REFERENCES

[1] Yun TK. Update from Asia: Asian studies on cancer chemoprevention. *Ann N Y Acad Sci* 1999;889:157-92.

[2] Huie CW, Di X. Chromatographic and electrophoretic methods for Lingzhi pharmacologically active components. *J Chromatogr B Analyt Technol Biomed Life Sci* 2004;812(1-2):241-57.

[3] Paterson RR. *Ganoderma* - A therapeutic fungal biofactory. *Phytochem* 2006; 67(18):1985-2001.

[4] Wasser SP. Reishi or Ling Zhi (*Ganoderma lucidum*). In: *Encyclopedia of Dietary Supplements*. 1st ed: Marcel Dekker 2005:603-22.

[5] Xu JW, Zhao W, Zhong JJ. Biotechnological production and application of ganoderic acids. *Appl Microbiol Biotechnol* 2010;87(2):457-66.

[6] Chang ST, Miles PG. *Ganoderma lucidum* - A leader of medicinal mushrooms. In: *Mushrooms: Cultivation, nutritional value, medicinal effect, and environmental impact*. 2nd ed: CRC Press, USA 2004:357-72.

[7] Morigiwa A, Kitabatake K, Fujimoto Y, Ikekawa N. Angiotensin converting enzyme-inhibitory triterpenes from *Ganoderma lucidum*. *Chem Pharm Bull (Tokyo)* 1986;34(7):3025-8.

[8] Koyama K, Imaizumi T, Akiba M, Kinoshita K, Takahashi K, Suzuki A, *et al*. Antinociceptive components of *Ganoderma lucidum*. *Planta Med* 1997;63(3): 224-7.

[9] Zhu M, Chang Q, Wong LK, Chong FS, Li RC. Triterpene antioxidants from *Ganoderma lucidum*. *Phytother Res* 1999;13(6):529-31.

[10] Lee S, Park S, Oh JW, Yang C. Natural inhibitors for protein prenyl-transferase. *Planta Med* 1998;64(4):303-8.

[11] Kim DH, Shim SB, Kim NJ, Jang IS. Beta-glucuronidase inhibitory activity and hepatoprotective effect of *Ganoderma lucidum*. *Biol Pharm Bull* 1999; 22(2):162-4.

[12] Wang GJ, Huang YJ, Chen DH, Lin YL. *Ganoderma lucidum* extract attenuates the proliferation of hepatic stellate cells by blocking the PDGF receptor. *Phytother Res* 2009;23(6):833-9.

[13] Kimura Y, Taniguchi M, Baba K. Antitumor and antimetastatic effects on liver of triterpenoid fractions of *Ganoderma lucidum*: Mechanism of action and isolation of an active substance. *Anticancer Res* 2002;22(6A):3309-18.

[14] Guan SH, Xia JM, Yang M, Wang XM, Liu X, Guo DA. Cytotoxic lanostanoid triterpenes from *Ganoderma lucidum*. *J Asian Nat Prod Res* 2008; 10(7-8):705-10.

[15] Jiang J, Grieb B, Thyagarajan A, Sliva D. Ganoderic acids suppress growth and invasive behavior of breast cancer cells by modulating AP-1 and NF-κB signaling. *Int J Mol Med* 2008;21(5):577-84.

[16] Yue QX, Song XY, Ma C, Feng LX, Guan SH, Wu WY, *et al.* Effects of triterpenes from *Ganoderma lucidum* on protein expression profile of HeLa cells. *Phytomed* 2010;17(8-9):606-13.

[17] Lin ZB. Cellular and molecular mechanisms of immunomodulation by *Ganoderma lucidum*. *J Pharmacol Sci* