanmongkol, W. and Subhadhirasakul, S. (2009). Uterine relaxant effects of *Curcuma aeruginosa* Roxb. rhizome extracts. **Journal of Ethnopharmacology**, 121(3), 433-443.

[9] Reanmongkol, W., Subhadhirasakul, S., Khaisombat, N., Fuengnawakit, P., Jantasila, S. and Khamjun, A. (2006). Investigation the antinociceptive, antipyretic and antiinflammatory activities of *Curcuma aeruginosa* Roxb. extracts in experimental animals. **Songklanakarin Journal of Science and Technology**, 28(5), 999-1008.

[10] Otake, T., Mori, H., Morimoto, M., Ueba, N., Sutardjo, S., Kusumoto, I. T., et al. (1995). Screening of Indonesian plant extracts for anti-human immunodeficiency virus-type 1 (HIV-1) activity. **Phytotherapy Research**, 9(1), 6-10.

[11] Jitoe, A., Masuda, T., Tengah, I. G. P., Suprapta, D. N., Gara, I. W. and Nakatani, N. (1992). Antioxidant activity of tropical ginger extracts and analysis of the contained curcuminoids. **Journal of Agricultural and Food Chemistry**, 40(8), 1337-1340.

[12] Jantan, I., Rafi, I. A. and Jalil, J. (2005). Platelet-activating factor (PAF) receptor-binding antagonist activity of Malaysian medicinal plants. **Phytomedicine**, 12(1-2), 88-92.

[13] Takano, I., Yasuda, I., Takeya, K. and Itokawa, H. (1995). Guaiane sesquiterpene lactones from *Curcuma aeruginosa*. **Phytochemistry**, 40(4), 1197-1200.

[14] Kitamura, C., Nagoe, T., Prana, M., Agusta, A., Ohashi, K. and Shibuya, H. (2007). Comparison of *Curcuma* sp. in Yakushima with *C. aeruginosa* and *C. zedoaria* in Java by trn K gene sequence, RAPD pattern and essential oil component. **Journal of Natural Medicines**, 61(3), 239-243.

[15] Sukari, M. A. H., Saad, S. M., Lajis, N. H., Rahmani, M., Muse, R., Yusuf, U. K., et al. (2007). Chemical constituents and bioactivity of *Curcuma aeruginosa* Roxb. **Natural Product Sciences**, 13(3), 175-179.

[16] Matsuda, H., Sato, N., Yamazaki, M., Naruto, S. and Kubo, M. (2001). Testosterone 5α-reductase inhibitory active constituents from Anemarrhenae Rhizoma. **Biological and Pharmaceutical Bulletin**, 24(5), 586-587.

[17] Michels, G. and Hoppe, U. C. (2008). Rapid actions of androgens. **Frontiers in Neuroendocrinology**, 29(2), 182-198.

[18] Harris, G. S. and Kozarich, J. W. (1997). Steroid 5α-reductase inhibitors in androgen-dependent disorders. **Current Opinion in Chemical Biology**, 1(2), 254-259.

[19] Steers, W. D. (2001). 5α-reductase activity in the prostate. **Urology**, 58(6 Suppl 1), 17-24.

[20] Brown, T. R. (1999). **Androgen Metabolism and Action Male Reproductive Function**. USA: Springer US.

[21] McPhaul, M. J. and Young, M. (2001). Complexities of androgen action. **Journal of the American Academy of Dermatology**, 45(3), S87-S94.

[22] Hiipakka, R. A. and Liao, S. (1998). Molecular mechanism of androgen action. **Trends in Endocrinology and Metabolism**, 9(8), 317-324.

*[23] Bob, D. and Vincenzo, M. The benefits of dual inhibition of 5α-reductase.* **European urology**, 5(20), 1013-1017.

[24] Soronen, P., Laiti, M., Torn, S., Harkonen, P., Patrikainen, L., Li, Y., et al. (2004). Sex steroid hormone metabolism and prostate cancer. **Journal of Steroid Biochemistry and Molecular Biology**, 92(4), 281-286.

[25] Toyoda, M. and Morohashi, M. (2001). Pathogenesis of acne. **Medical Electron Microscopy**, 34(1), 29-40.

[26] Rosenfield, R. L. (2005). Hirsutism. **The New England Journal of Medicine**, 353, 2578-2588.

[27] Ali, I. and Dawber, R. (2006). Hirsutism. **Women's health medicine**, 3(3), 134-138.

[28] V.K, S. (2009). Androgenic alopecia: A counterproductive outcome of the anabolic effect of androgens. **Medical Hypotheses**, 73(3), 420-426.

[29] Inui, S. and Itami, S. (2011). Molecular basis of androgenetic alopecia: From androgen to paracrine mediators through dermal papilla. **Journal of Dermatological Science**, 61(1), 1-6.

[30] Szmulewitz, R. Z. and Posadas, E. M. (2007). Antiandrogen therapy in prostate cancer. **Update on Cancer Therapeutics**, 2(3), 119-131.

[31] Syed, A. A. and Amshumali, M. K. (2001). LC determination of finasteride and its application to storage stability studies. **Journal of Pharmaceutical and Biomedical Analysis**, 25(5-6), 1015-1019.

[32] Schwartz, J. I., Tanaka, W. K., Wang, D. Z., Ebel, D. L., Geissler, L. A., Dallob, A., et al. (1997). MK-386, an inhibitor of 5α-reductase type 1, reduces dihydrotestosterone concentrations in serum and sebum without affecting dihydrotestosterone concentrations in semen. **Journal of Clinical Endocrinology and Metabolism**, 82(5), 1373-1377.

[33] McIntyre, B. S., Barlow, N. J. and Foster, P. M. D. (2001). Androgen-mediated development in male rat offspring exposed to flutamide in utero: permanence and correlation of early postnatal changes in anogenital distance and nipple retention with malformations in androgen-dependent tissues. **Toxicological Sciences**, 62(2), 236-249.

[34] Wirth, M. P., Hakenberg, O. W. and Froehner, M. (2007). Antiandrogens in the treatment of prostate cancer. **European Urology**, 51(2), 306-314.

[35] Liang, T. and Liao, S. (1992). Inhibition of steroid 5 alpha-reductase by specific aliphatic unsaturated fatty acids. **Biochemical Journal**, 285, 557-562.

[36] Matsuda, H., Yamazaki, M., Matsuo, K., Asanuma, Y. and Kubo, M. (2001). Anti-androgenic activity of Myricae Cortex--isolation of active constituents from bark of *Myrica rubra*. **Biological and Pharmaceutical Bulletin**, 24(3), 259-263.

[37] Matsuda, H., Yamazaki, M., Naruto, S., Asanuma, Y. and Kubo, M. (2002). Anti-androgenic and hair growth promoting activities of Lygodii Spora (Spore of *Lygodium japonicum*) I. Active constituents inhibiting testosterone 5α-reductase. **Biological and Pharmaceutical Bulletin**, 25(5), 622-626.

[38] Stamatiadis, D., Bulteau-Portois, M. C. and Mowszowicz, I. (1988). Inhibition of 5α-reductase activity in human skin by zinc and azelaic acid. **British Journal of Dermatology**, 119(5), 627-632.

[39] Takahashi, T., Kamiya, T. and Yokoo, Y. (1998). Proanthocyanidins from grape seeds promote proliferation of mouse hair follicle cells *in vitro* and convert hair cycle *in vivo*. **Acta Dermato-Venereologica**, 78(6), 428-432.

[40] Takahashi, T., Kamiya, T., Hasegawa, A. and Yokoo, Y. (1999). Procyanidin oligomers selectively and intensively promote proliferation of mouse hair epithelial cells *in vitro* and activate hair follicle growth *in vivo*. **Journal of Investigative Dermatology**, 112(3), 310-316.

[41] Liao, S. (2001). The medicinal action of androgens and green tea epigallocatechin gallate. **Hong Kong Medicinal Journal**, 7(4), 369-374.

[42] Park, J. S., Yeom, M. H., Park, W. S., Joo, K. M., Rho, H. S., Kim, D. H., et al. (2006). Enzymatic hydrolysis of green tea seed extract and its activity on 5α-reductase inhibition. **Bioscience Biotechnology and Biochemistry**, 70(2), 387-394.

[43] Hiipakka, R. A., Zhang, H.-Z., Dai, W., Dai, Q. and Liao, S. (2002). Structure-activity relationships for inhibition of human 5α-reductases by polyphenols. **Biochemical Pharmacology**, 63(6), 1165-1176.

[44] Raynaud, J. P., Cousse, H. and Martin, P. M. (2002). Inhibition of type 1 and type 2 5α-reductase activity by free fatty acids, active ingredients of Permixon. **The Journal of Steroid Biochemistry and Molecular Biology**, 82(2-3), 233-239.

[45] Talpur, N., Echard, B., Bagchi, D., Bagchi, M. and Preuss, H. G. (2003). Comparison of saw palmetto (extract and whole berry) and cernitin on prostate growth in rats. **Molecular and Cellular Biochemistry**, 250(1-2), 21-26.

[46] Yang, Y., Ikezoe, T., Zheng, Z., Taguchi, H., Koeffler, H. P. and Zhu, W. G. (2007). Saw Palmetto induces growth arrest and apoptosis of androgen-dependent prostate cancer LNCaP cells via inactivation of STAT 3 and androgen receptor signaling. **International Journal of Oncology**, 31(3), 593-600.

[47] Shimizu, K., Fukuda, M., Kondo, R. and Sakai, K. (2000). The 5α-reductase inhibitory components from heartwood of *Artocarpus incisus*: structure-activity investigations. **Planta Medica**, 66(1), 16-19.

[48] Shimiz, K., Kondo, R., Sakai, K., Buabarn, S. and Dilokkunanant, U. (2000). A geranylated chalcone with 5α -reductase inhibitory properties from *Artocarpus incisus*. **Phytochemistry**, 54(8), 737-739.

[49] Park, W. S., Son, E. D., Nam, G. W., Kim, S. H., Noh, M. S., Lee, B. G., et al. (2003). Torilin from *Torilis japonica*, as a new inhibitor of testosterone 5α-reductase. **Planta Medica**, 69(5), 459-461.

[50] Kim, Y.-u., Son, H. K., Song, H. K., Ahn, M.-J., Lee, S. S. and Lee, S. K. (2003). Inhibition of 5α-reductase activity by diarylheptanoids from *Alpinia officinarum*. **Planta Medica**, 69(1), 72-74.

[51] Radhika, P., Cabeza, M., Bratoeff, E. and Garcia, G. (2004). 5α-reductase inhibition activity of steroids isolated from marine soft corals. **Steroids**, 69(7), 439-444.

[52] Fujita, R., Liu, J., Shimizu, K., Konishi, F., Noda, K., Kumamoto, S., et al. (2005). Anti-androgenic activities of *Ganoderma lucid*um. **Journal of Ethnopharmacology**, 102(1), 107-112.

[53] Liu, J., Kurashiki, K., Shimizu, K. and Kondo, R. (2006). Structure-activity relationship for inhibition of 5α-reductase by triterpenoids isolated from *Ganoderma lucidum*. **Bioorganic and Medicinal Chemistry**, 14(24), 8654-8660.

[54] Liu, J., Shimizu, K., Konishi, F., Noda, K., Kumamoto, S., Kurashiki, K., et al. (2007). Anti-androgenic activities of the triterpenoids fraction of *Ganoderma lucidum*. **Food Chemistry**, 100(4), 1691-1696.

[55] Liu, J., Shimizu, K., Konishi, F., Kumamoto, S. and Kondo, R. (2007). The anti-androgen effect of ganoderol B isolated from the fruiting body of *Ganoderma lucidum*. **Bioorganic and Medicinal Chemistry**, 15(14), 4966-4972.

[56] Abdel-Rahman, M. K. (2006). Effect of pumpkin seed (*Cucurbita pepo* L.) Diets on benign prostatic hyperplasia (BPH): chemical and morphometric evaluation in rats. **World Journal of Chemistry**, 1(1), 33-40.

[57] Kumar, T., Chaiyasut, C., Rungseevijitprapa, W. and Suttajit, M. (2011). Screening of steroid 5α-reductase inhibitory activity and total phenolic content of Thai plants. **Journal of Medicinal Plants Research**, 5(7), 1265-1271.

[58] Liao, S., Lin, J., Dang, M. T., Zhang, H., Kao, Y. H., Fukuchi, J., et al. (2001). Growth suppression of hamster flank organs by topical application of catechins, alizarin, curcumin, and myristoleic acid. **Archives of Dermatological Research**, 293(4), 200-205.

[59] Lina, L., Shib, Q., Sub, C.-Y., Shihb, C. C.-Y. and Lee, K.-H. (2006). Antitumor agents 247. New 4-ethoxycarbonylethyl curcumin analogs as potential antiandrogenic agents. **Bioorganic and Medicinal Chemistry**, 14(8), 2527-2534.

[60] E. Bertoft, J.U. Eskola, V. Niintii and Liivgren, T. (1984). Competitive solid-phase immunoassay of testosterone time-resolved fluorescence. **FEBS Letters**, 173(1), 213-216.

[61] Rodiguez, L., Begtashi, I., Zanuy, S. and Carrillo, M. (2000). Development and validation of an enzyme immunoassay for testosterone: Effect of photoperoid on plasma testosterone levels and gonadal development in male sea (*Dicentrarchus Labrax*, L.) at puberty. **Fish Physiology and Biochemistry**, 23(2), 141-150.

[62] Inoue, K., Ferrante, P., Hirano, Y., Yasukawa, T., Shiku, H. and Matsue, T. (2007). A competitive immunochromatographic assay for testosterone based on electrochemical detection. **Talanta**, 73(5), 886-892.

[63] Washburn, B. E., Millspaugh, J. J., Morris, D. L., Schulz, J. H. and Faaborg, J. (2007). Using a commercially available enzyme immunoassay to quantify testosterone in avian plasma. **The Condor**, 109(1), 181-186.

[64] Bologna, M., Muzi, P., Biordi, L., Festuccia, C. and Vicentini, C. (1995). Finasteride dose-dependently reduces the proliferation rate of the LNCaP human prostatic cancer cell line *in vitro*. **Urology**, 45(2), 282-290.

[65] Laplante, Y. and Poirier, D. (2008). Proliferative effect of androst-4-ene-3,17-dione and its metabolites in the androgen-sensitive LNCaP cell line. **Steroids**, 73(3), 266-271.

[66] Alley, M. C., Scudiero, D. A., Monks, A., Hursey, M. L., Czerwinski, M. J., Fine, D. L., et al. (1988). Feasibility of drug screening with panels of human tumor cell lines using a microculture tetrazolium assay. **Cancer Research**, 48, 589-601.

[67] Sultan, C., Terraza, A., Deviller, C., Michel, B. and Jean, R. (1982). Androgen receptors in cultured human skin.**British Journal of Dermatology**, 107(23), 40-46.

[68] Liang, T. and Liao, S. (1997). Growth suppression of hamster flank organs by topical application of gamma-linolenic and other fatty acid inhibitors of 5α-reductase. **Journal of Investigative Dermatology**, 109(2), 152-157.

[69] Srivastava, S., Chitranshi, N., Srivastave, S., Dan, M., Rawat, A. and Pushpangadan, P. (2006). Pharmacognostic evaluation of *Curcuma aeurigenosa* Roxb. **Natural Product Sciences**, 12(3), 162-165.

[70] Pongbunrod, S. (1979). **Mai-Tet-Muang-Thai: medicinal characteristic of foreign and Thai traditional medicine**. Bangkok: Kasem Bannakit.

[71] Matsuda, H., Morikawa, T., Ninomiya, K. and Yoshikawa, M. (2001). Hepatoprotective constituents from Zedoariae Rhizoma: absolute stereostructures of three new carabrane-type sesquiterpenes, curcumenolactones A, B, and C. **Bioorganic and Medicinal Chemistry**, 9(4), 909-916.

[72] Qu, Y., Xu, F., Nakamura, S., Matsuda, H., Pongpiriyadacha, Y., Wu, L., et al. (2009). Sesquiterpenes from *Curcuma comosa* **Journal of Natural Medicines**, 63, 102-104.

[73] Ranjini, C. E. and Vijayan, K. K. (2005). Structural characterization of a glucan from the tubers of *Curcuma aeruginosa*. **Indian Journal of Chemistry**, 44, 643-647.

[74] Ranjini, C. E. and Vijayan, K. K. (2006). A high amylose starch isolated from the tubers of *Curcuma aeruginosa*. **Indian Journal of Chemistry**, 45, 2773-2775.

[75] Barrero, A. F., Herrador, M. M., Arteaga, P. and Catalan, J. V. (2009). ChemInform abstract: germacrone: occurrence, synthesis, chemical transformations and biological properties. **Natural Product Communications**, 3(4), 567-576.

[76] Yoshioka, T., Fujii, E., Endo, M., Wada, K., Tokunaga, Y., Shiba, N., et al. (1998). Antiinflammatory potency of dehydrocurdione, a zedoary-derived sesquiterpene. **Inflammation Research**, 47(12), 476-481.

[77] Irie, K., Yoshioka, T., Nakai, A., Ochiai, K., Nishikori, T., Wu, G. R., et al. (2000). A $Ca^{2+}$ channel blocker-like effect of dehydrocurdione on rodent intestinal and vascular smooth muscle. **European Journal of Pharmacology**, 403(3), 235-242.

[78] Lai, E. Y. C., Chyau, C. C., Mau, J. L., Chen, C. C., Lai, Y. J., Shih, C. F., et al. (2004). Antimicrobial activity and cytotoxicity of the essential oil of *Curcuma zedoaria*. **The American Journal of Chinese Medicine**, 32(2), 281-290.

[79] Lakshmi, S., Padmaja, G. and Remani, P. (2011). **Antitumour effects of isocurcumenol isolated from *Curcuma zedoaria* rhizomes on human and murine cancer cells**. Retrieved December 9, 2011, from http://www.hindawi.com/journals/ijmc/2011/253962/

[80] Choa, W., Namb, J.-W., Kanga, H.-J., Windonoc, T., Seob, E.-K. and Lee, K.-T. (2009). Zedoarondiol isolated from the rhizoma of *Curcuma heyneana* is involved in the inhibition of iNOS, COX-2 and pro-inflammatory cytokines via the downregulation of NF-κB pathway in LPS-stimulated murine macrophages. **International Immunopharmacology**, 9(9), 1049-1057.

[81] Nukui, F. (1997). Effects of chlormadinone acetate and ethinylestradiol treatment on epididymal 5α-alpha-reductase activities in patients with prostate cancer. **Endocrine Journal**, 44(1), 127-132.

[82] Srivilai, J. (2011). ***In vitro* anti-androgenic activity of germacrone analogs**. Master thesis, M.Sc., Naresuan University, Phitsanulok.

[83] Jin, P., Madieh, S. and Augsburger, L. L. (2007). The solution and solid state stability and excipient compatibility of parthenolide in feverfew. **AAPS PharmSciTech**, 8(4), 200-205.

[84] Yan, J., Chen, G., Tong, S., Feng, Y., Sheng, L. and Lou, J. (2005). Preparative isolation and purification of germacrone and curdione from the essential oil of the rhizomes of *Curcuma wenyujin* by high-speed counter-current chromatography. **Journal of Chromatography A**, 1070(1-2), 207-210.

[85] Kuroyanagi, M., Ueno, A., Ujiie, K. and Sato, S. (1987). Structures of sesquiterpenes from *Curcuma aromatica* SALISB. **Chemical and Pharmaceutical Bulletin**, 35(1), 53-59.

[86] Firman, K., Kinoshita, T., Itai, A. and Sankawa, U. (1988). Terpenoids from *Curcuma heyneana*. **Phytochemistry**, 27(12), 3887-3891.

[87] Hikino, H., Takahashi, S., Sakurai, Y., Takemoto, T. and Bhacca, N. S. (1968). Structure of zederone. **Chemical and Pharmaceutical Bulletin**, 16(6), 1081-1087.

[88] Hikino, H., Konno, C. and Takemto, T. (1972). Structure of dehydrocurdione, a sesquiterpenoid of *Curcuma zedoaria*. **Chemical and Pharmaceutical Bulletin**, 20(5), 987-989.

[89] Hirata, N., Tokunaga, M., Naruto, S., Iinuma, M. and Matsuda, H. (2007). Testosterone 5α-Reductase Inhibitory Active Constituents of Piper nigrum Leaf. **Biological and Pharmaceutical Bulletin**, 30(12), 2402-2405.

[90] Zhong, Z., Chen, X., Tan, W., Xu, Z., Zhou, K., Wu, T., et al. (2011). Germacrone inhibits the proliferation of breast cancer cell lines by inducing cell cycle arrest and promoting apoptosis. **European Journal of Pharmacology**, 667(1-3), 50-55.

[91] Horoszewicz, J. S., Leong, S. S., Kawinski, E., Karr, J. P., Rosenthal, H., Chu, T. M., et al. (1983). LNCaP model of human prostatic carcinoma. **Cancer Research**, 43, 1809-1818.

[92] Liu, J., Tamura, S., Kurashiki, K., Shimizu, K., Noda, K., Konishi, F., et al. (2009). Anti-androgen effects of extracts and compounds from *Ganoderma lucidum*. **Chemistry and Biodiversity**, 6(2), 231-243.

[93] Bull, H. G., Garcia-Calvo, M., Andersson, S., Baginsky, W. F., Chan, H. K., Ellsworth, D. E., et al. (1996). Mechanism-based inhibition of human steroid 5α-reductase by finasteride: enzyme-catalyzed formation of NADP−dihydrofinasteride, a potent bisubstrate analog inhibitor. **Journal of the American Chemical Society**, 118(10), 2359-2365.

[94] Drake, L., Hordinsky, M., Fiedler, V. and Swinehart, J. (1999). The effects of finasteride on scalp skin and serum androgen levels in men with androgenetic alopecia. **Journal of the American Academy of Dermatology**, 41, 550-554.

[95] Yang, F. Q., Li, S. P., Zhao, J., Lao, S. C. and Wang, Y. T. (2007). Optimization of GC–MS conditions based on resolution and stability of analytes for simultaneous determination of nine sesquiterpenoids in three species of *Curcuma* rhizomes. **Journal of Pharmaceutical and Biomedical Analysis**, 43(1), 73-82.

[96] Zhou, X., Li, Z., Liang, G., Zhu, J., Wang, D. and Cai, Z. (2007). Analysis of volatile components of *Curcuma sichuanensis* X. X. Chen by gas chromatography-mass spectrometry. **Journal of Pharmaceutical and Biomedical Analysis**, 43(2), 440-444.

[97] Reichardt, P. B., Anderson, B. J., Clausen, T. P. and Hoskins, L. C. (1989). Thermal instability of germacrone: implications for gas chromatographic analysis of thermally unstable analytes. **Canadian Journal of Chemistry**, 67(7), 1174-1177.

[98] Annunziata, O., Asherie, N., Lomakin, A., Pande, J., Ogun, O. and Benedek, G. B. (October 21, 2002). **Effect of polyethylene glycol on the liquid–liquid phase transition in aqueous protein solutions**. Retrieved December 17, 2011, from http://www.pnas.org/content/99/22/14165.long

[99] Dhara, D. and Shah, D. O. (2001). Stability of sodium dodecyl sulfate micelles in the presence of a range of water-soluble polymers: A pressure-jump study. **Journal of Physical Chemistry B**, 105, 7133-7138.

[100] Rangel-Yagui, C. O., Pessoa-Jr, A. and Tavares, L. C. (2005). Micellar solubilization of drugs. **Journal of Pharmacy and Pharmaceutical Sciences**, 8(2), 147-163.

# APPENDIX

## APPENDIX A SPECTRAL DATA OF GERMACRONE (1)

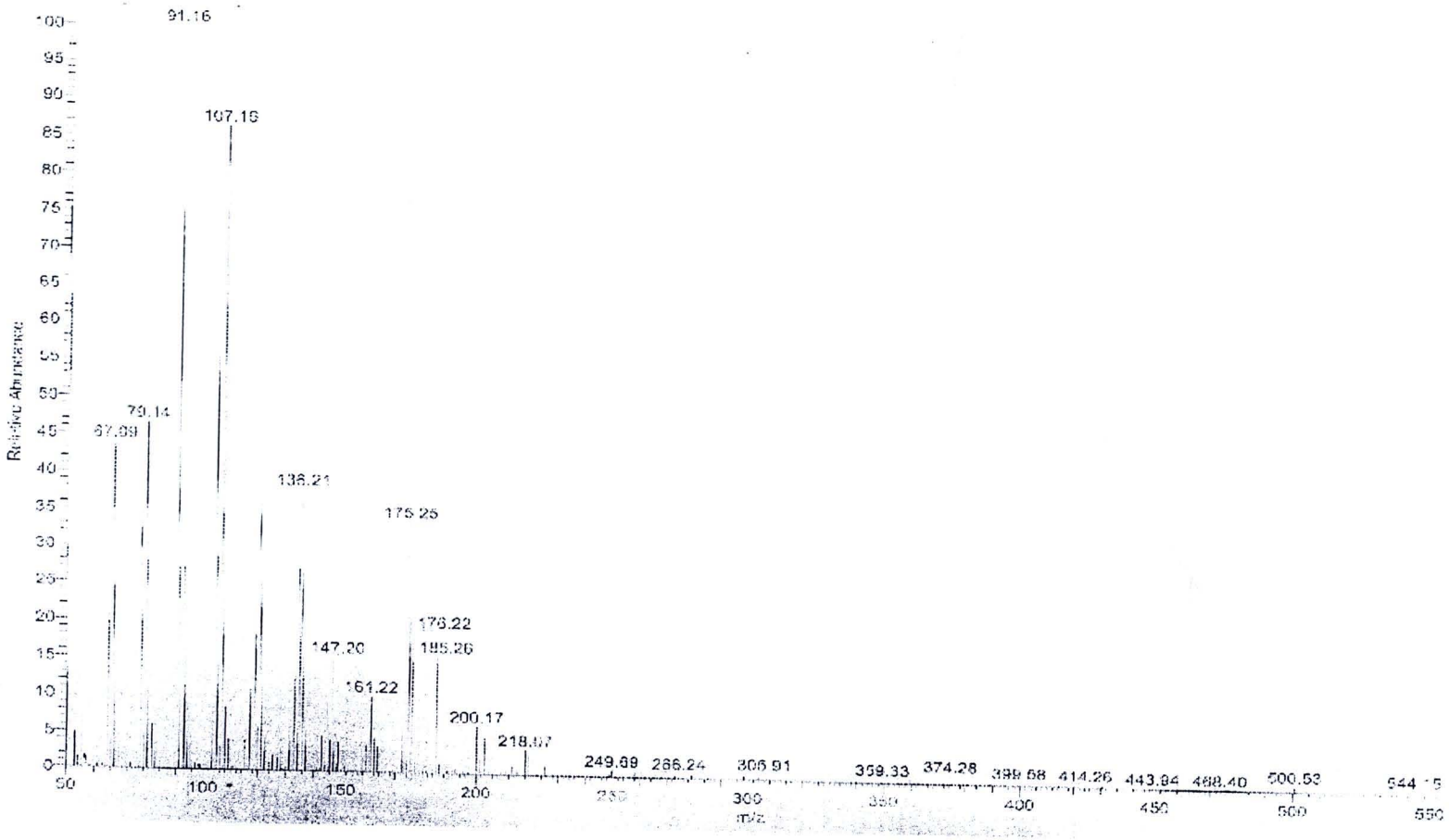


**Figure 68 EI-MS spectrum of germacrone (1)**

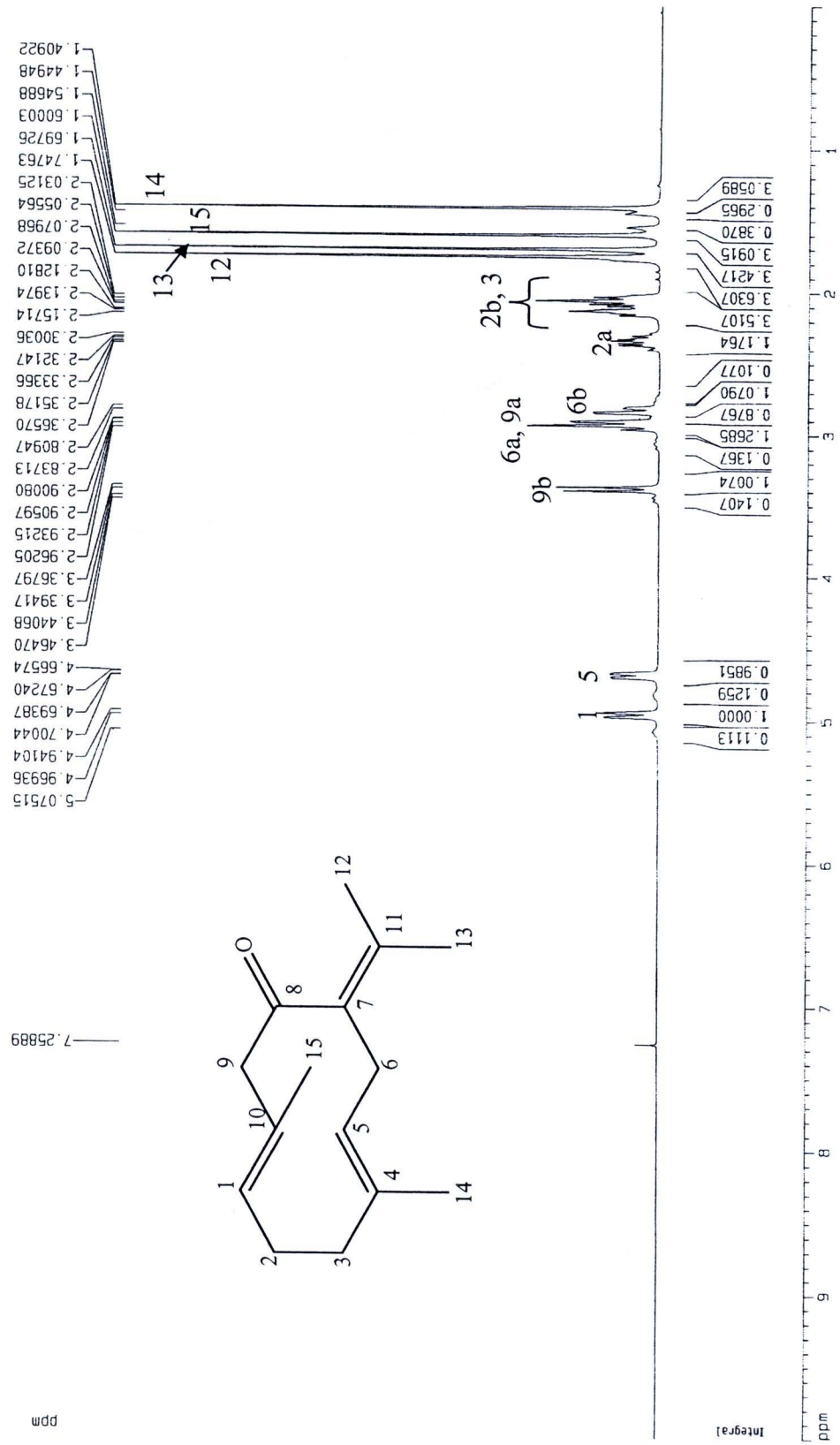


**Figure 69 $^{1}$H-NMR spectrum of germacrone (1) (400 MHz, $CDCl_3$)**

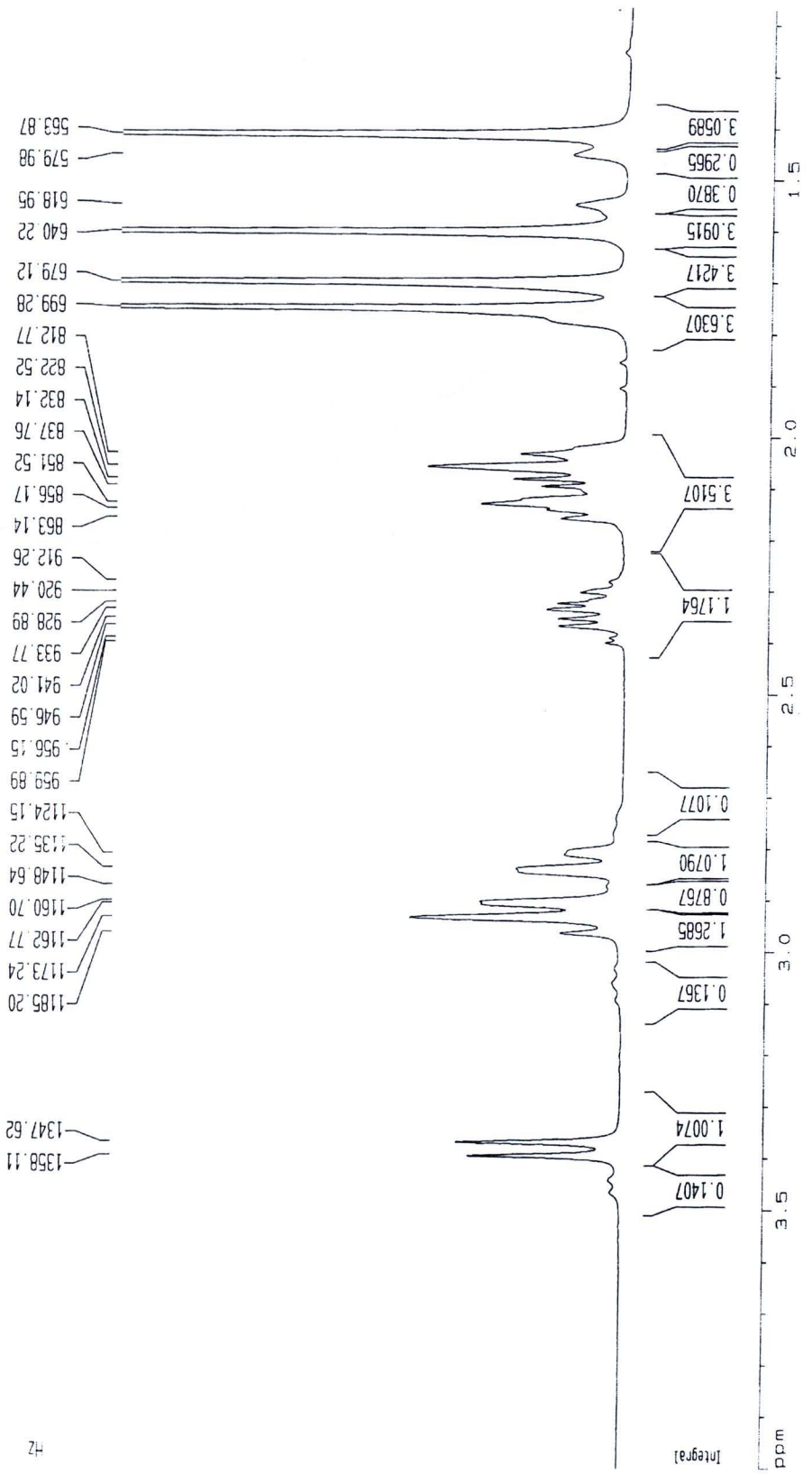


**Figure 70 Enlarged $^{1}$H-NMR spectrum of germacrone (1) (1.4-3.5 ppm, 400 MHz, $CDCl_3$)**

## APPENDIX B SPECTRAL DATA OF ZEDERONE (2)

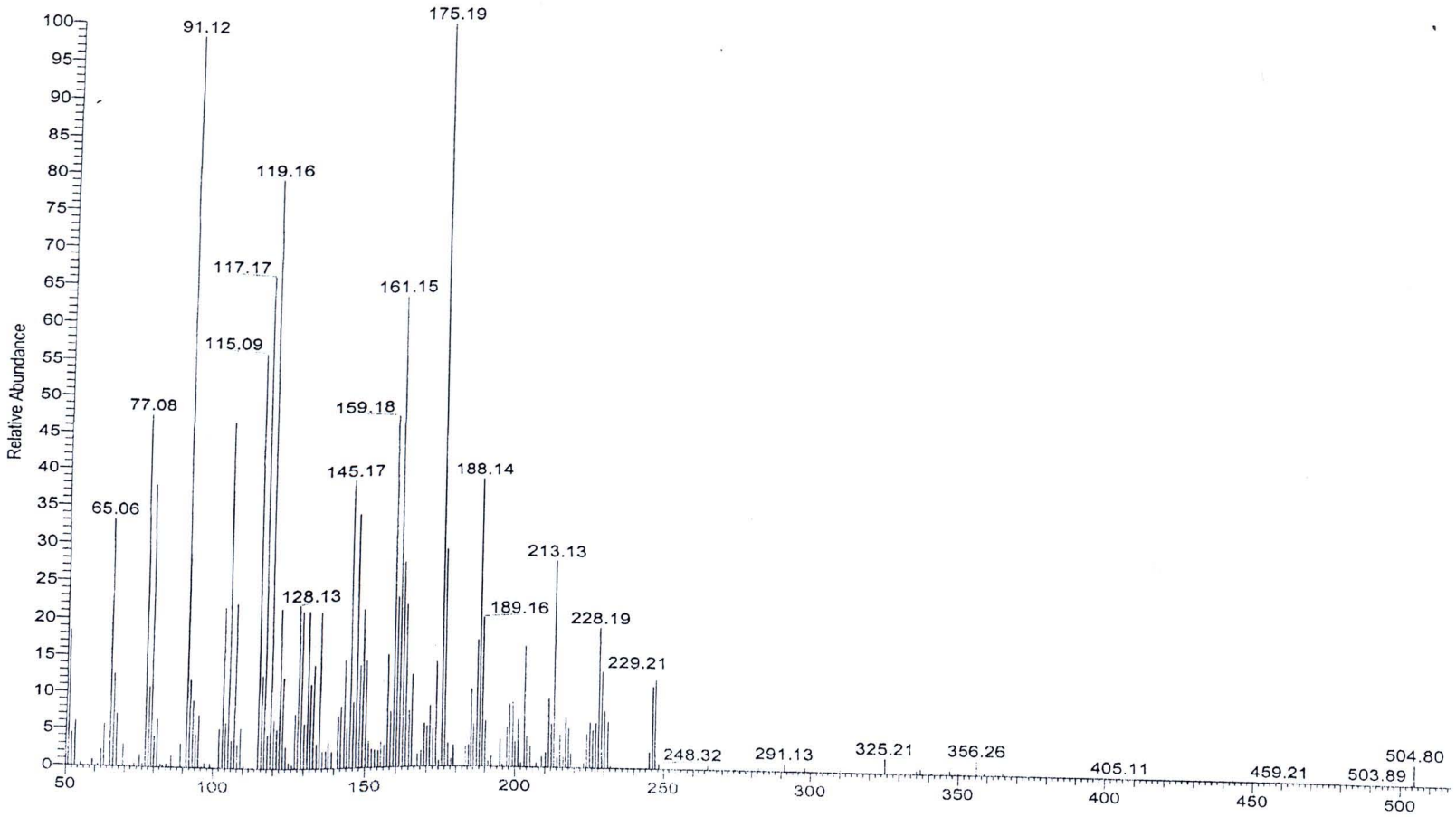


**Figure 71 EI-MS spectrum of zederone (2)**

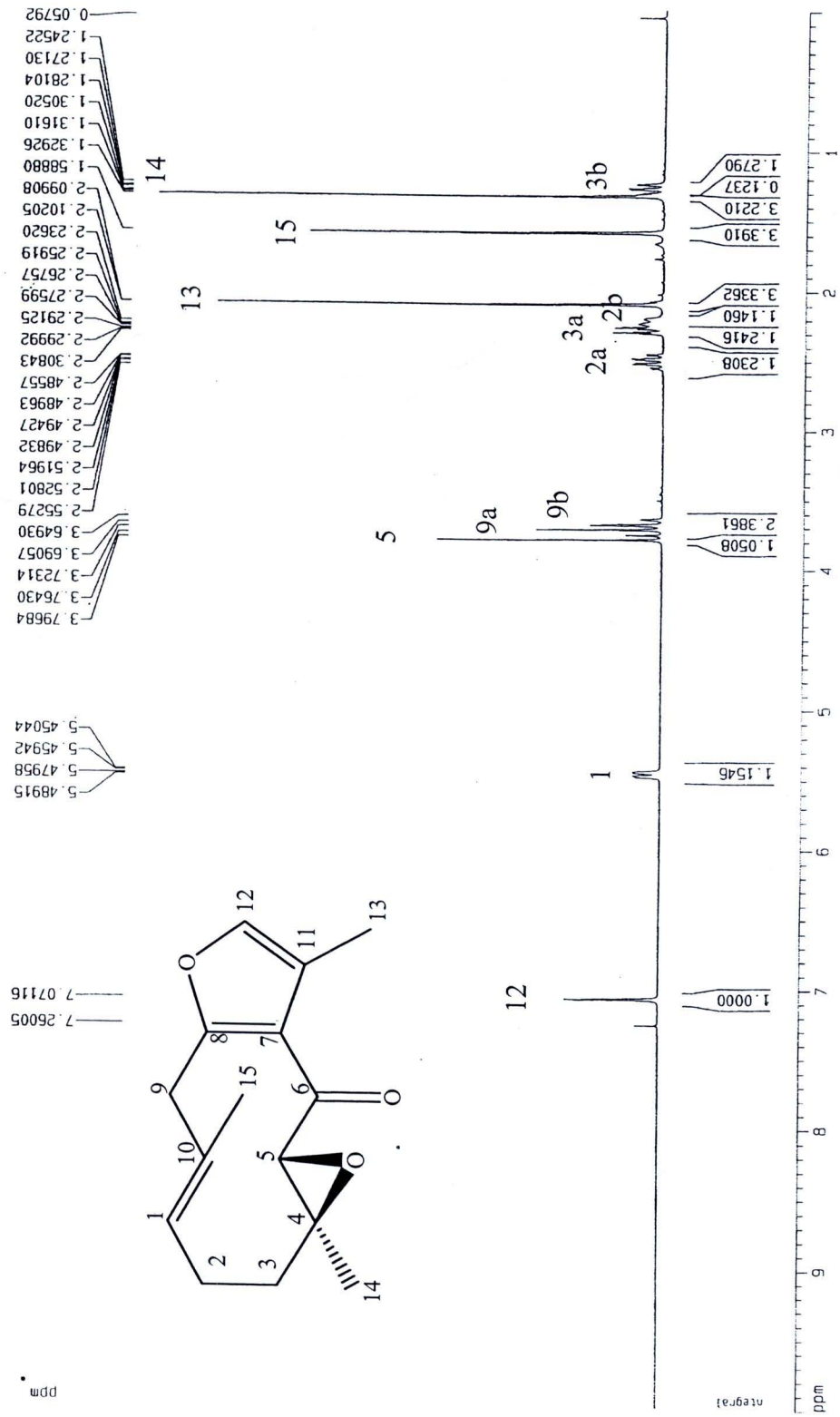


**Figure 72 $^{1}$H-NMR spectrum of zederone (2) (400 MHz, $CDCl_3$)**

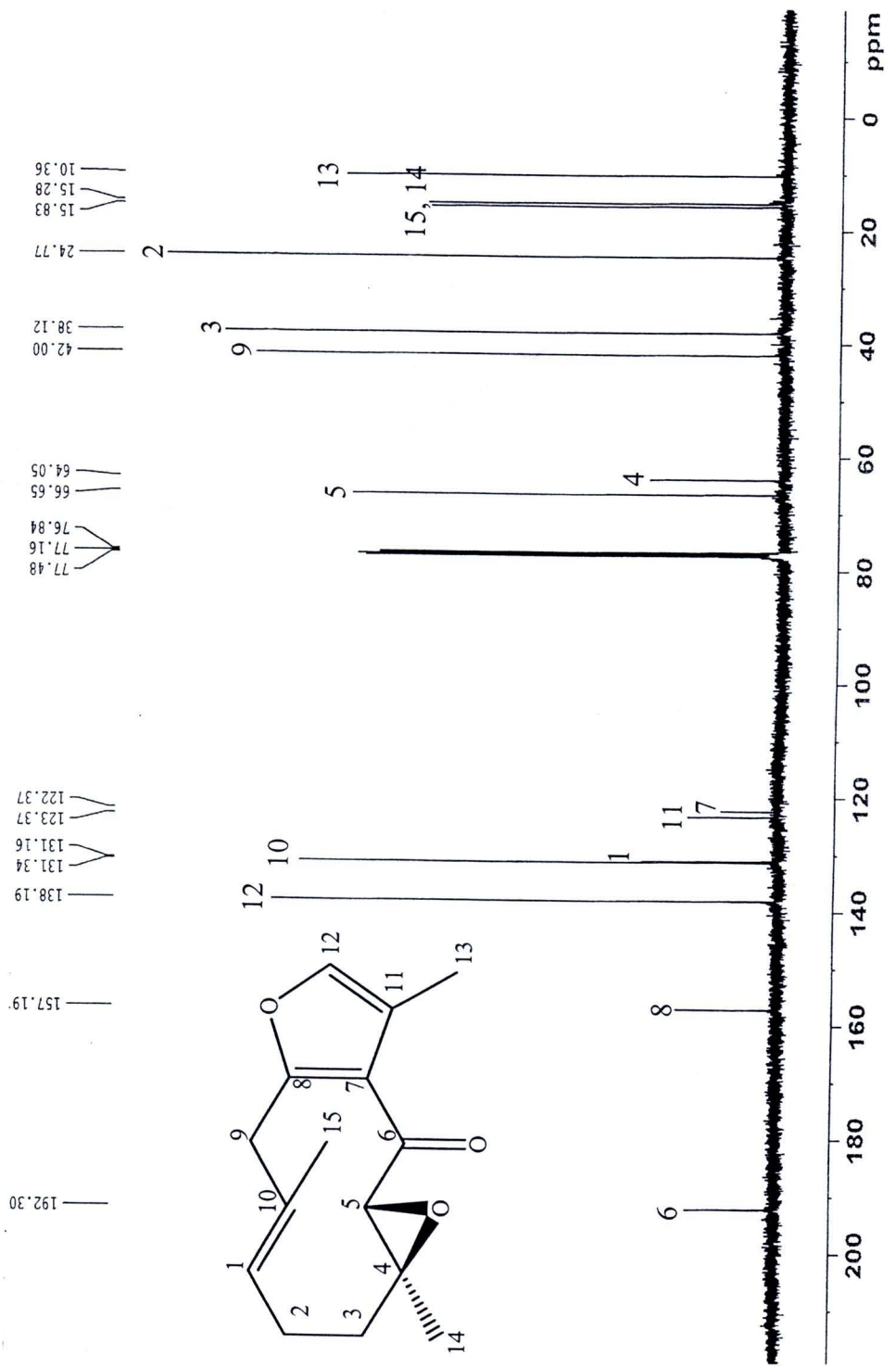


**Figure 73 $^{13}$C-NMR spectrum of zederone (2) (100 MHz, $CDCl_3$)**

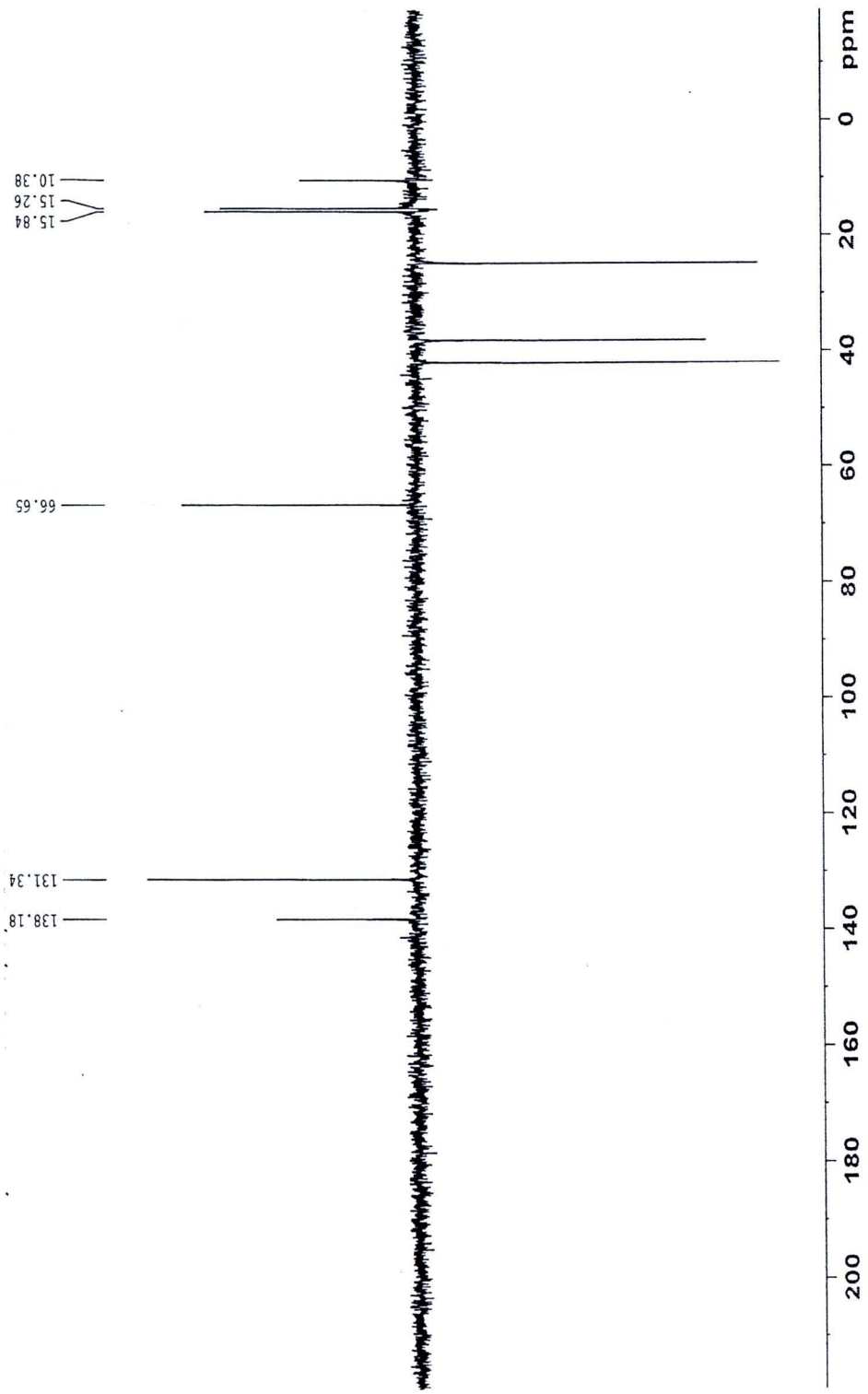


**Figure 74 DEPT 135 spectrum of zederone (2) (100 MHz, $CDCl_3$)**

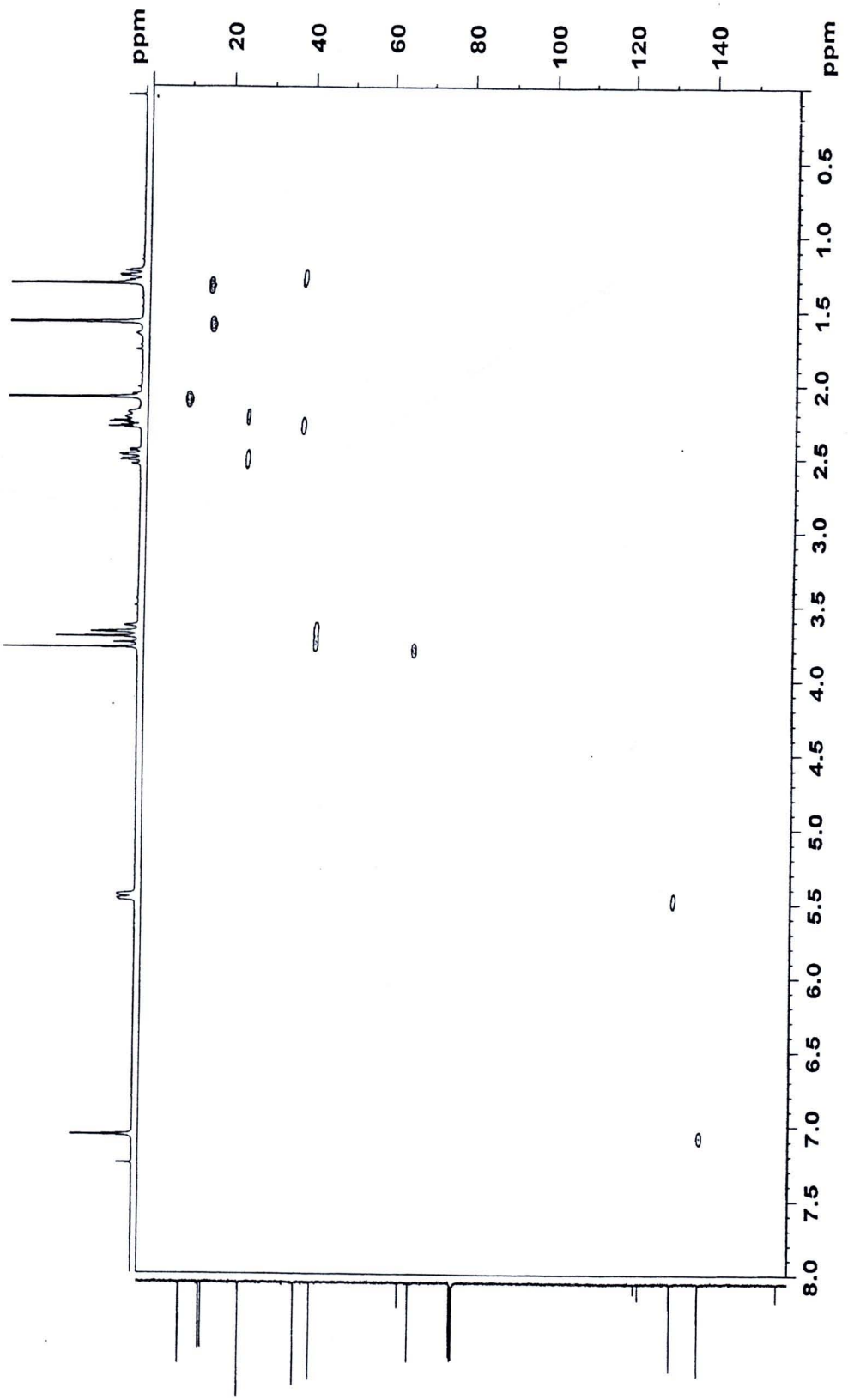


Figure 75 HMQC spectrum of zederone (2) (400 MHz, $CDCl_3$)

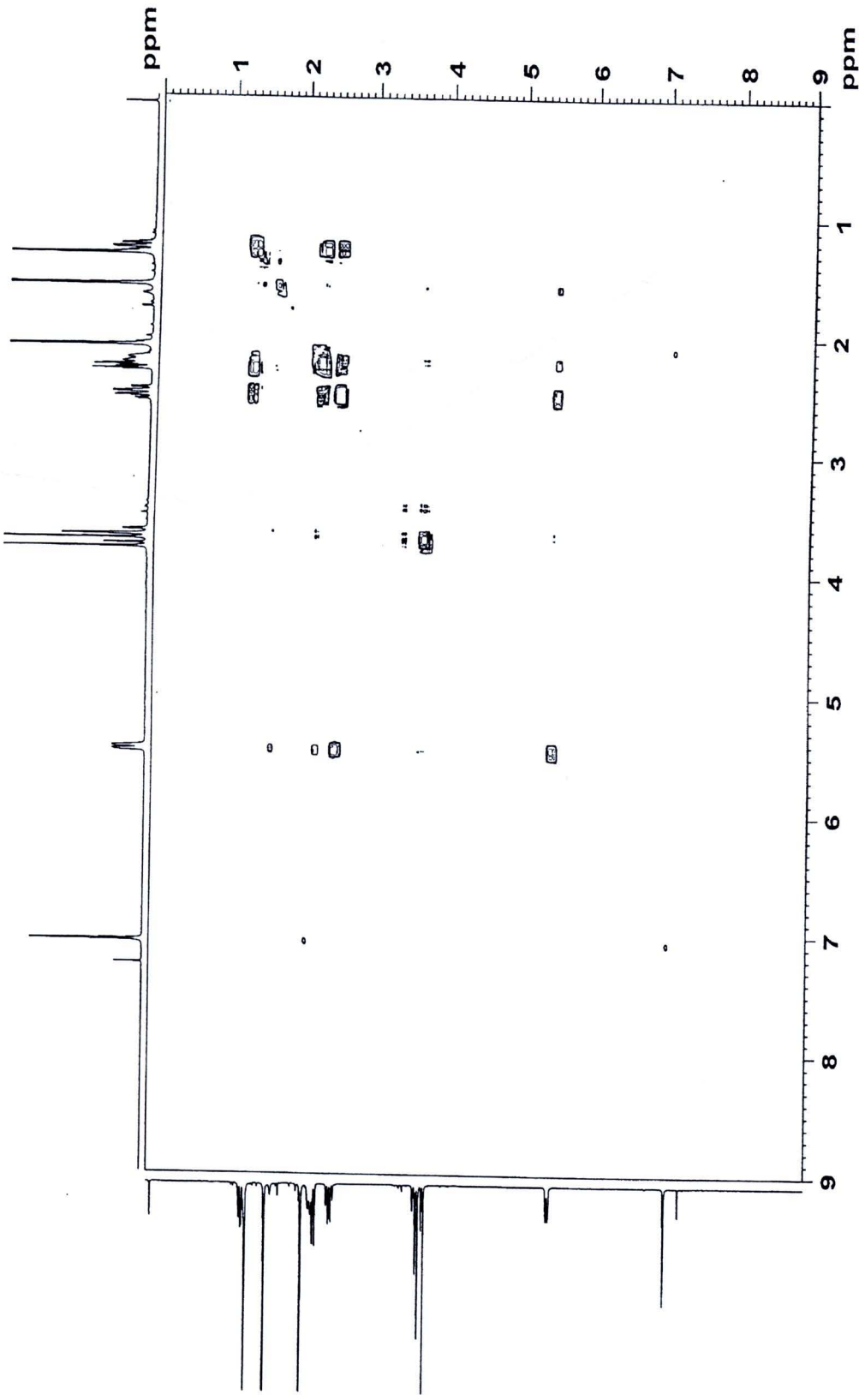


**Figure 76 COSY spectrum of zederone (2) (400 MHz, $CDCl_3$)**

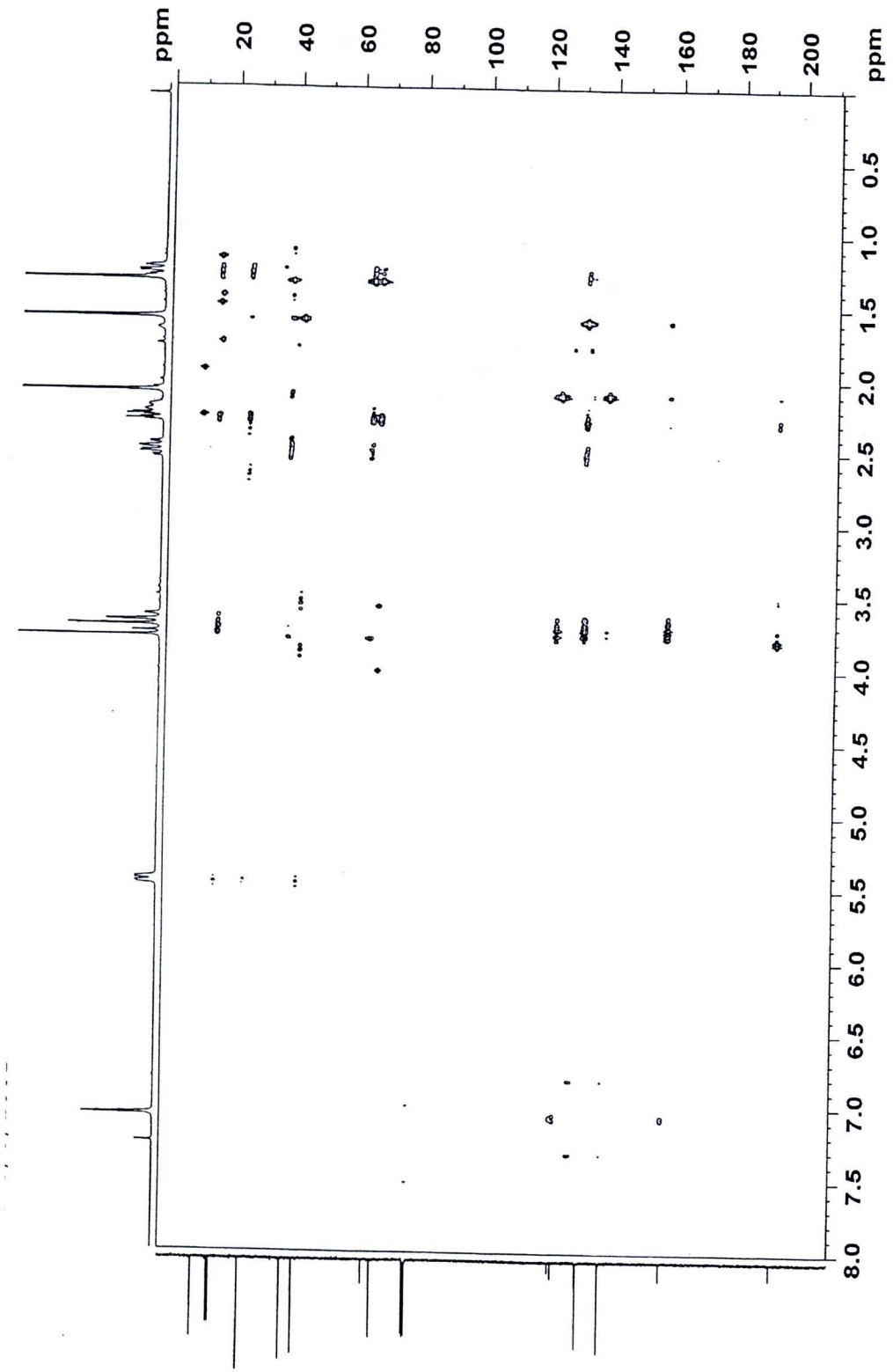


**Figure 77 HMBC spectrum of zederone (2) (400 MHz, $CDCl_3$)**

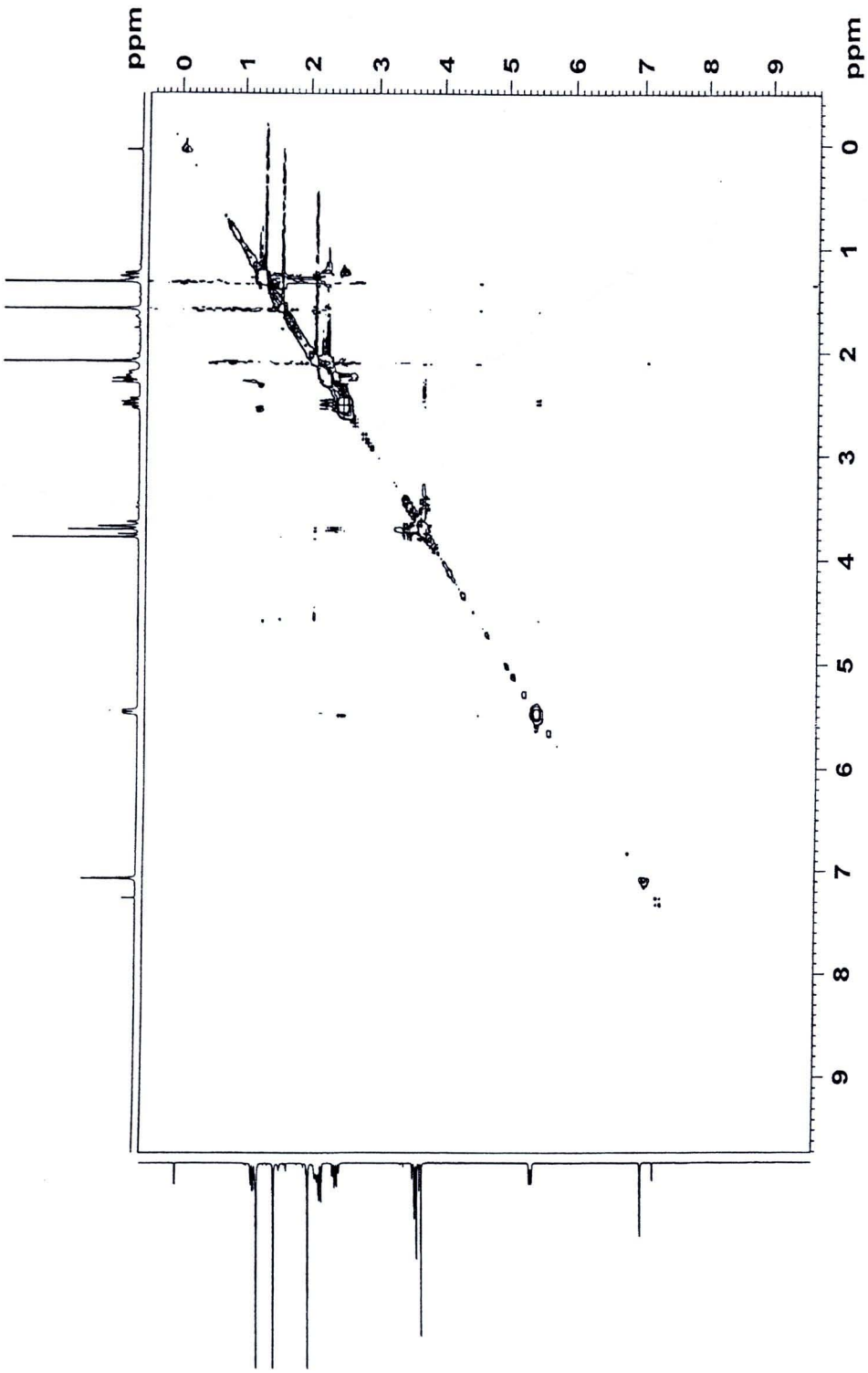


**Figure 78 NOESY spectrum of zederone (2) (400 MHz, $CDCl_3$)**

## APPENDIX C SPECTRAL DATA OF DEHYDROCURDIONE (3)

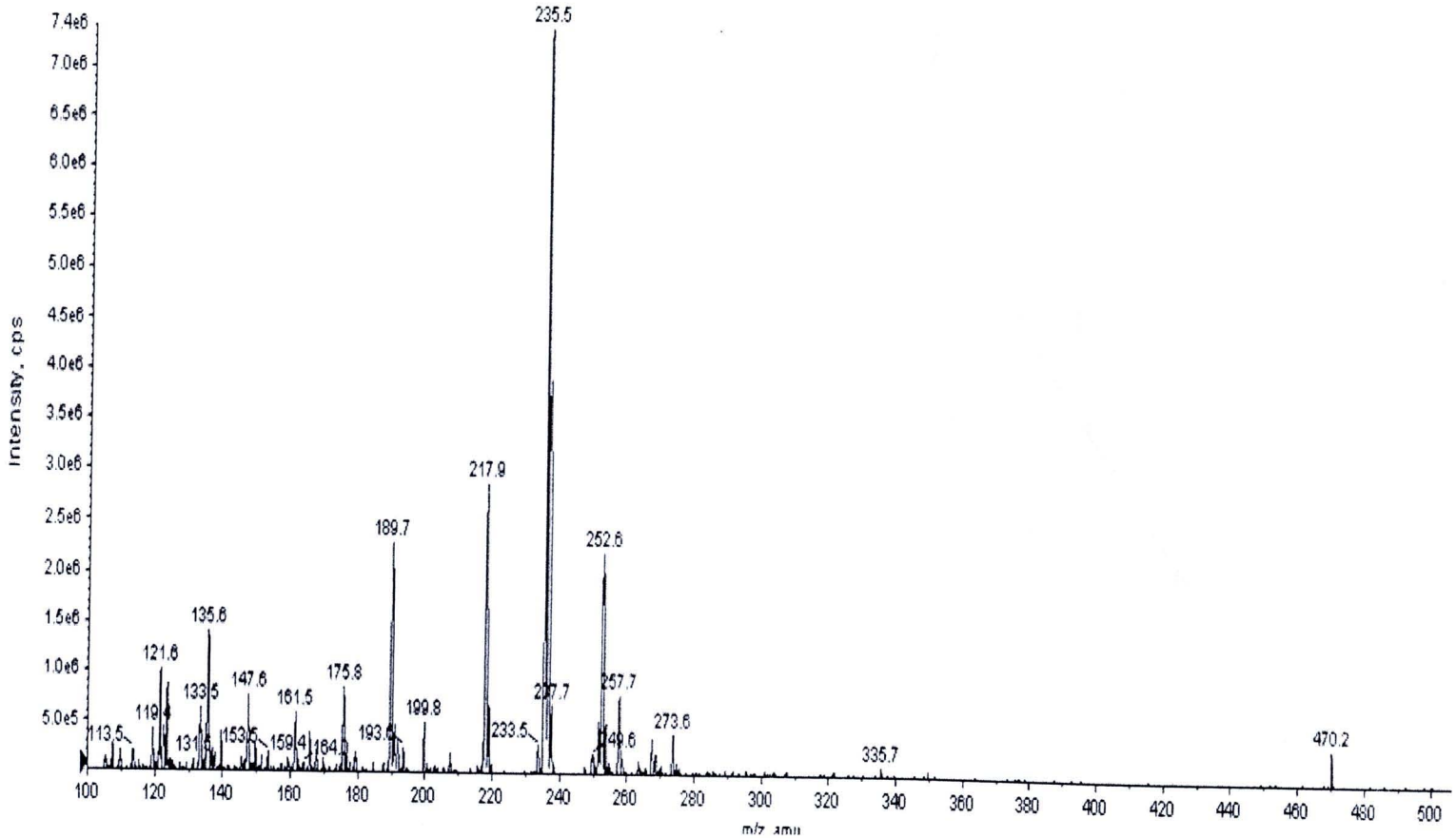


**Figure 79 The positive ESI-MS spectrum of dehydrocurdione (3)**

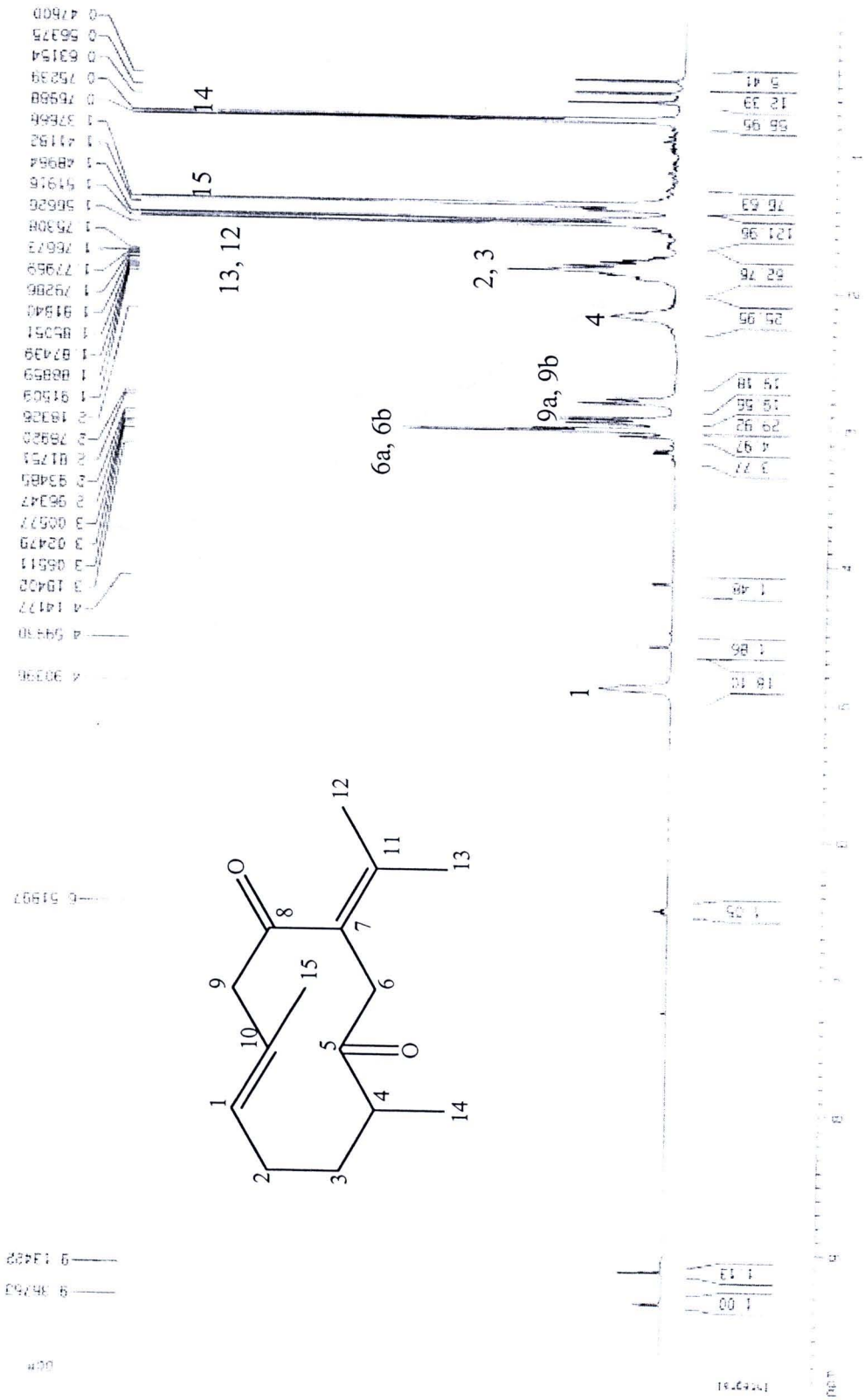


**Figure 80 $^{1}$H-NMR spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)**

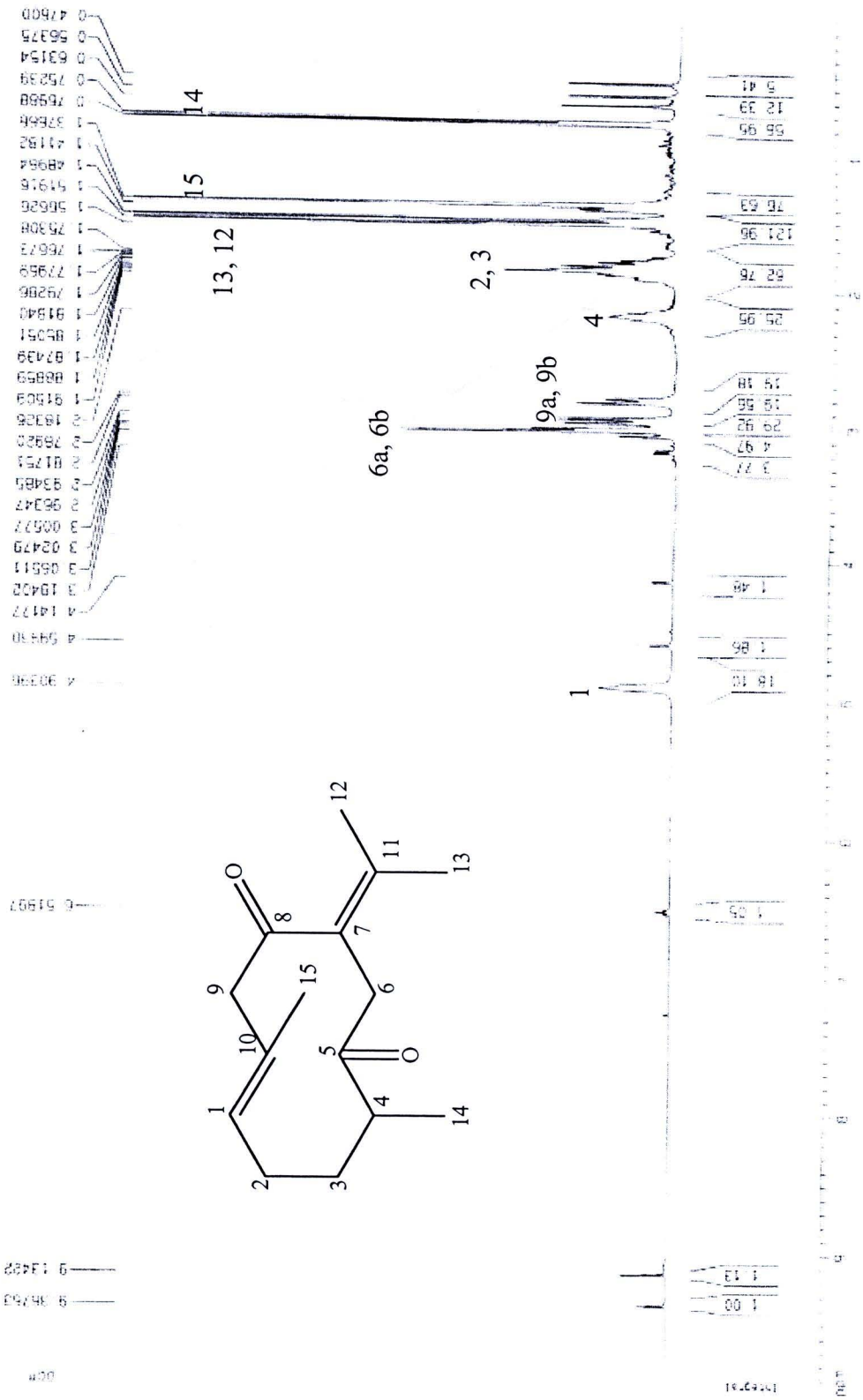


**Figure 80 $^{1}$H-NMR spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)**

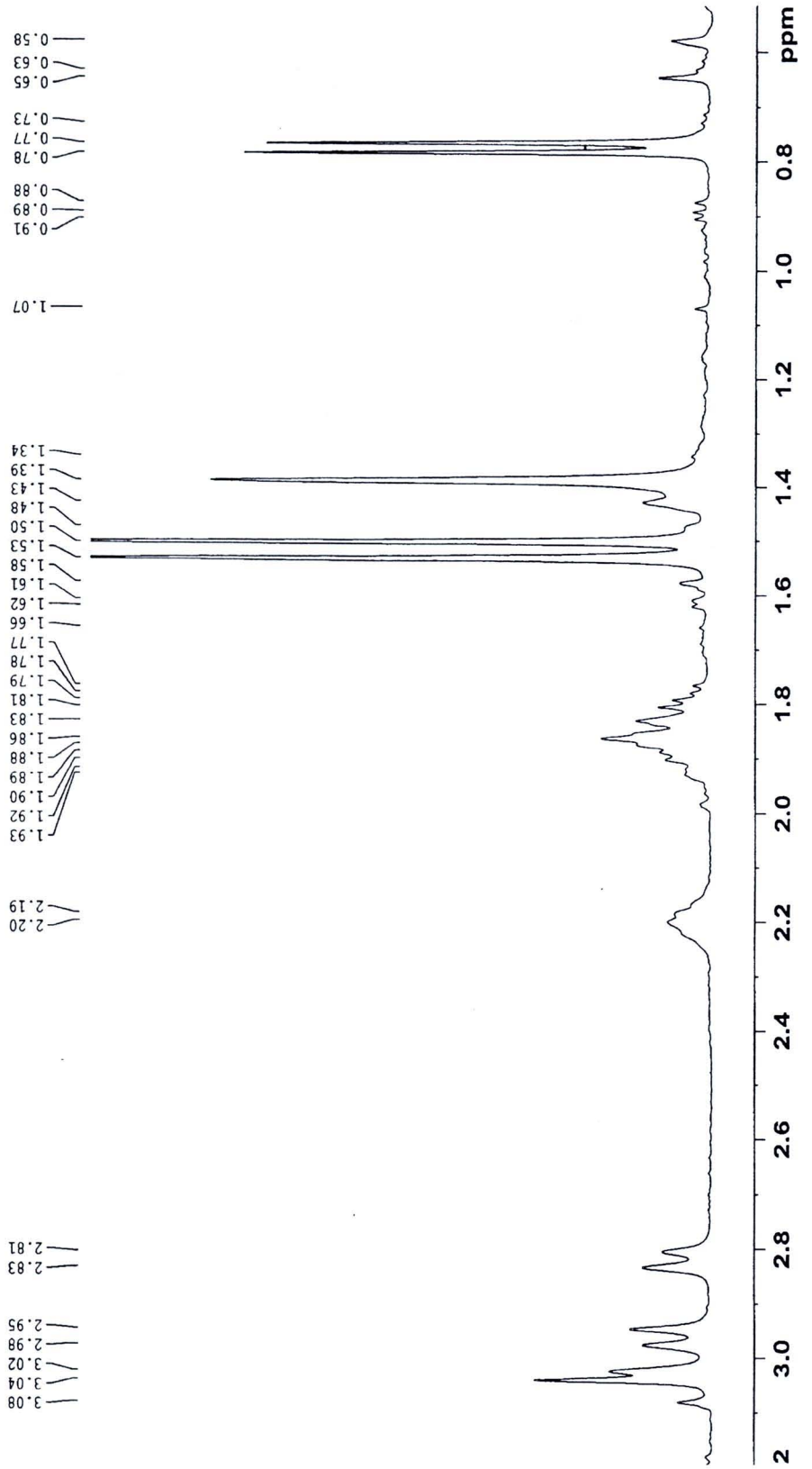


**Figure 81 Enlarged $^{1}$H-NMR spectrum of dehydrocurdione (3) (0.6 – 3.1 ppm, 400 MHz, $CDCl_3$)**

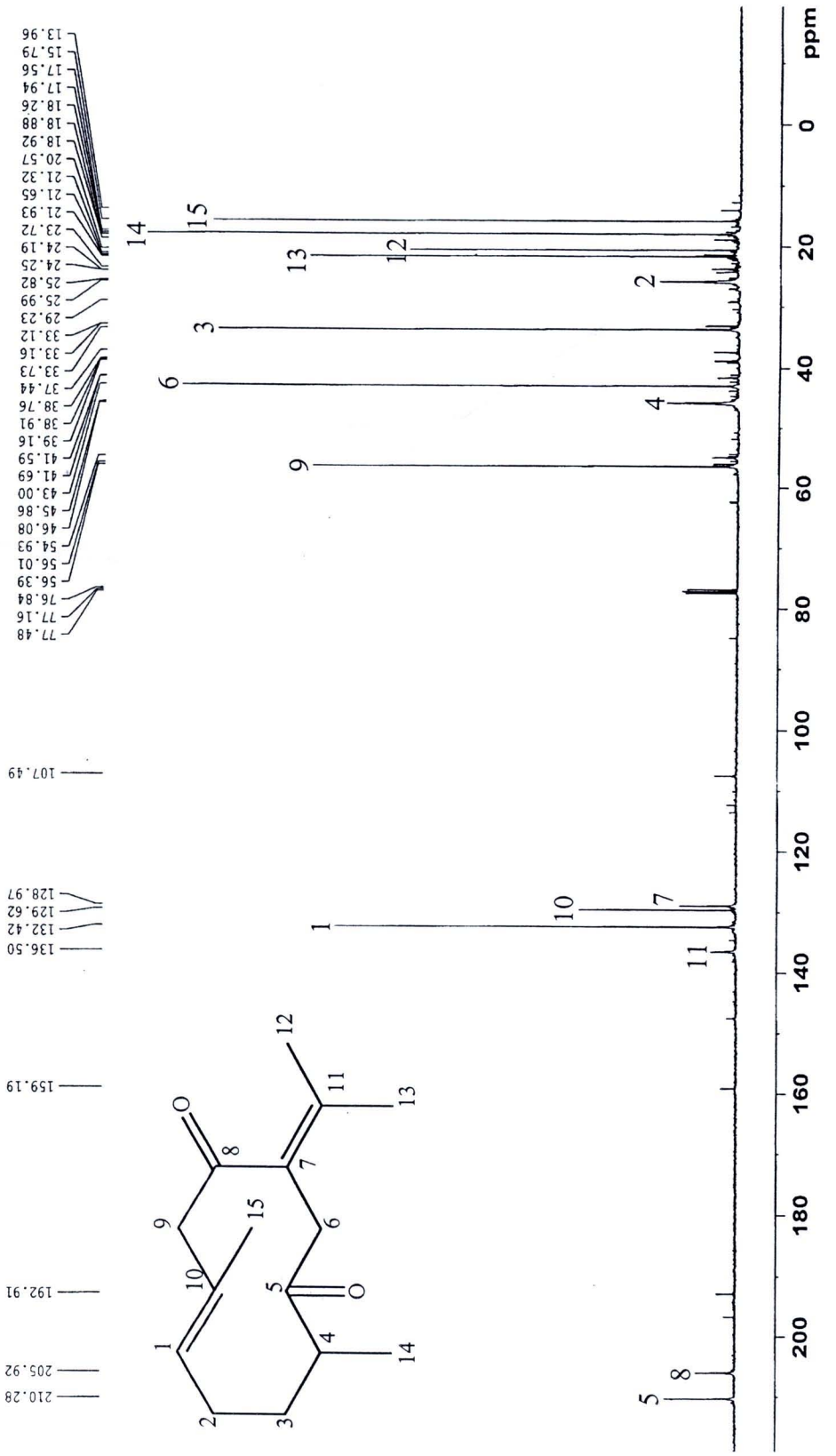


**Figure 82 $^{13}$C-NMR spectrum of dehydrocurdione (3) (100 MHz, $CDCl_3$)**

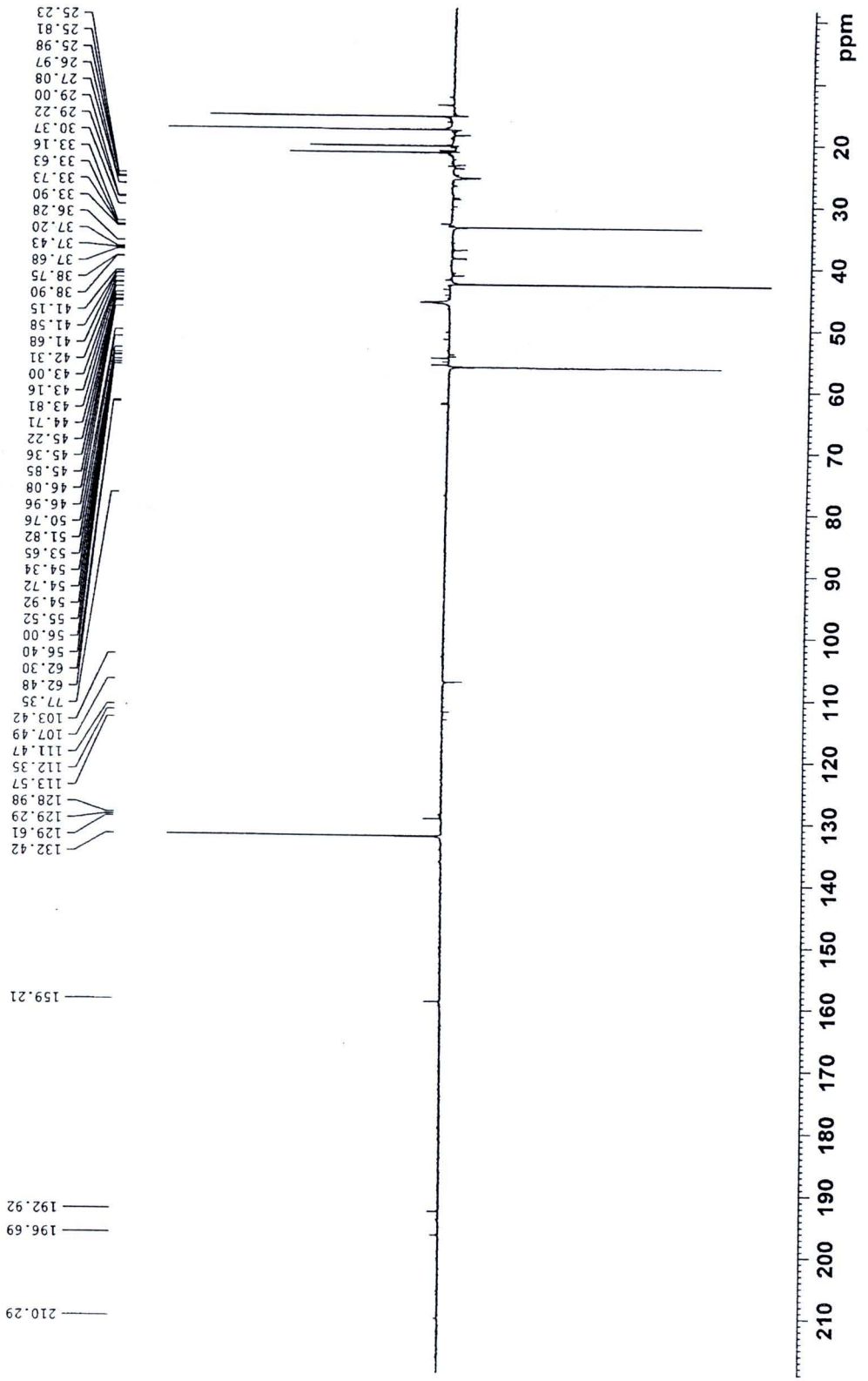


**Figure 83 DEPT 135 spectrum of dehydrocurdione (3) (100 MHz, $CDCl_3$)**

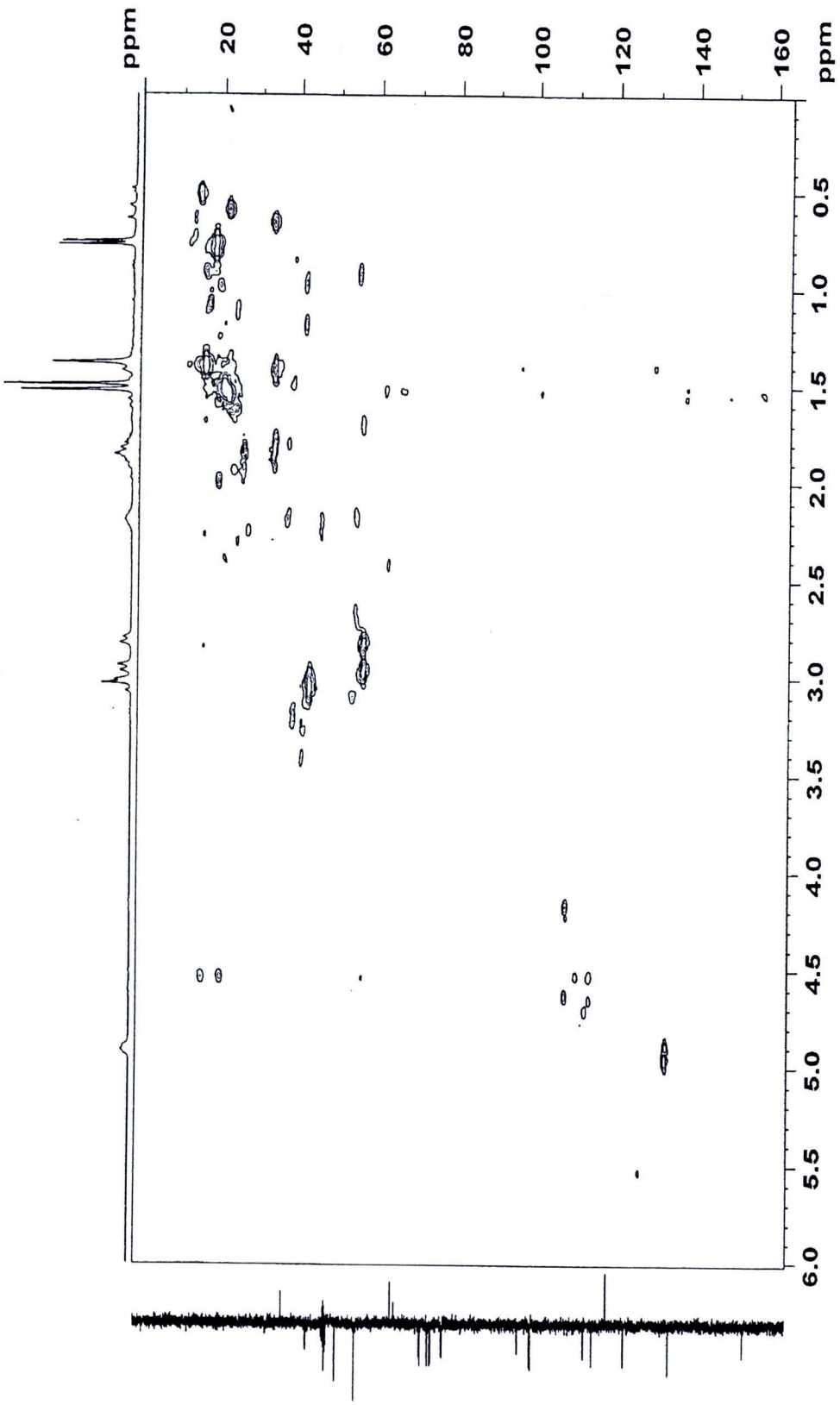


Figure 84 HMQC spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)

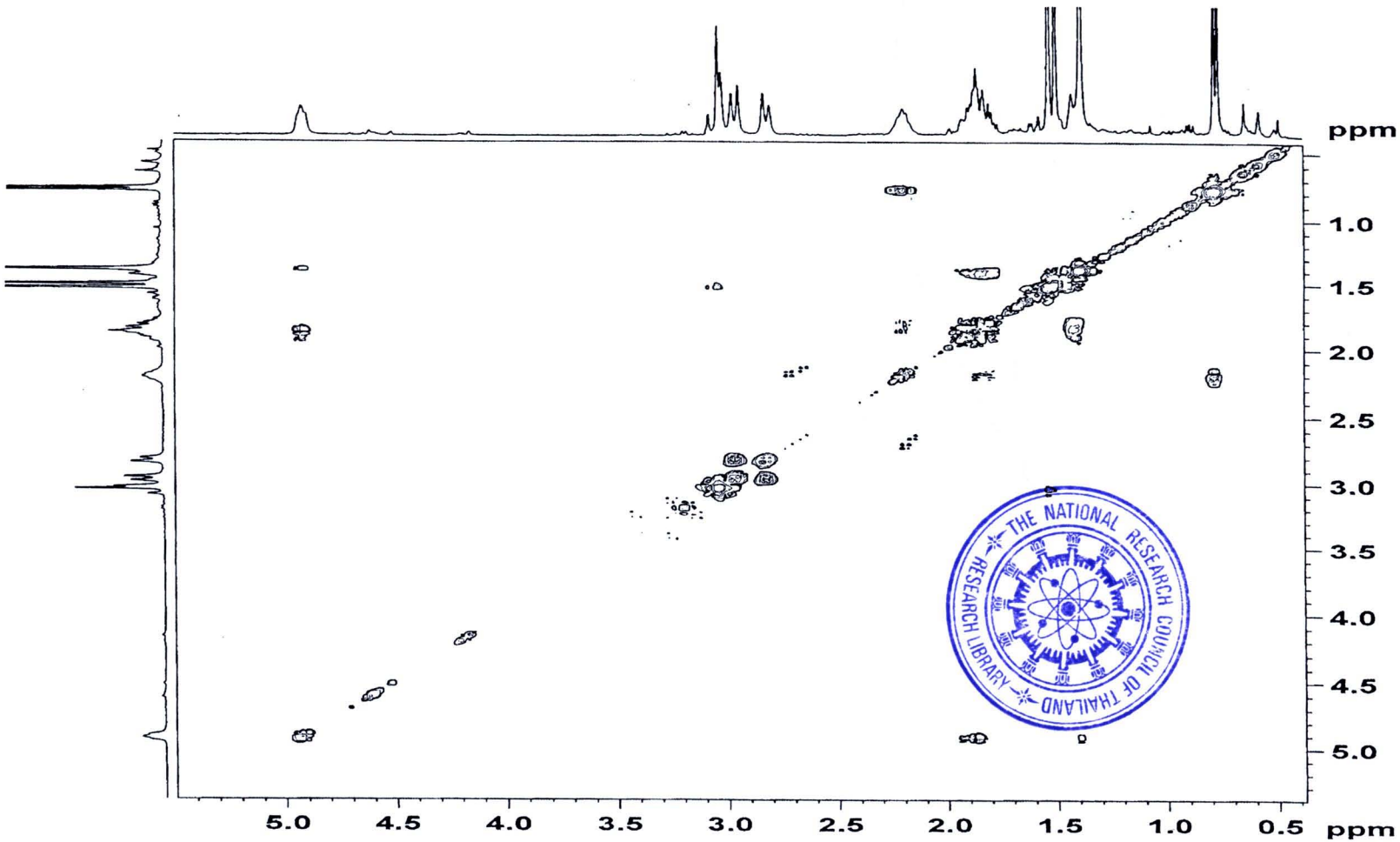


**Figure 85 COSY spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)**

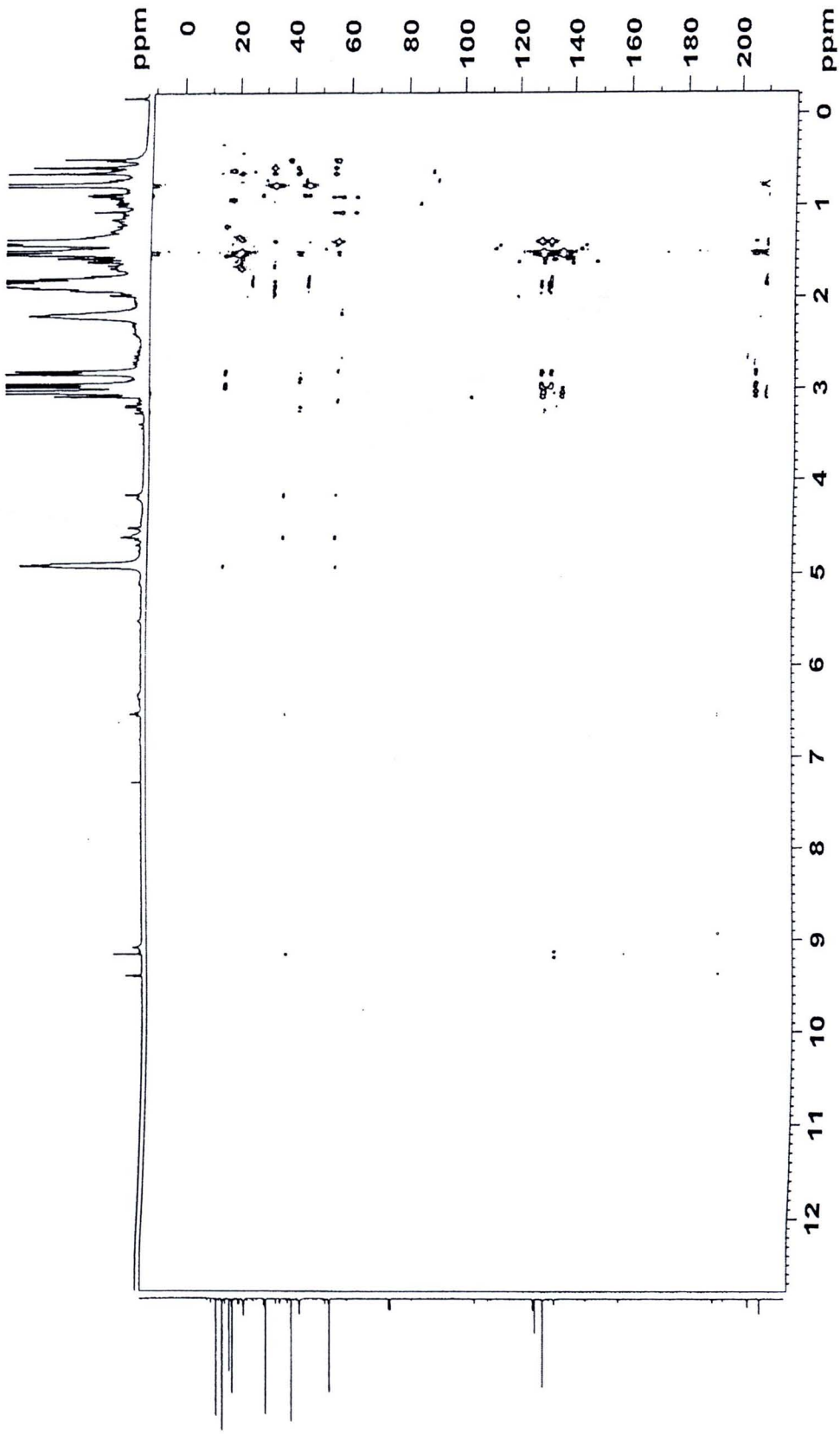


**Figure 86 HMBC spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)**

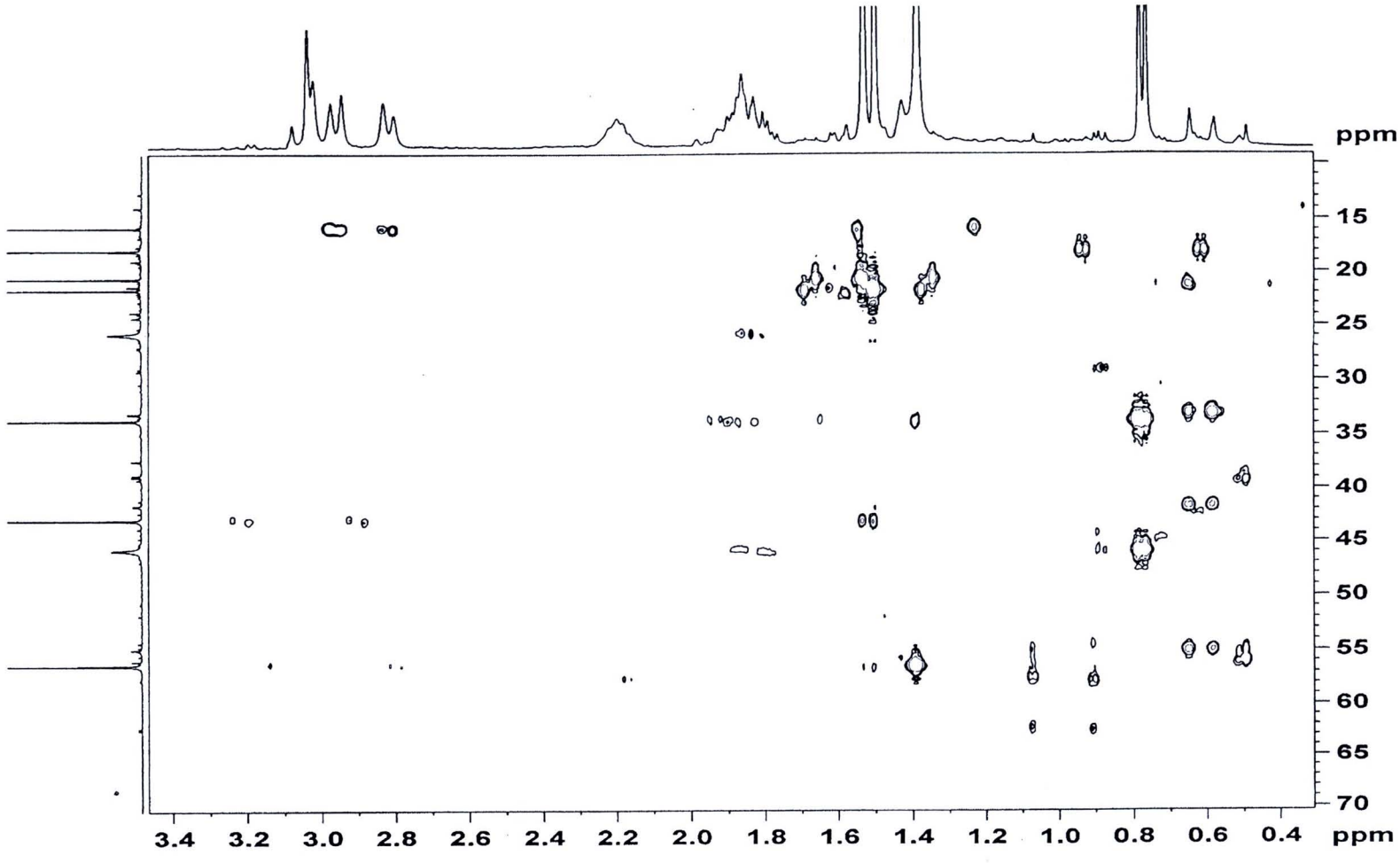


**Figure 87 Enlarged HMBC spectrum of dehydrocurdione (3) ($^{1}$H-NMR: 0.4-3.4 ppm, $^{13}$C-NMR: 10.0-70.0 ppm, 400 MHz, $CDCl_3$)**

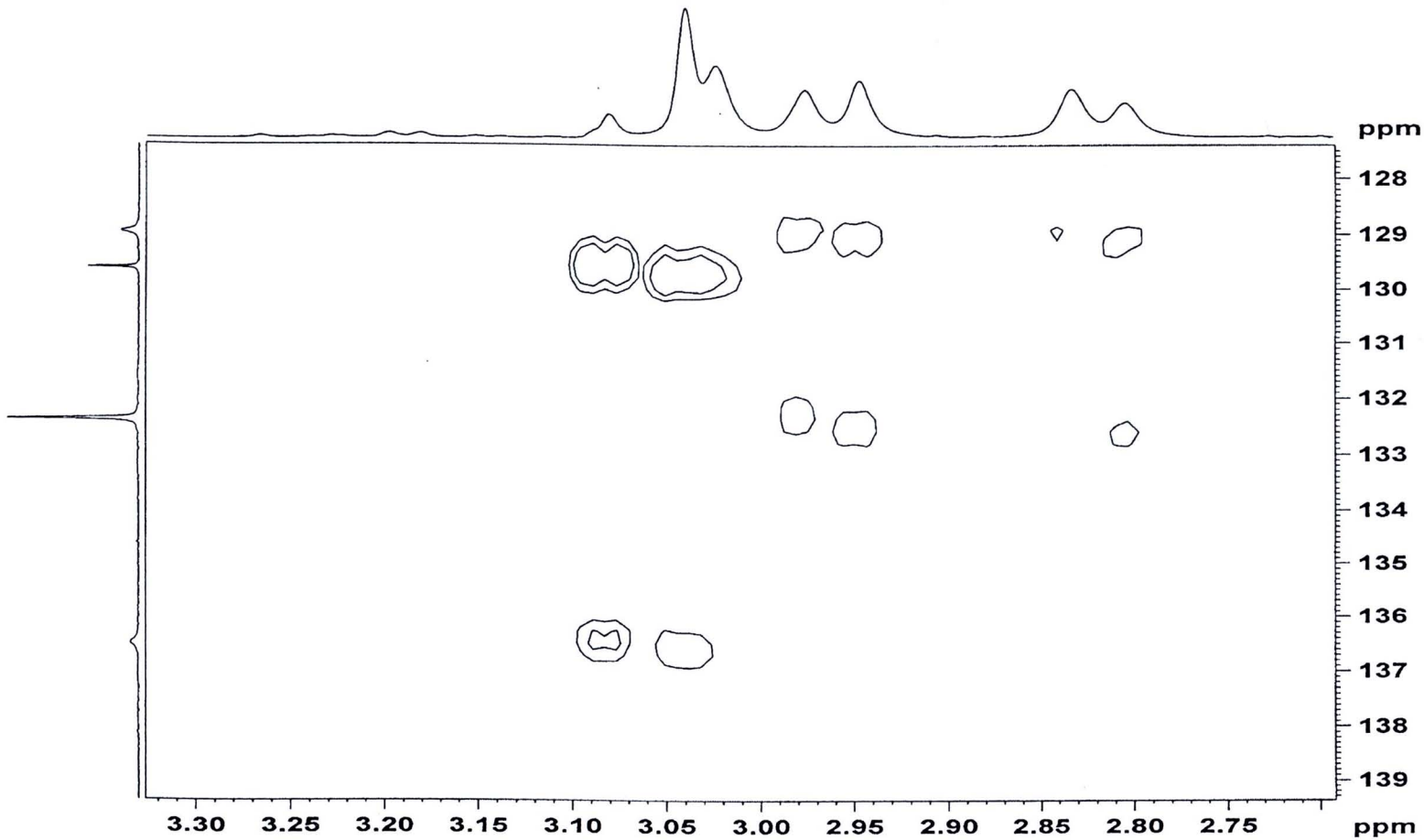


**Figure 88 Enlarged HMBC spectrum of dehydrocurdione (3) ($^{1}$H-NMR: 2.7-3.3 ppm, $^{13}$C-NMR: 128.0-139.0 ppm, 400 MHz, $CDCl_3$)**

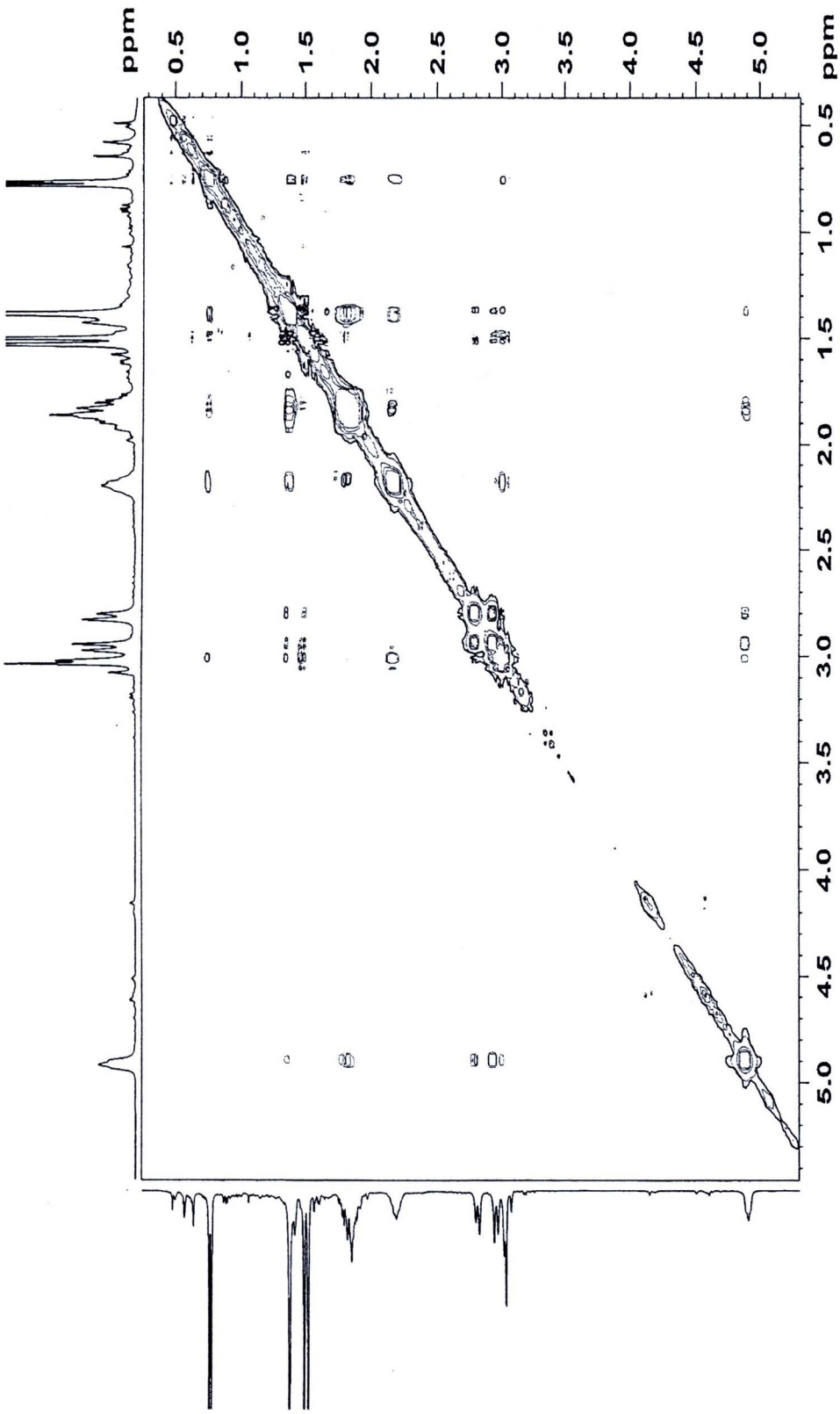


**Figure 89 NOESY spectrum of dehydrocurdione (3) (400 MHz, $CDCl_3$)**

## APPENDIX D SPECTRAL DATA OF CURCUMENOL (4)

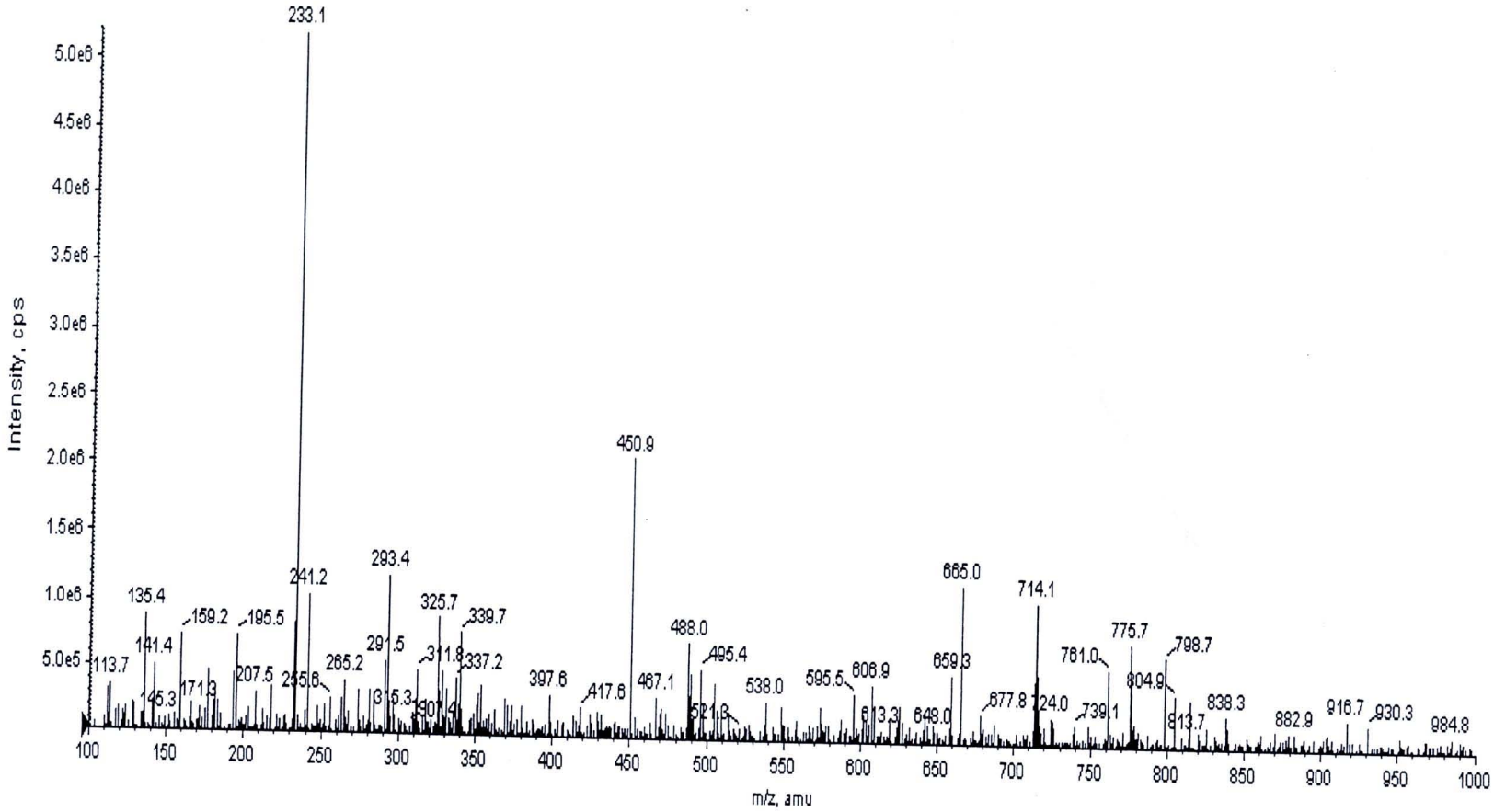


**Figure 90 The negative ESI-MS spectrum of curcumenol (4)**

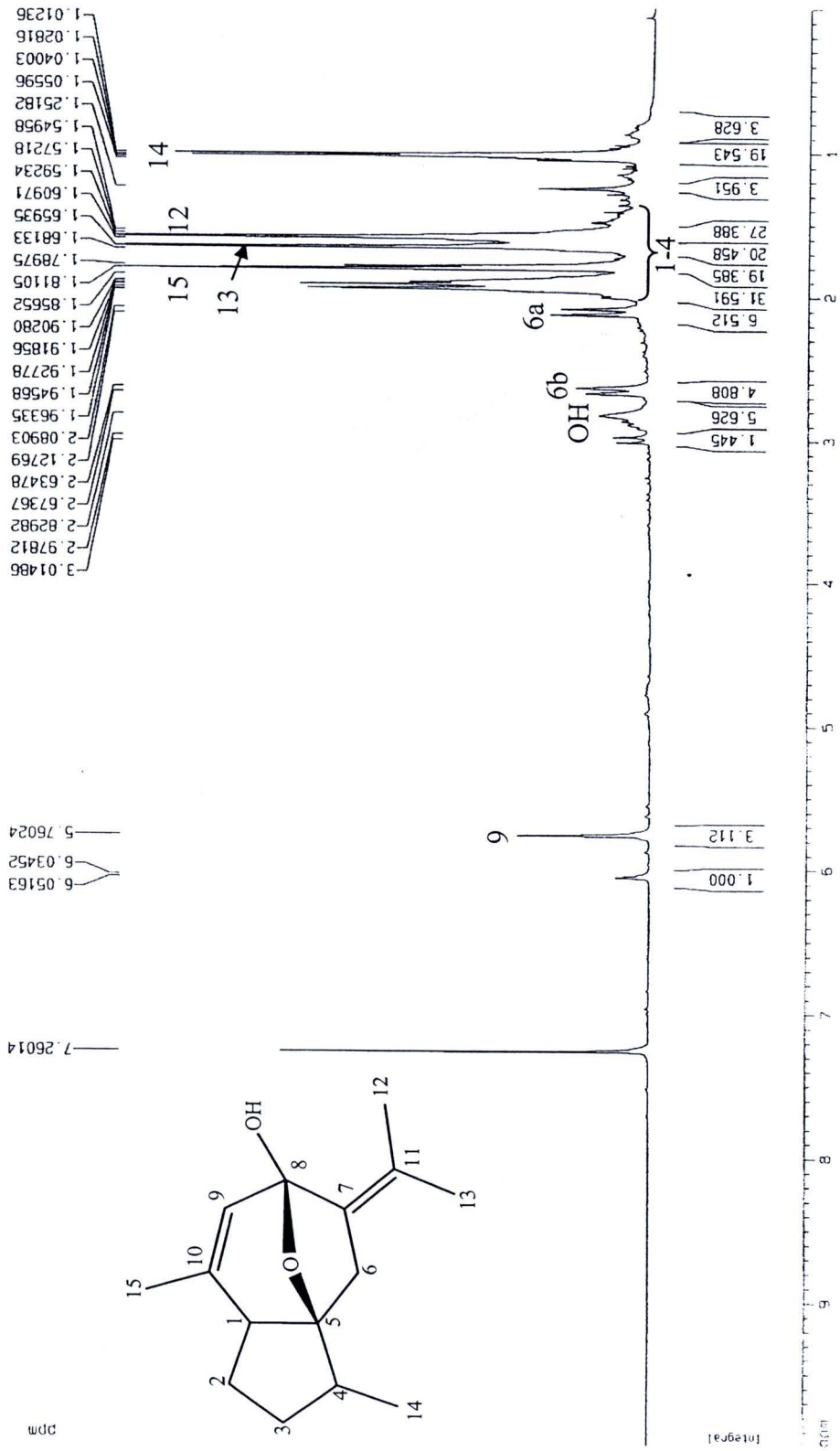


**Figure 91 $^1$H-NMR spectrum of curcumenol (4) (400 MHz, $CDCl_3$)**

## APPENDIX E SPECTRAL DATA OF ZEDOARONDIOL (5)

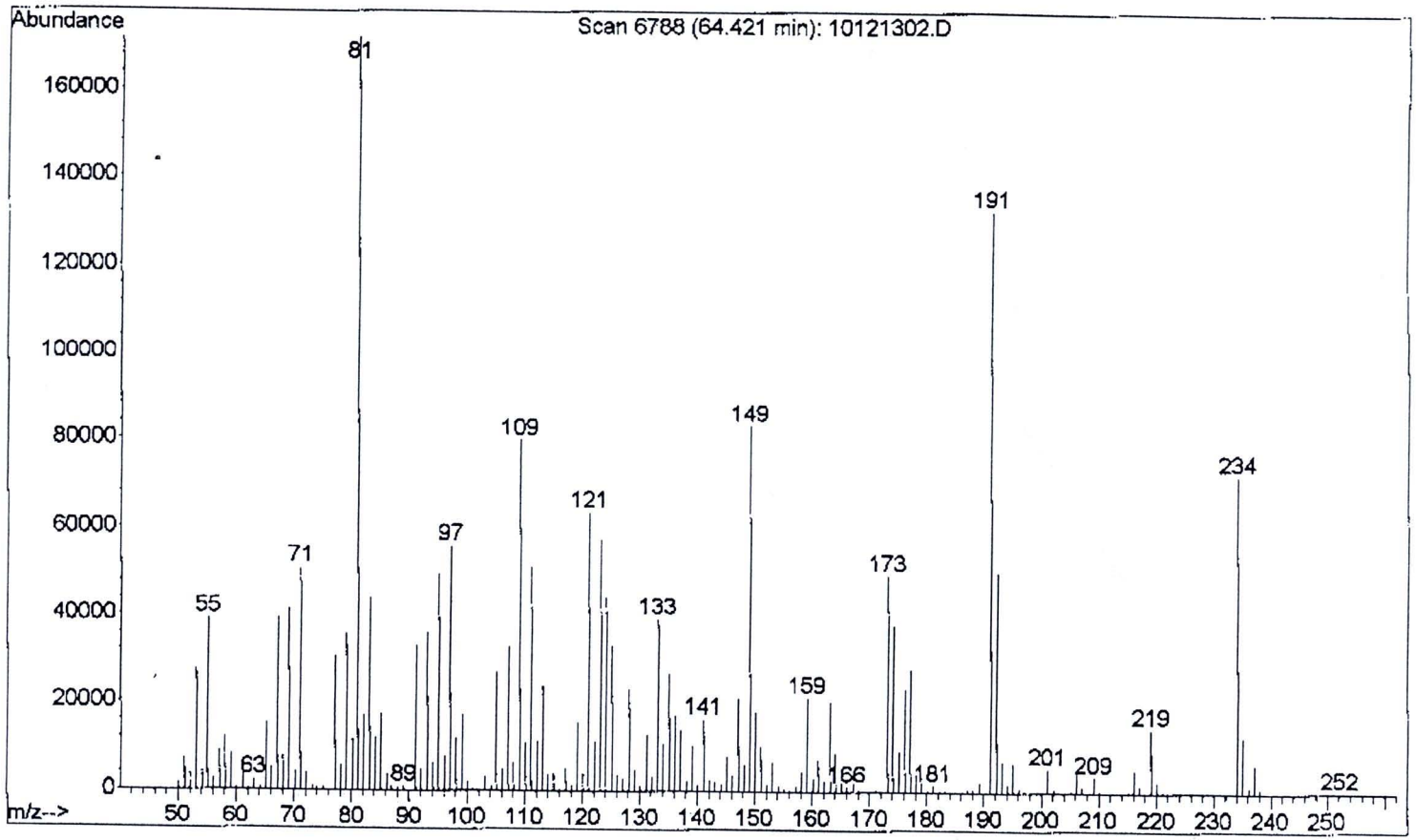


**Figure 92 EI-MS spectrum of zedoarondiol (5)**

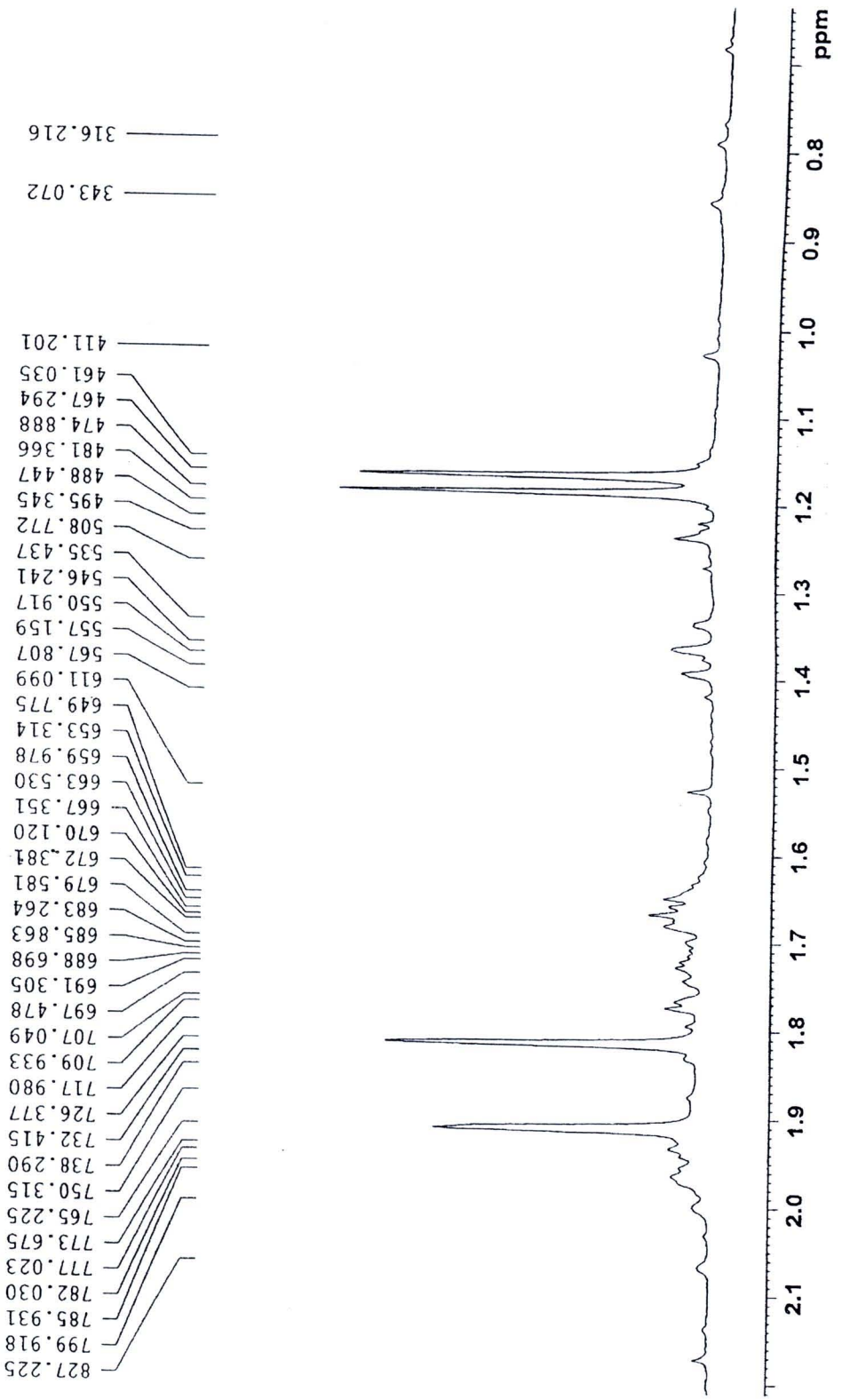


**Figure 94 Enlarged $^{1}$H-NMR spectrum of zedoarondiol (5) (0.8 – 2.1 ppm, 400 MHz, $CDCl_3$)**

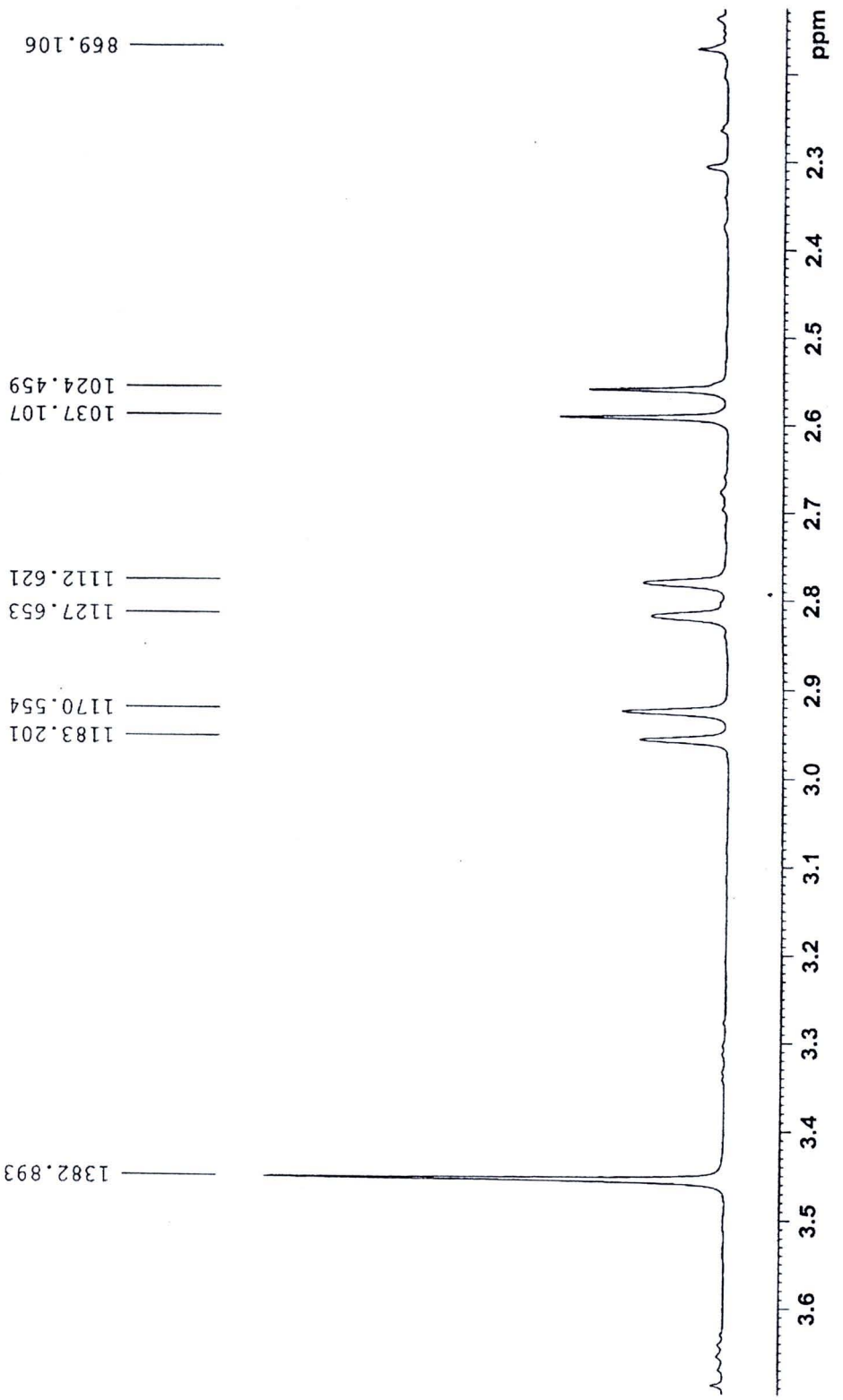


**Figure 95 Enlarged $^{1}$H-NMR spectrum of zedoarondiol (5) (2.2 – 3.6 ppm, 400 MHz, $CDCl_3$)**

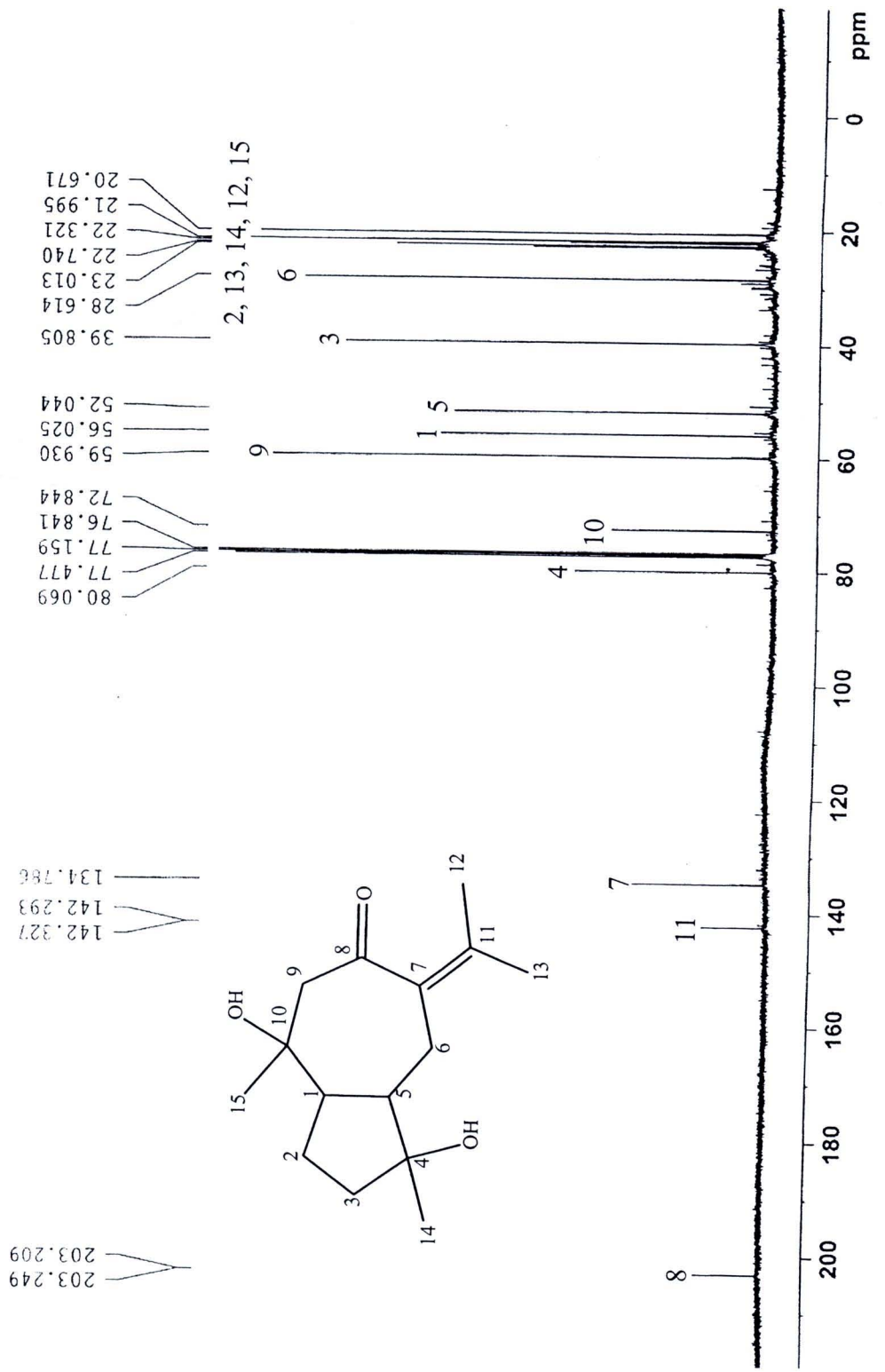


**Figure 96 $^{13}$C-NMR spectrum of zedorondiol (5) (100 MHz, $CDCl_3$)**

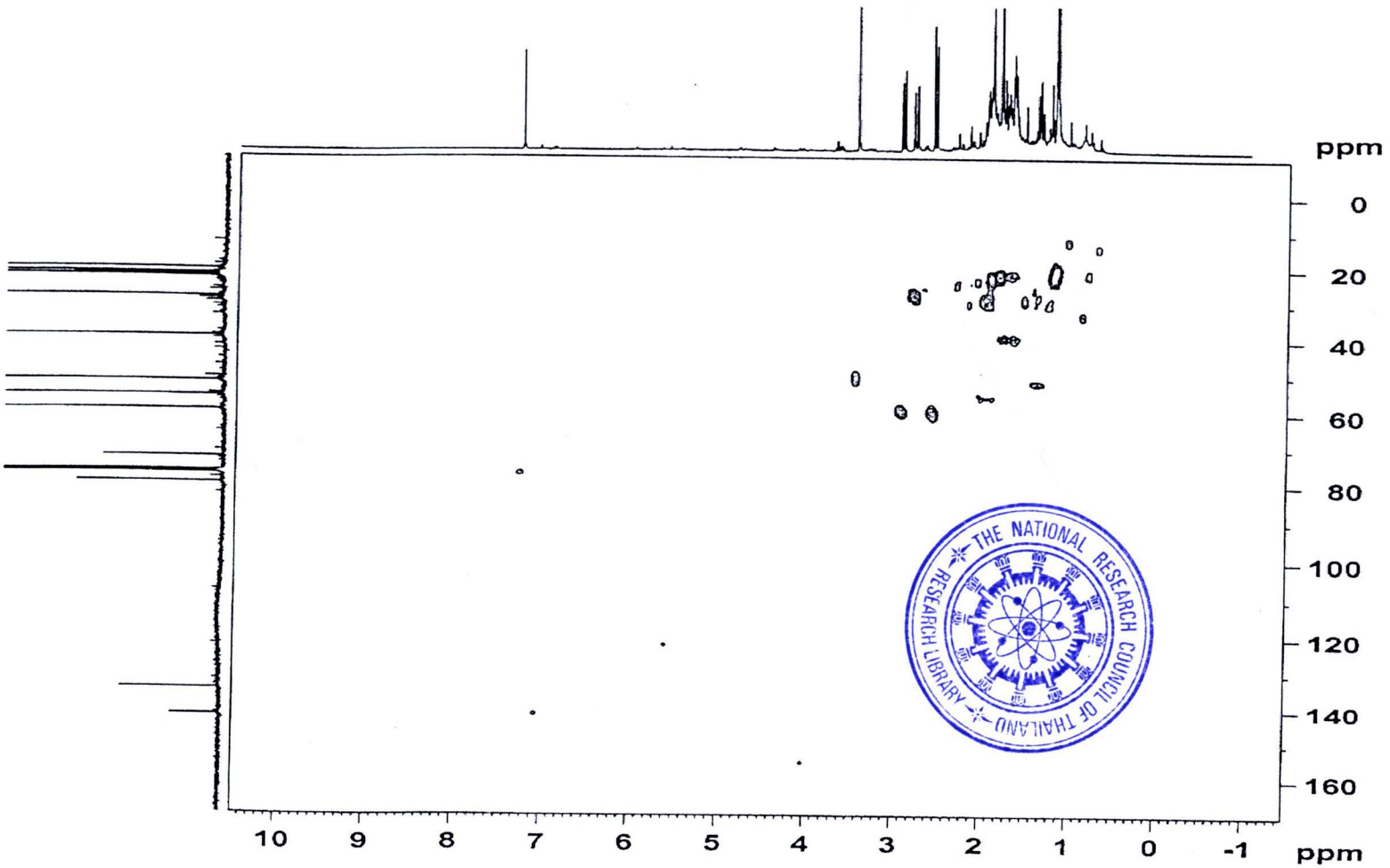


**Figure 97 HMQC spectrum of zedoarondiol (5) (400 MHz, $CDCl_3$)**

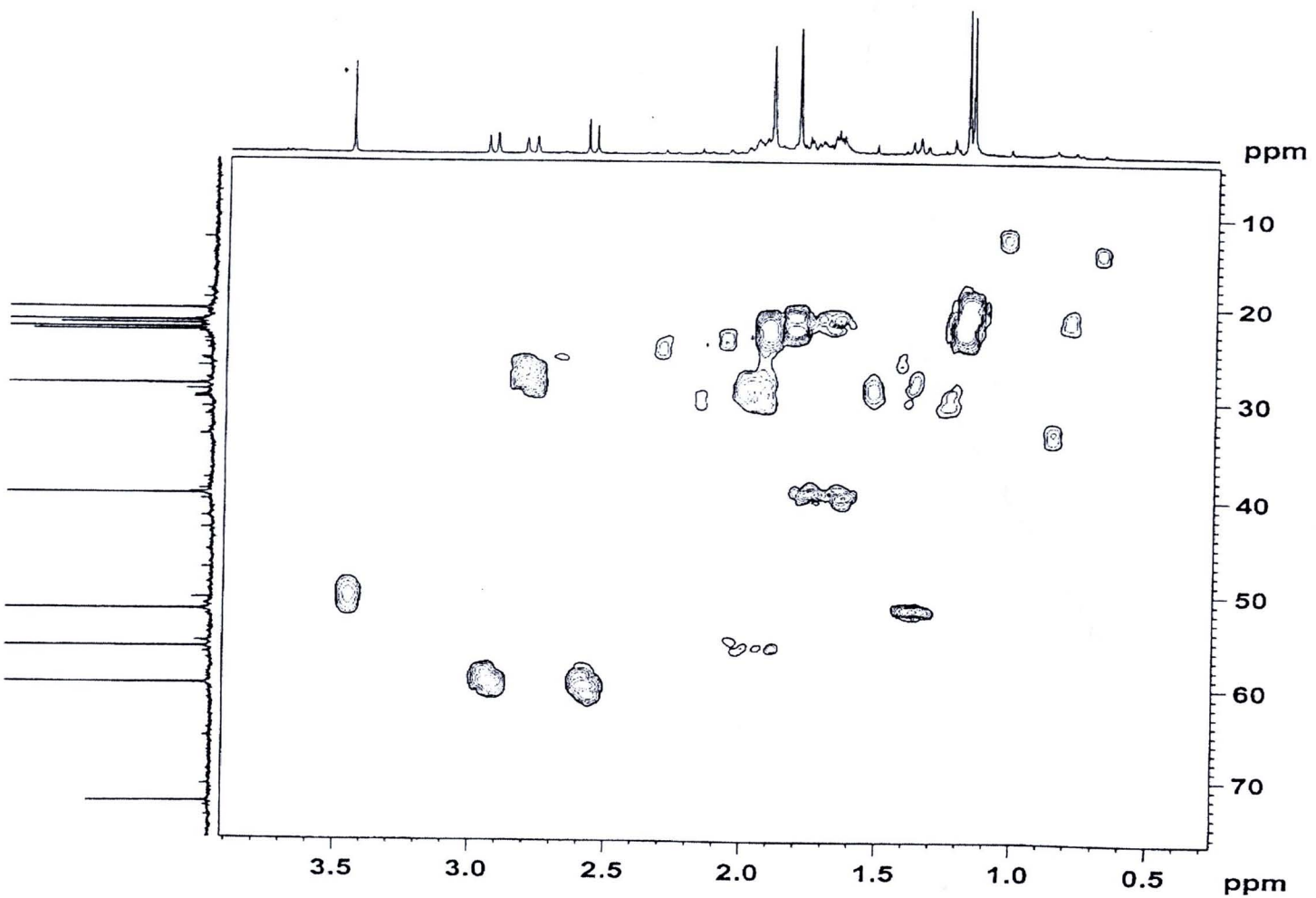


**Figure 98 Enlarged HMQC spectrum of zedparondiol (5) ($^{1}$H-NMR: 0.2-3.9 ppm, $^{13}$C-NMR: 5.0-70.0 ppm, 400 MHz, $CDCl_3$)**

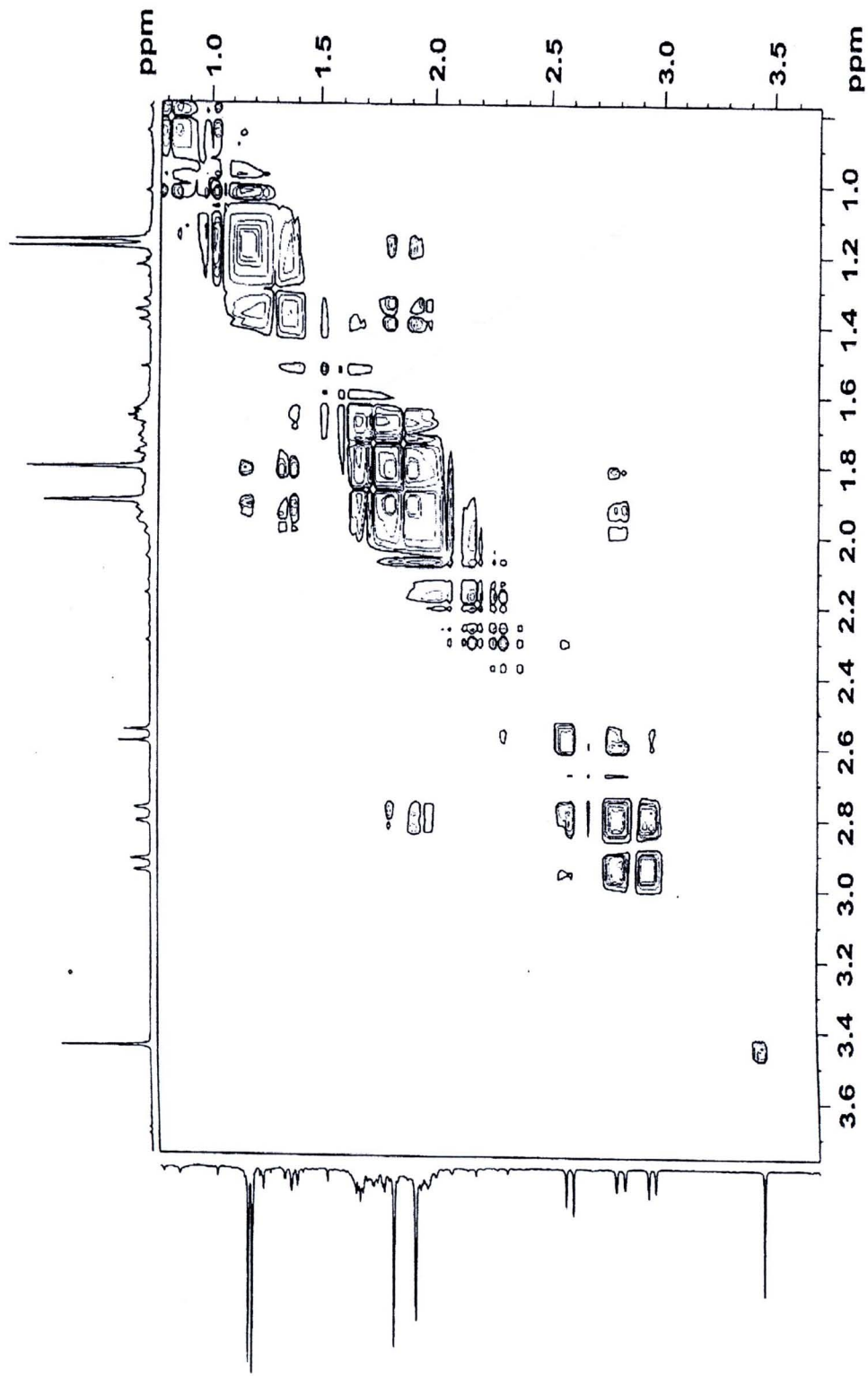


**Figure 99 Enlarged COSYspectrum of zedoarondiol (5) (0.8-3.7 ppm, 400 MHz, $CDCl_3$)**

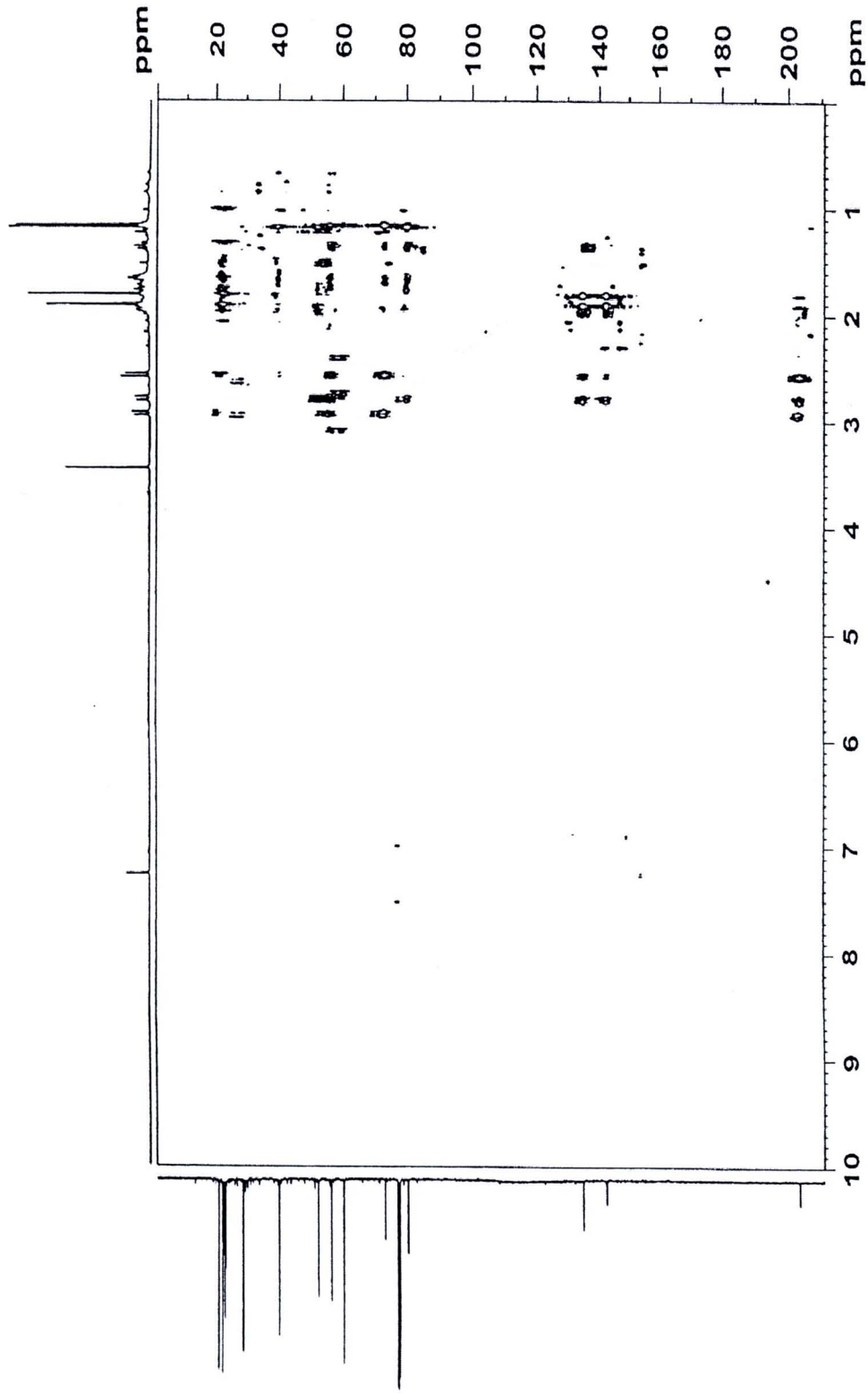


**Figure 100 HMBC spectrum of zedoarondiol (5) (400 MHz, $CDCl_3$)**

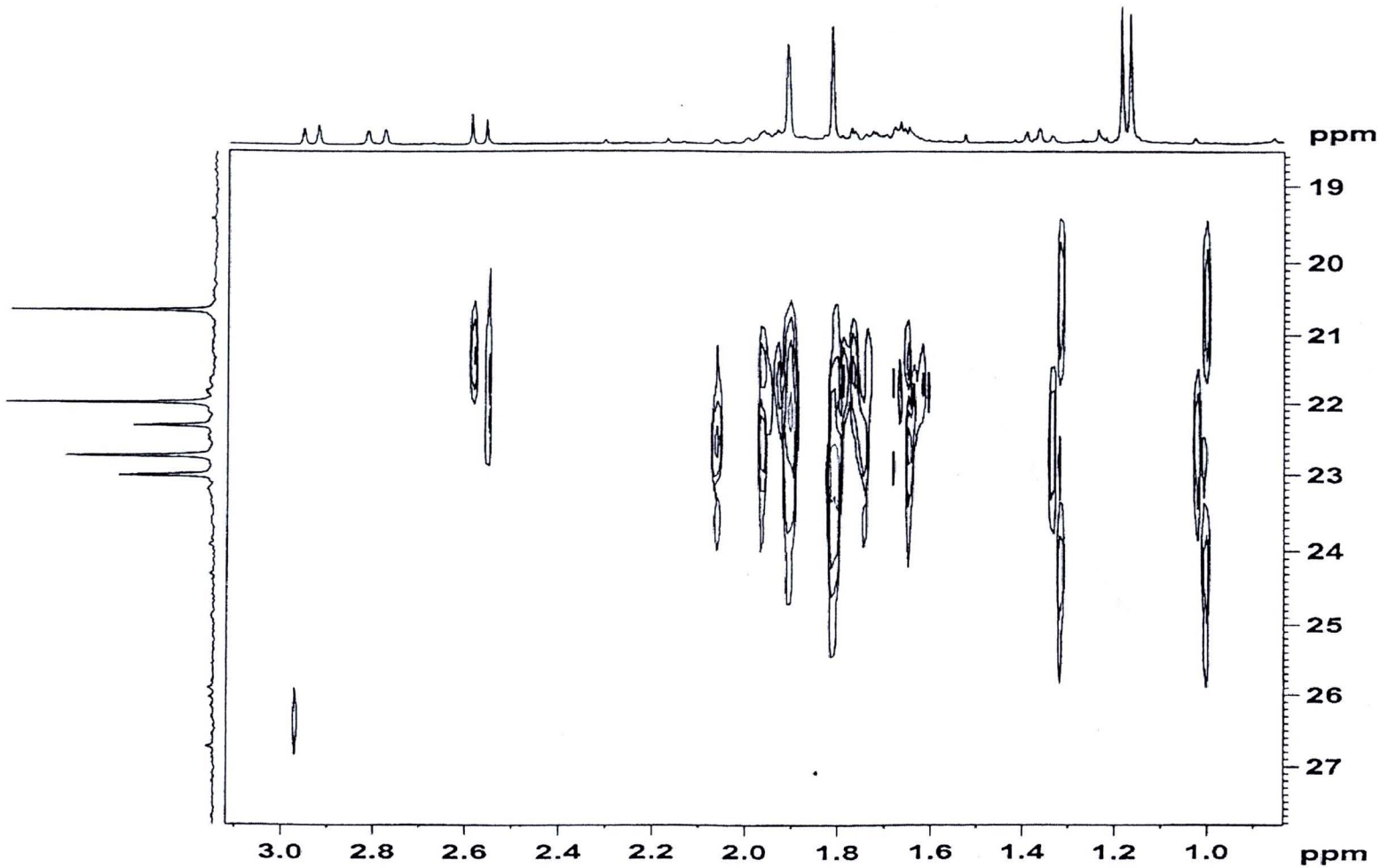


**Figure 101 Enlarged HMBC spectrum of zedoarondiol (5) ($^{1}$H-NMR: 0.6-3.2 ppm, $^{13}$C-NMR: 18.0-28.0 ppm, 400 MHz, $CDCl_3$)**

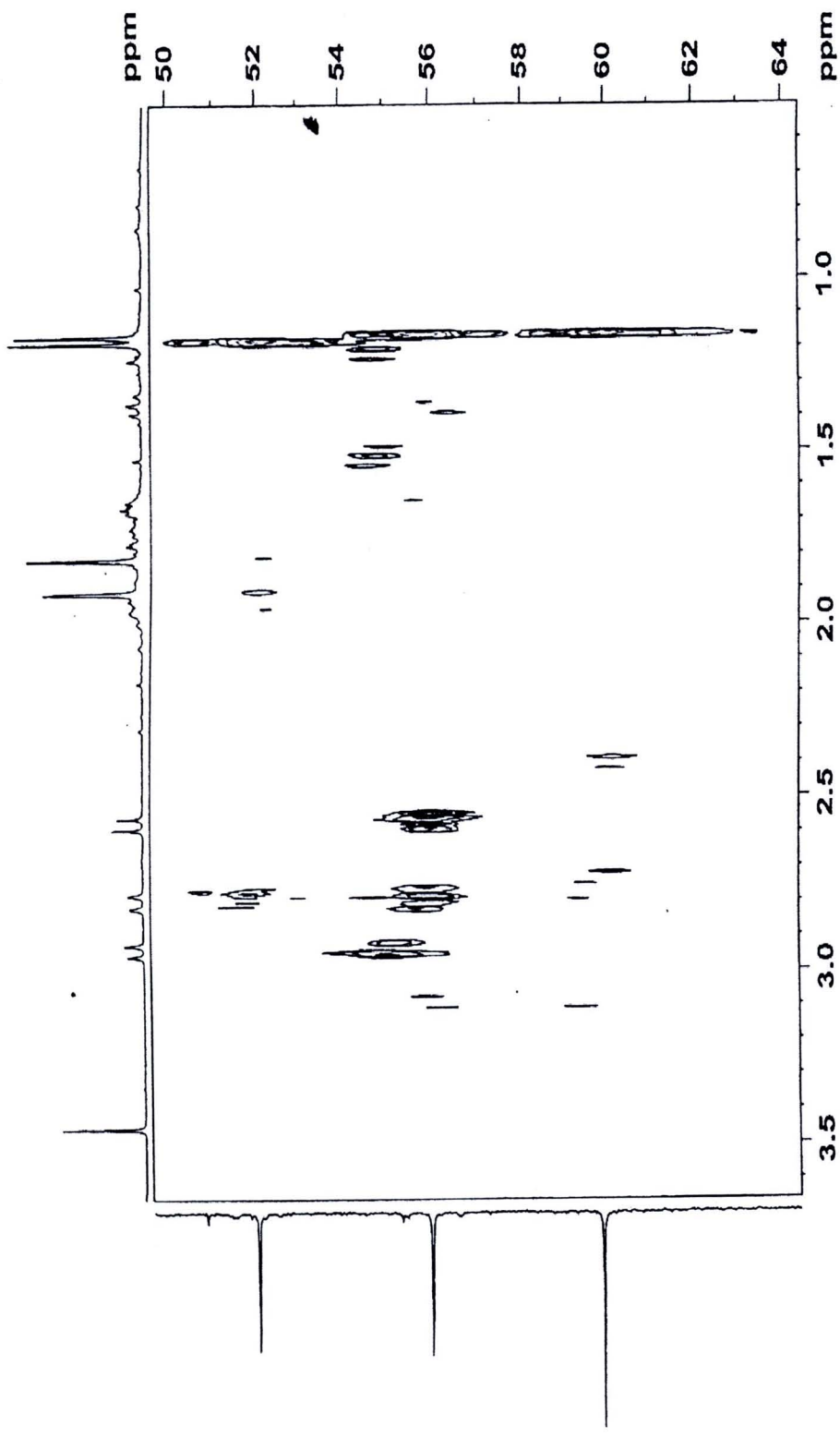


**Figure 102 Enlarged HMBC spectrum of zedoarondiol (5) ($^{1}$H-NMR: 0.5-3.6 ppm, $^{13}$C-NMR: 50.0-64.0 ppm, 400 MHz, $CDCl_3$)**

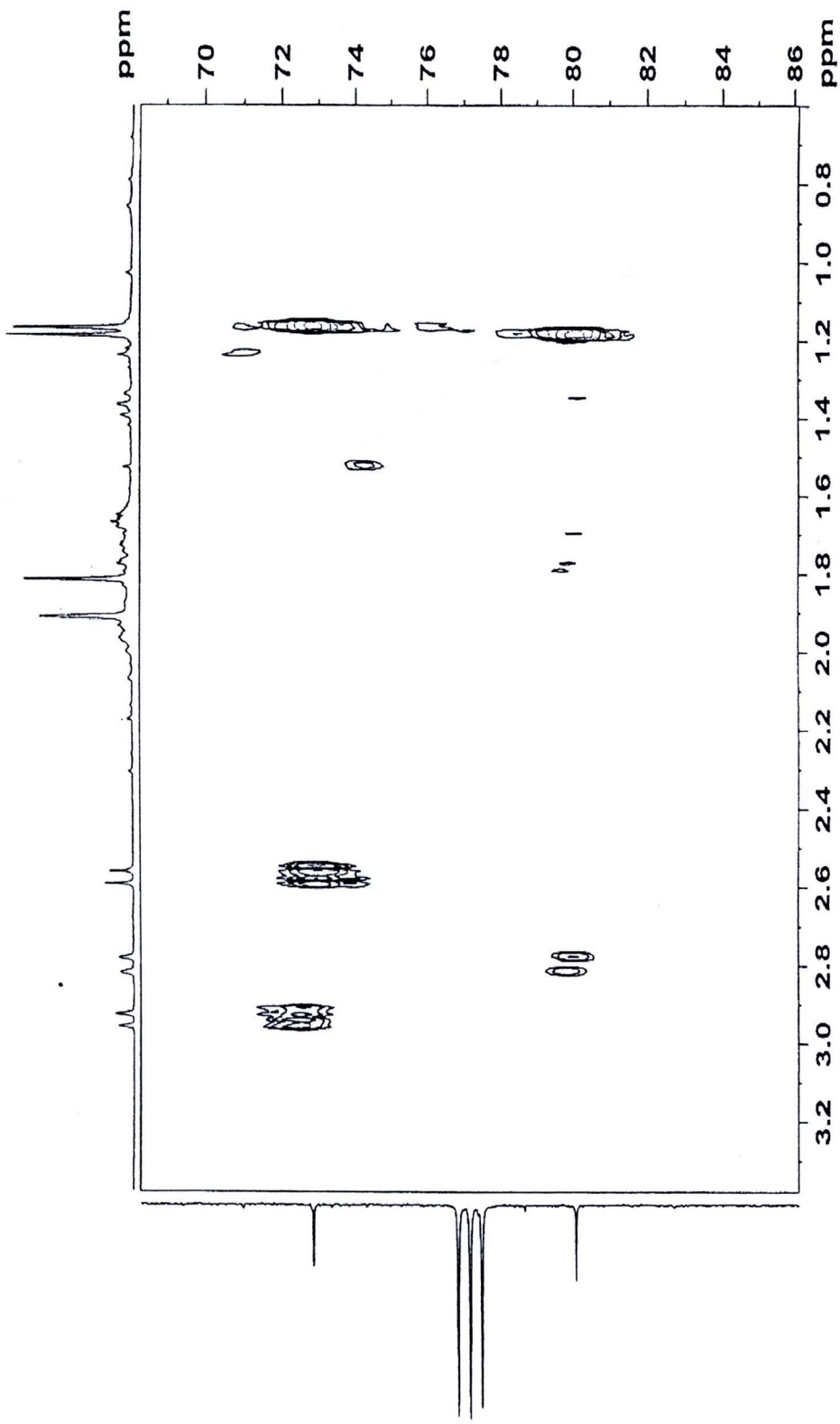


Figure 103 Enlarged HMBC spectrum of zedoarondiol (5) ($^1$H-NMR: 0.6-3.4 ppm, $^{13}$C-NMR: 66.0-86.0 ppm, 400 MHz, $CDCl_3$)

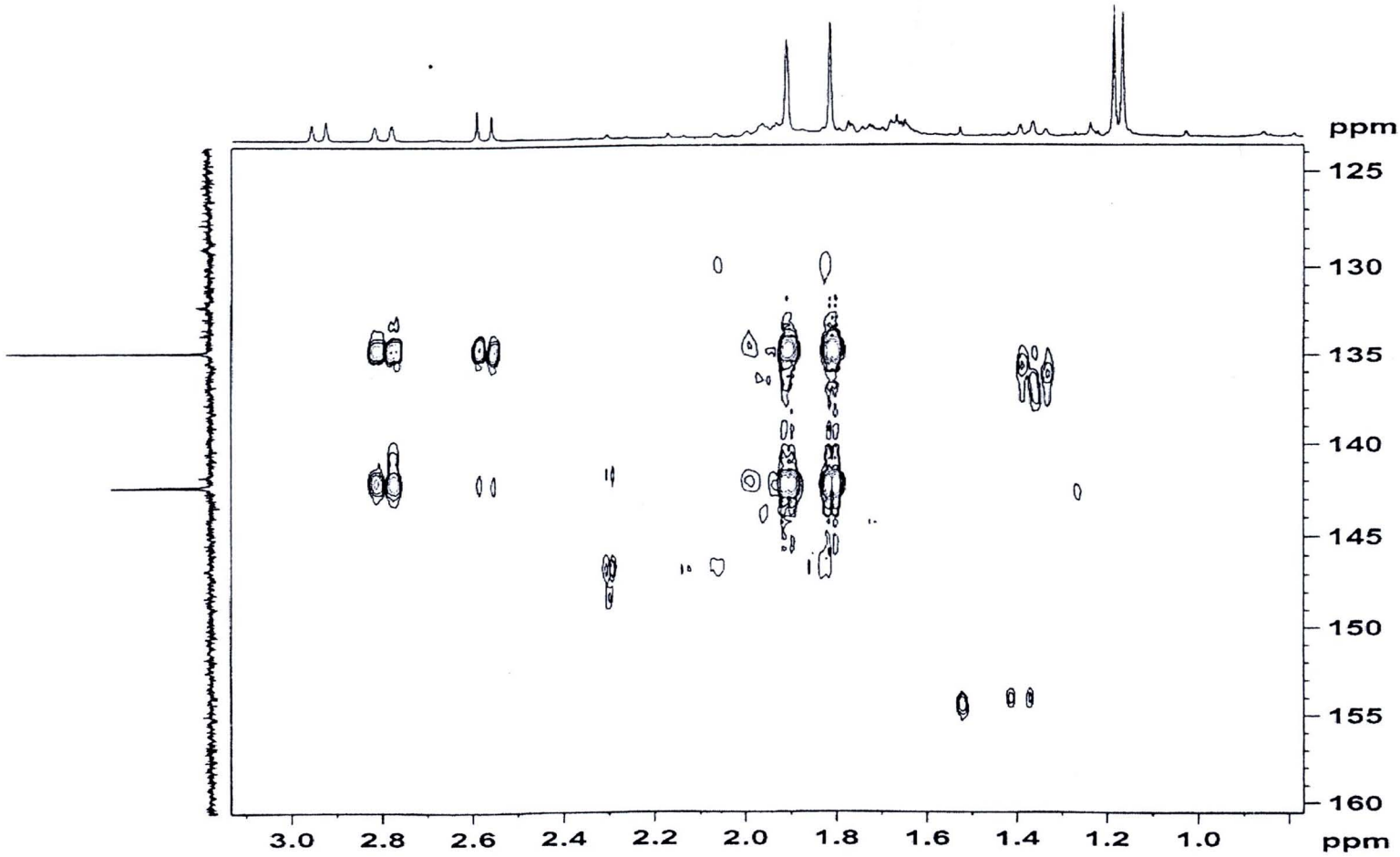


**Figure 104 Enlarged HMBC spectrum of zedoarondiol (5) ($^{1}$H-NMR: 0.8-3.2 ppm, $^{13}$C-NMR: 124.0-160.0 ppm, 400 MHz, $CDCl_3$)**

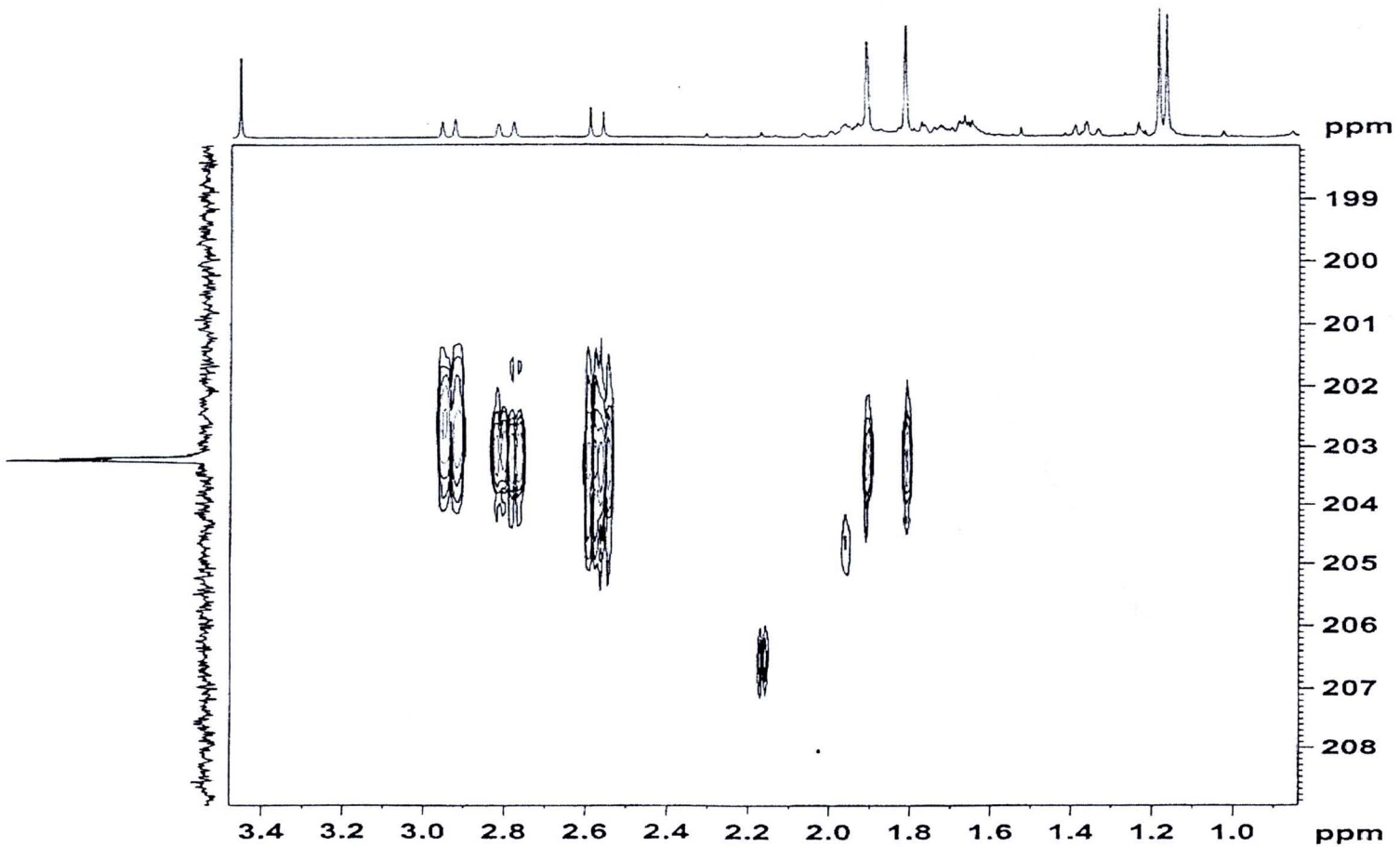


**Figure 105 Enlarged HMBC spectrum of zedoarondiol (5) ($^{1}$H-NMR: 0.8-3.4 ppm, $^{13}$C-NMR: 198.0-209.0 ppm, 400 MHz, $CDCl_3$)**

## APPENDIX F SPECTRAL DATA OF ISOCURCUMENOL (6)

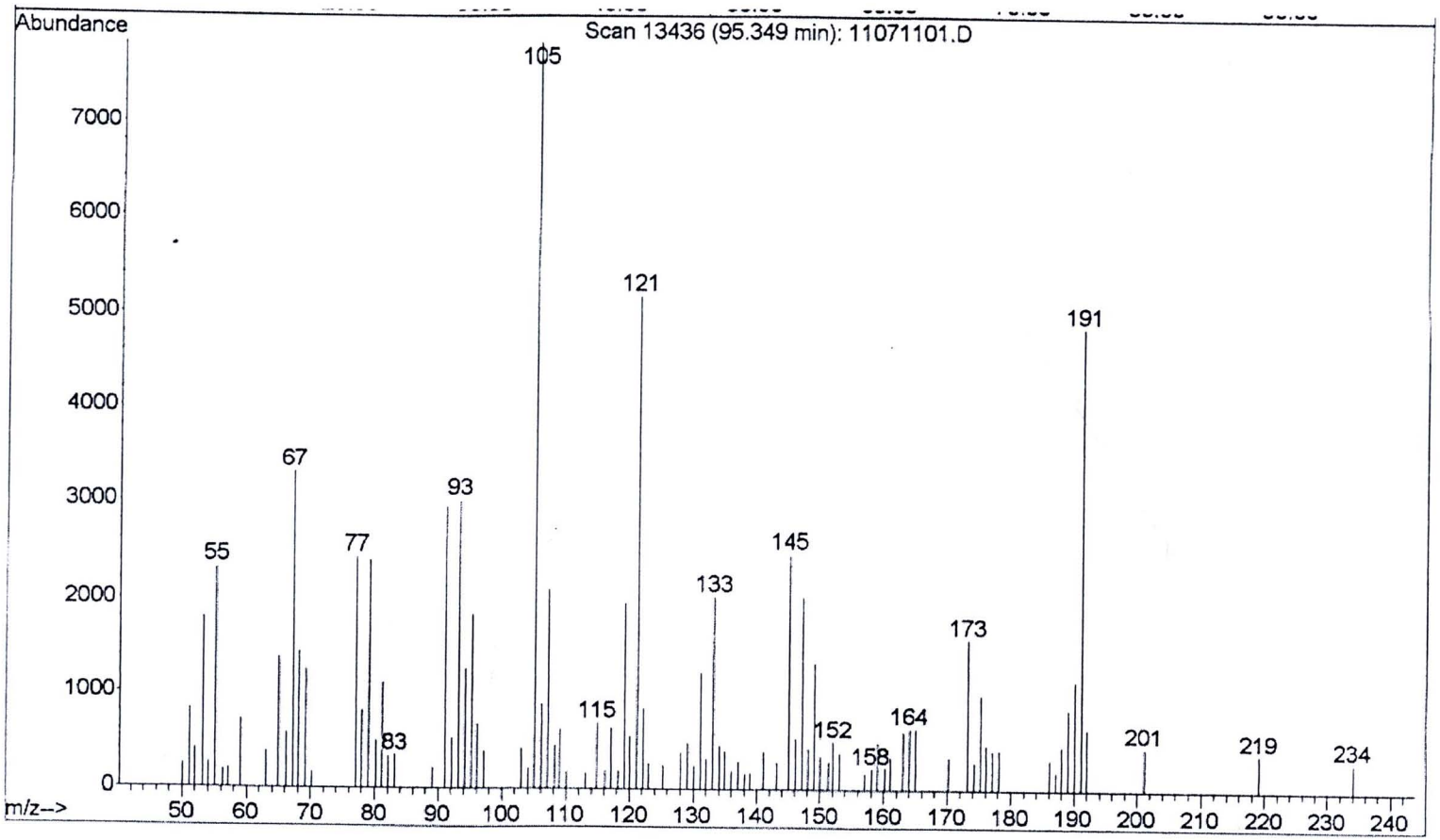


**Figure 106 EI-MS spectrum of isocurcumenol (6)**

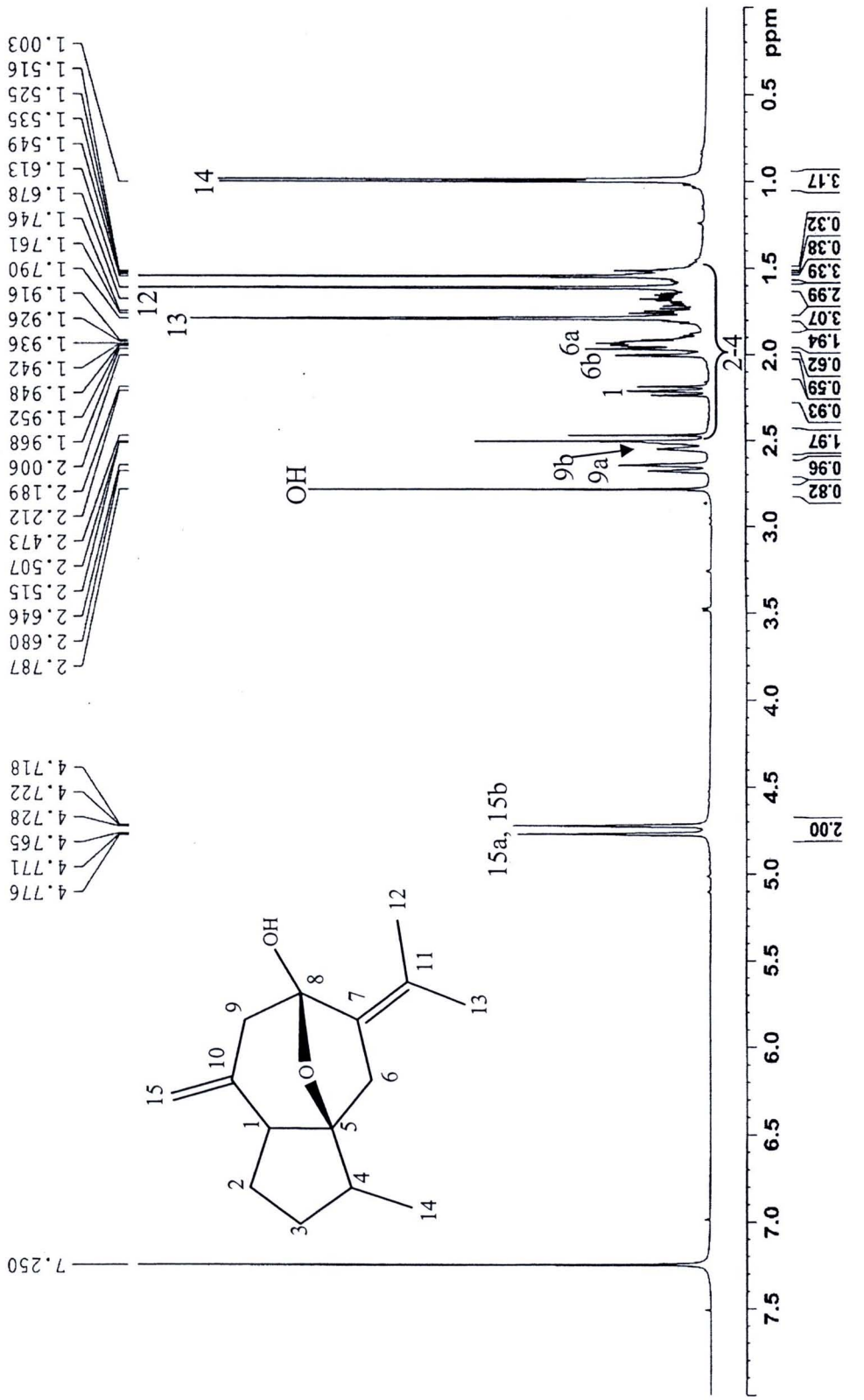


**Figure 107 $^{1}$H-NMR spectrum of isocurcumenol (6) (400 MHz, $CDCl_3$)**

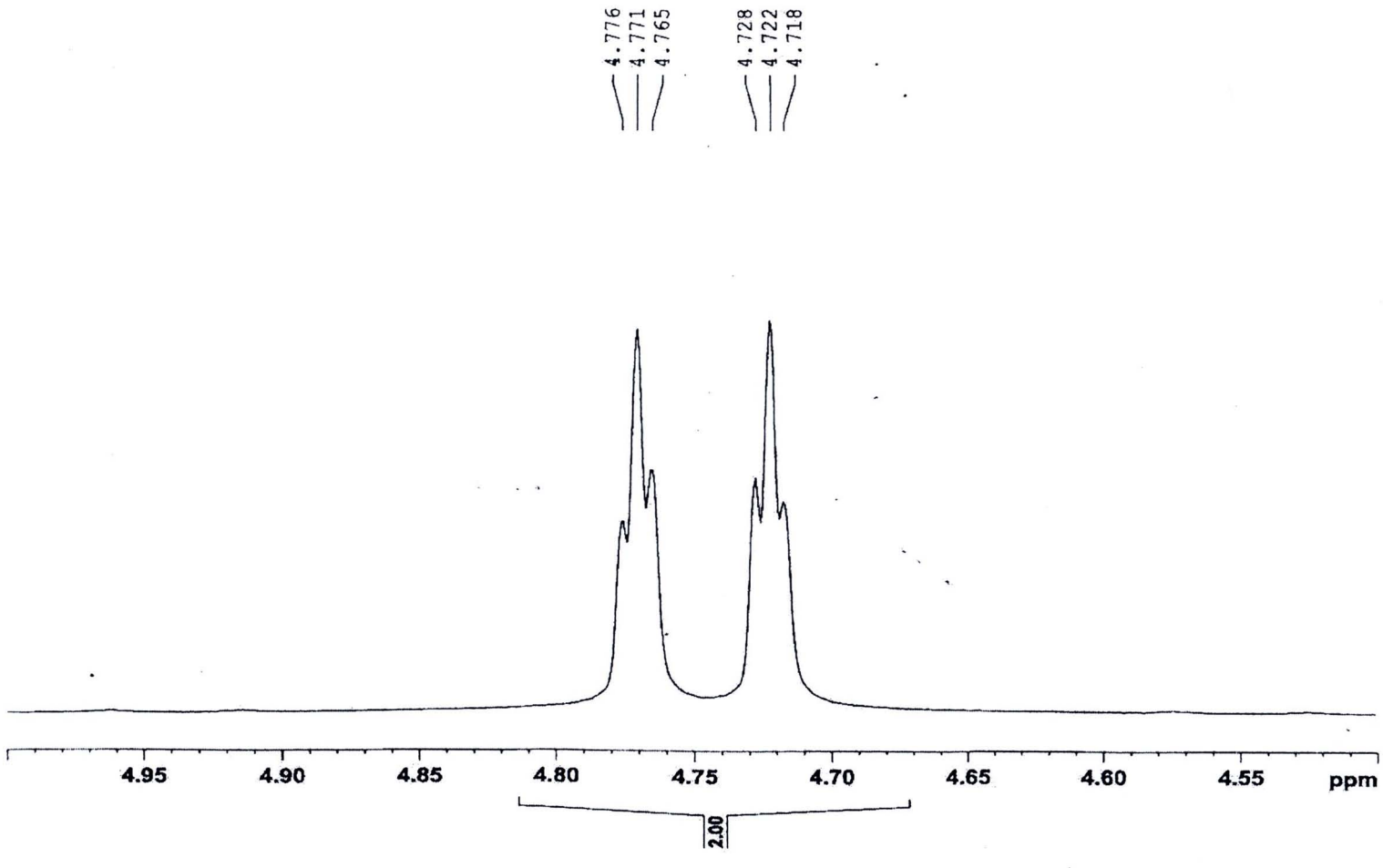


**Figure 108 Enlarged $^{1}$H-NMR spectrum of isocurcumenol (6) (4.5 – 6.0 ppm, 400 MHz, $CDCl_3$)**

## APPENDIX G SOME OF HPLC CHROMATOGRAMS OBTAINED FROM IN VITRO ENZYMATIC ASSAY

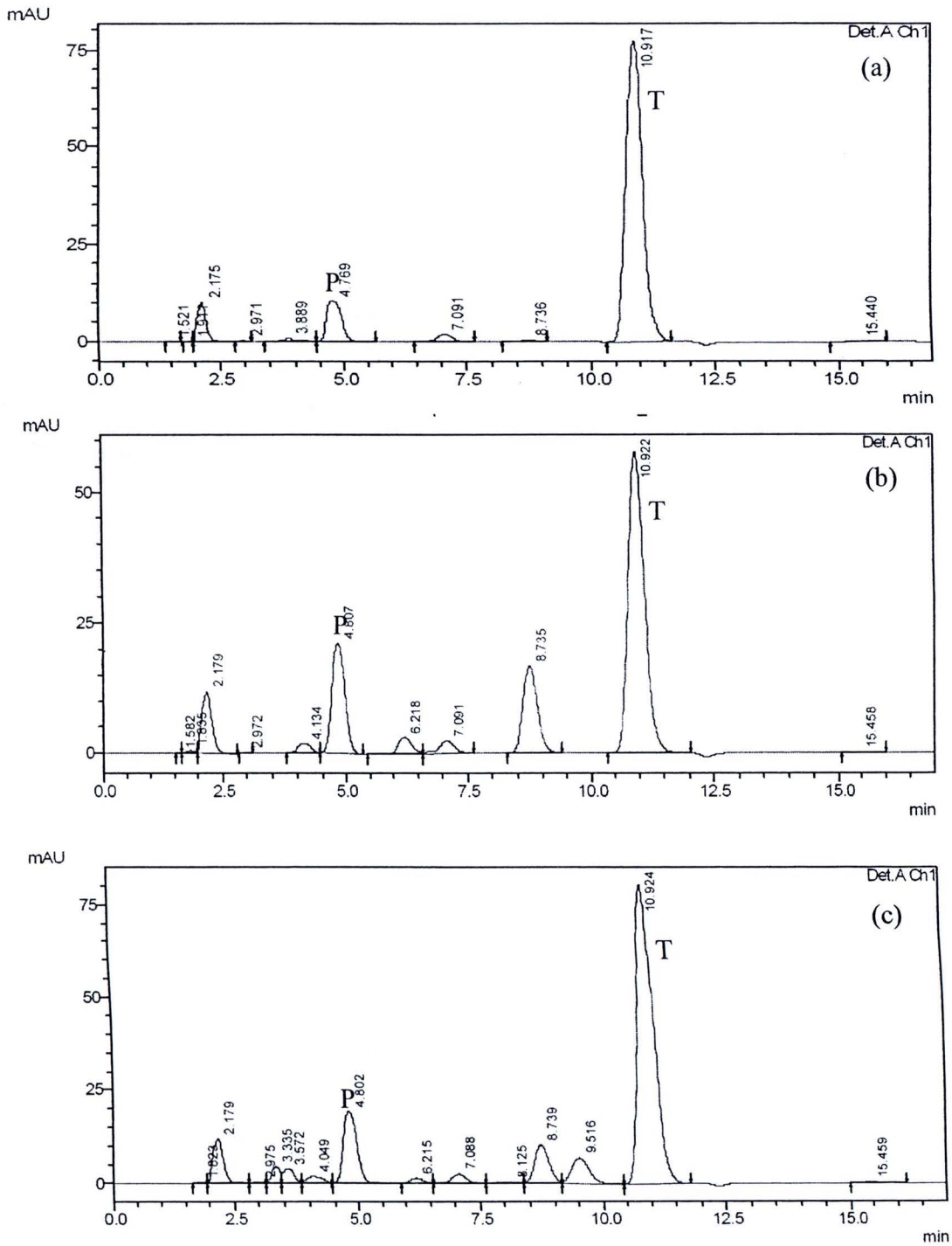


**Figure 109 HPLC chromatogram of: (a) $Control_{0\ min}$, (b) $Control_{30\ min}$, (c) positive control, peak P and T represent prednisolone and testosterone, respectively**

## APPENDIX H THE EFFECT OF TEMPERATURE ON THE STABILITY OF CHEMICAL CONSTITUENTS IN CURCUMA AERUGINOSA EXTRACT

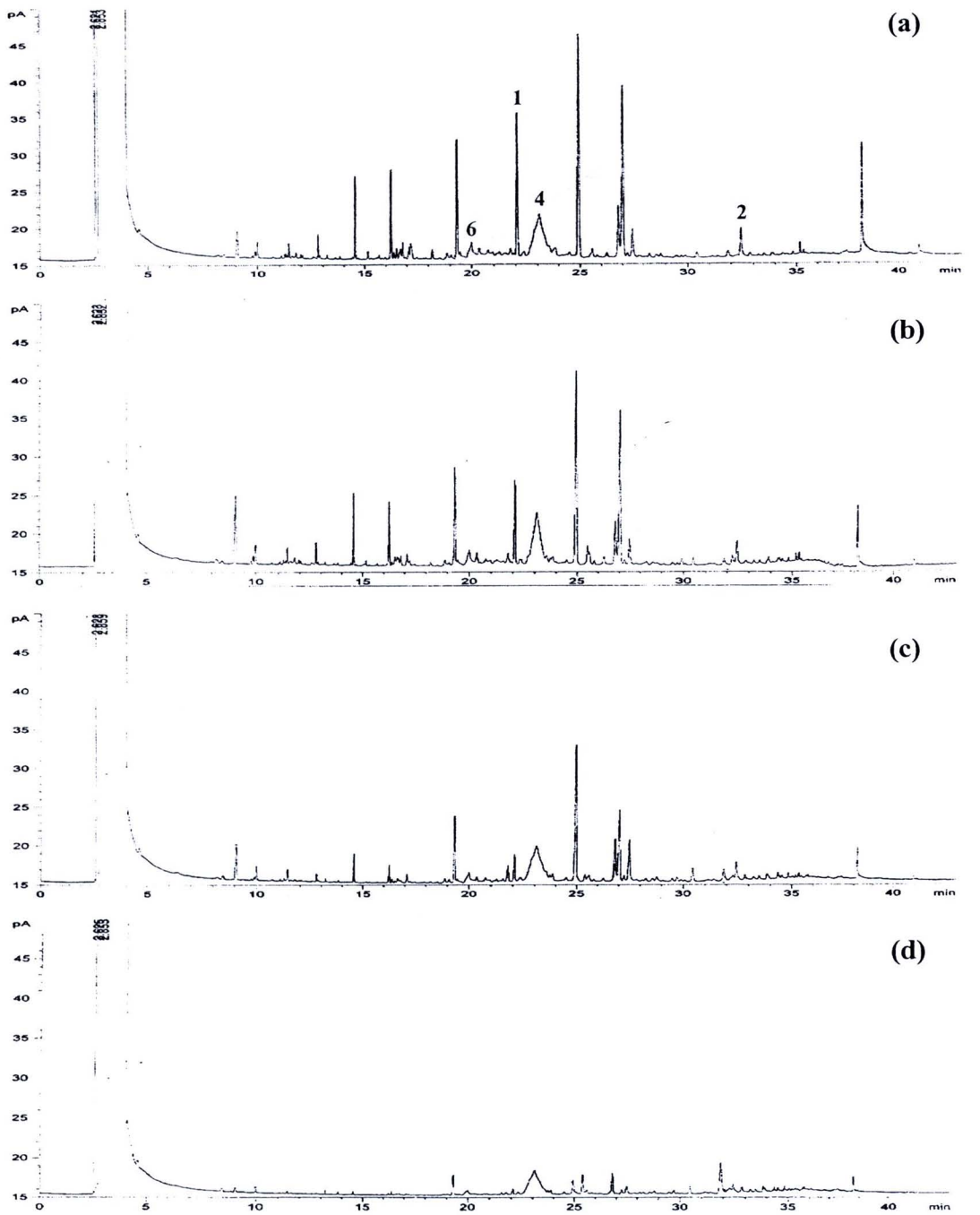


**Figure 110 GC chromatogram of the effect of temperature on the stability of chemical constituents in solid form of crude extract; (a) at day 0, (b)-(d) 3 months after stored at 4, 25, and 45°C, respectively**

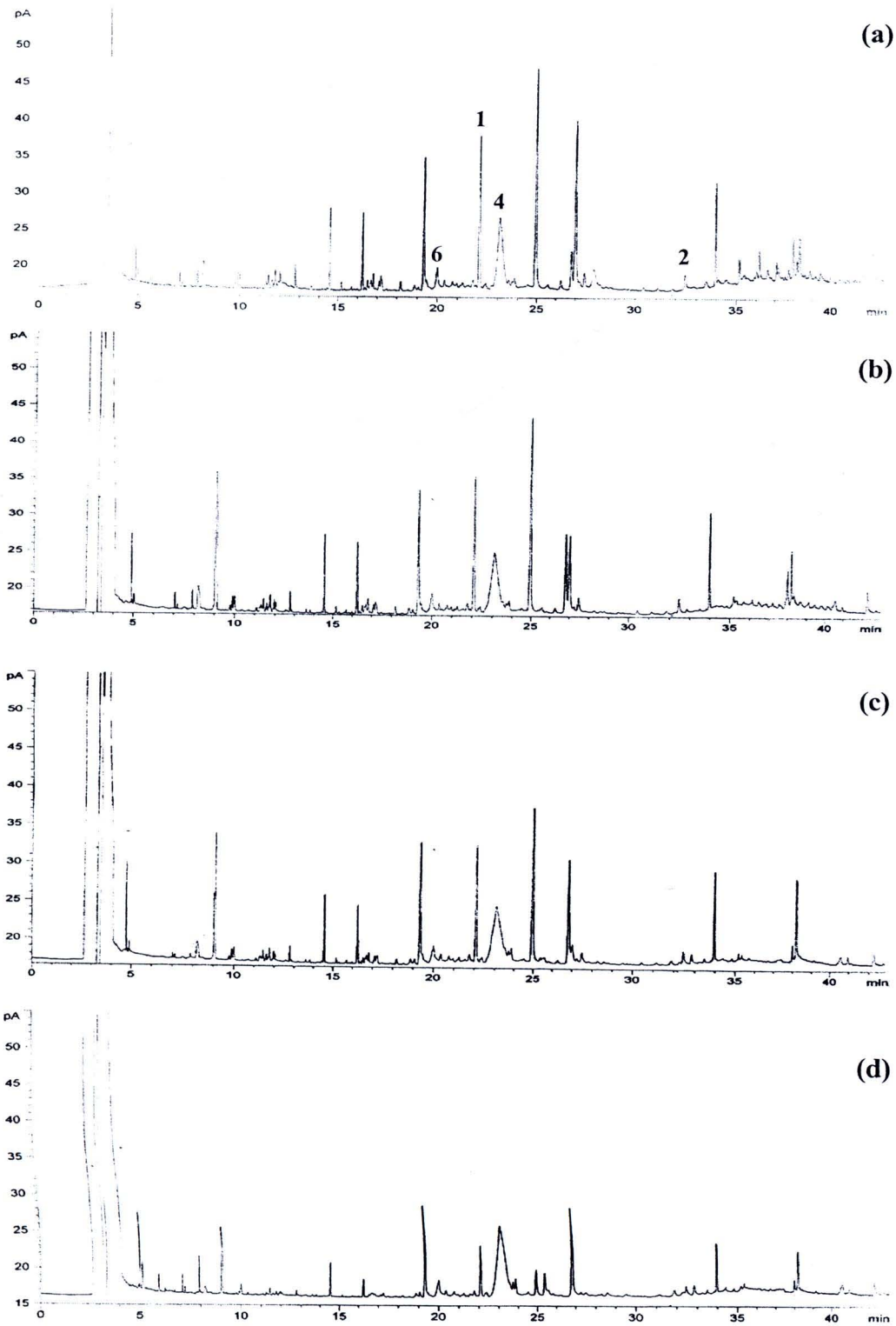


**Figure 111 GC chromatogram of the effect of temperature on the stability of chemical constituents in solution form of crude extract; (a) at day 0, (b)-(d) 3 months after stored at 4, 25, and 45°C, respectively**

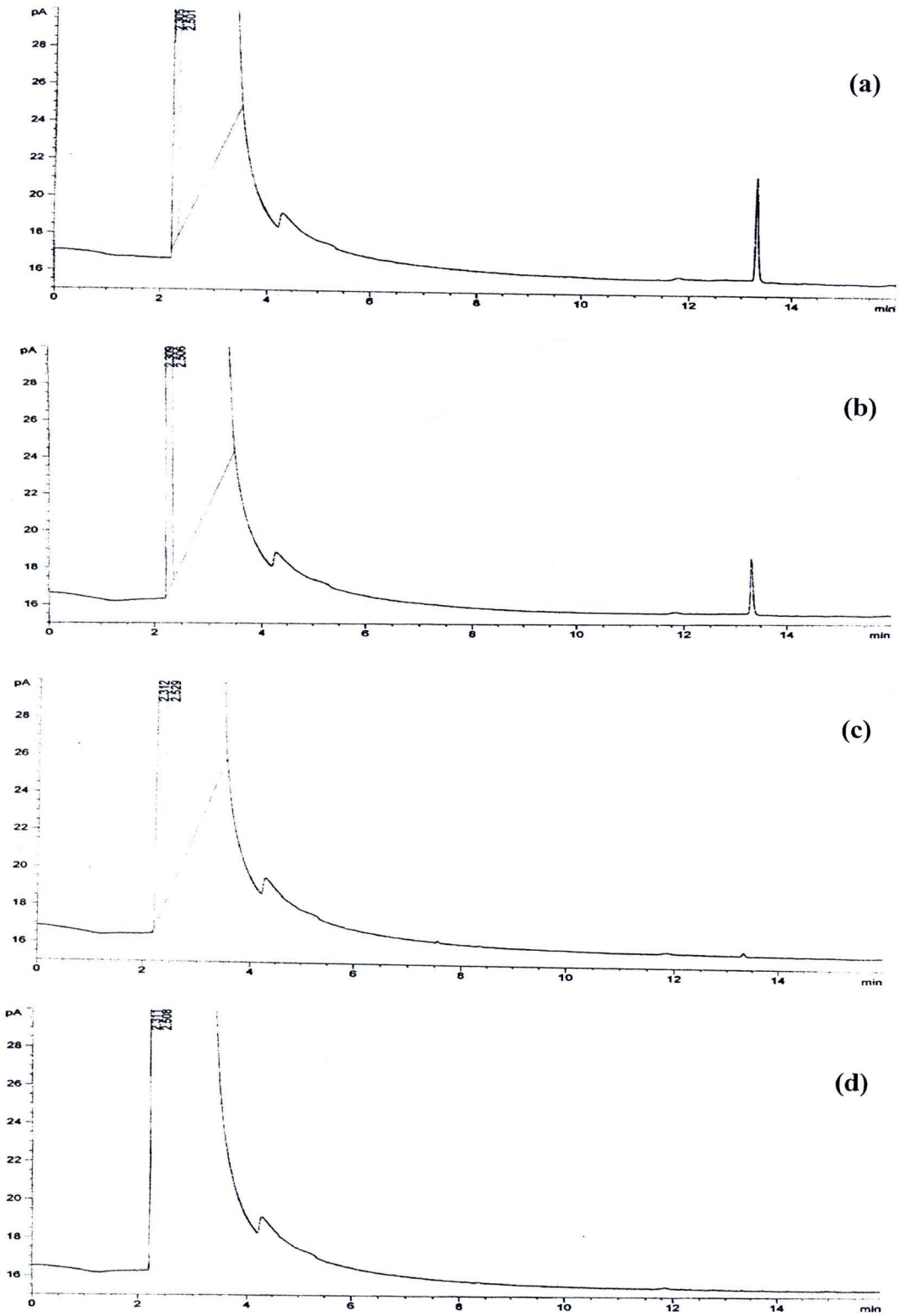


**Figure 112 GC chromatogram of the effect of temperature on the stability of 1 (solid form of pure compound); (a) at day 0, (b)-(d) 3 months after stored at 4, 25, and 45°C, respectively**

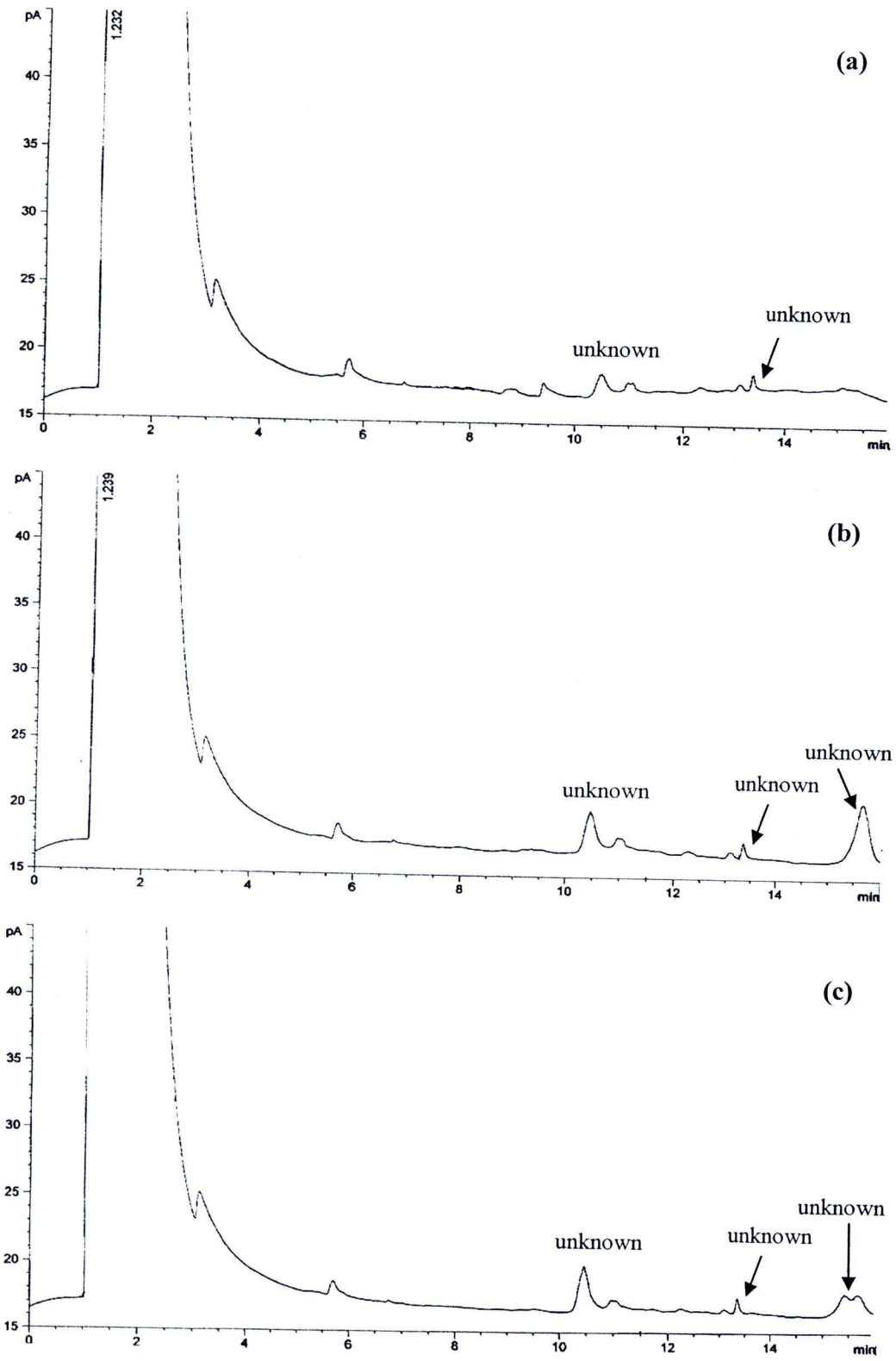


**Figure 113 GC chromatogram of the effect of temperature on the stability of 1 (solid form of pure compound) after the samples were stored for 6 months; (a) at 4°C, (b) at 25°C and (c) at 45°C**

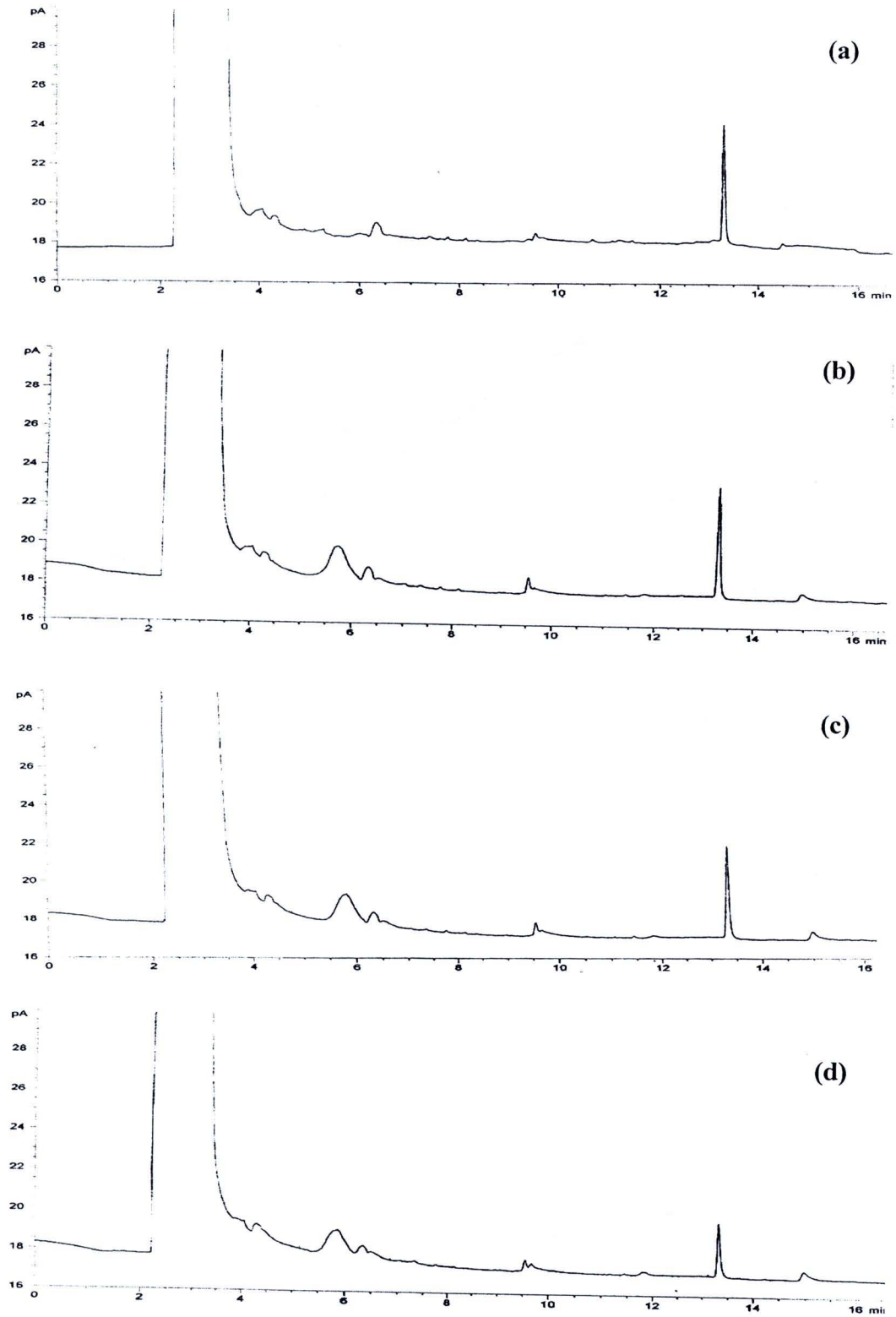


**Figure 114 GC chromatogram of the effect of temperature on the stability of 1 (solution form of pure compound); (a) at day 0, (b)-(d) 3 months after stored at 4, 25, and 45°C, respectively**

**APPENDIX I THE ETHICAL APPROVAL FOR IN VIVO STUDY FROM THE ANIMAL ETHIC COMMITTEE OF NARESUAN UNIVERSITY**

เอกสารรับรองโครงการวิจัยในสัตว์ทดลอง
คณะกรรมการจรรยาบรรณการใช้สัตว์ทดลอง มหาวิทยาลัยนเรศวร

---

ชื่อโครงการ การศึกษาสารต้านเอนไซม์ไฟว์แอลฟารีดักเทสในว่านมหาเมฆ
Investigation of 5α-reductase inhibitors in *Curcuma aeruginosa*

ชื่อหัวหน้าโครงการ รศ.ดร.กรกนก อิงคนินันท์

เลขที่โครงการ/รหัส 52 04 0023

สังกัดหน่วยงาน/คณะ เภสัชศาสตร์

การรับรอง ขอรับรองโครงการวิจัยดังกล่าวข้างบนนี้ ได้ผ่านการพิจารณาและรับรอง
จากคณะกรรมการจรรยาบรรณการใช้สัตว์ มหาวิทยาลัยนเรศวร
ในการประชุมครั้งที่ 4/2552 วันที่ 15 ธันวาคม 2552

ลงนาม

(ศาสตราจารย์พิเศษ ดร.กาญจนา เงารังษี)

ประธานคณะกรรมการจรรยาบรรณการใช้สัตว์ มหาวิทยาลัยนเรศวร

# BIOGRAPHY

# BIOGRAPHY

**Name –Surname** Nungruthai Suphrom

**Date of Birth** April 19, 1985

**Address** 33/1 Moo 3 Thapkhor District, Phitchit Province, Thailand 66150

**Work Experiences**

2008 Assistant researcher, Faculty of Pharmaceutical Sciences, Naresuan University, Phitsanulok, Thailand

2007 Assistant engineering, Mattel Bangkok Co. Ltd., Bangpoo Industrial estate, Samutprakarn, Thailand

**Education Background**

2007 B.S. (Chemistry)
Naresuan University, Phitsanulok, Thailand

**Publications**

Changwichit, K., Khorana, N., Suwanborirux, K., Waranuch, N., Limpeanchob, N., Wisuitiprot, W., Suphrom, N., and Ingkaninan, K. (2011). Bisindole alkaloids and secoiridoids from *Alstonia macrophylla* Wall. ex G. Don. **Fitoterapia**, 82, 798-804.

Ingkaninan, K., Suphrom, N., Srivilai, J., Khorana, N., Waranuch, N., Pumthong, G. et al. (February 16, 2011). **Chemical constituents for control the growth of hair** [Patent application]. Nonthaburi: Department of Intellectual Property.

Klamtet, J., Suphrom, N., and Wanwat, C. (2008). A flow injection system for the spectro-photometric determination of lead after preconcentration by solid phase extraction onto Amberlite XAD-4. **Maejo International Journal of Science and Technology**, 2(02), 408-417.

Suphrom, N., Pumthong, G., Waranuch, N., and Ingkaninan, K. (2008). Screening for anti-androgenic activity of some Thai plants. In **The 2nd International Conference on Natural Products for Health and Beauty**. Phayao: Naresuan University at Phayao.

Suphrom, N., Pumthong, G., Waranuch, N., and Ingkaninan, K. (2009). Anti-androgen from *Curcuma aeruginosa* extract. In **The International congress for innovation in chemistry (PERCH-CIC Congress VI), Toward a Sustainable Future**. Pattaya City, Chonburi: Jomtien Palm Beach Hotel & Resort.

Suphrom, N., Pumthong, G., Waranuch, N., and Ingkaninan, K. (2009). 5α-reductase inhibitors from *Curcuma aeruginosa* Roxb. In **Commission on Higher Education Congress II: University Staff Development Consortium (CHE-USDC Congress II)**. Pattaya city, Chonburi: Dusit Thani Hotel.

Suphrom, N., Pumthong, G., Waranuch, N., Limpeanchob, N., and Ingkaninan, K. (2011). Anti-androgenic effects of the chemical constituents from *Curuma aeruginosa* Roxb. In **The 3rd International Conference on Natural Products for Health and Beauty (NATPRO3), "Through Sustainable Health"**. Bangkok: The Emerald Hotel.

Suphrom, N., Pumthong, G., Waranuch, N., Limpeanchob, N., and Ingkaninan, K. (2011). Investigation of anti-androgenic compounds from *Curuma aeruginosa* Roxb. In **International congress for innovation in chemistry (PERCH-CIC VII), "Chemistry, environment and society"**. Pattaya City, Chonburi: Jomtien Palm Beach Hotel & Resort.

Suphrom, N., Pumthong, G., Waranuch, N., Limpeanchob, N. and Ingkaninan, K. (2011). Anti-androgenic effect of sesquiterpenes isolated from the rhizomes of *Curcuma aeruginosa* Roxb. In **The 14th Asian Chemical Congress 2011 (14ACC), Contemporary chemistry for sustainability and economic sufficiency**., Bangkok: Queen Sirikit Convention Center in Bangkok.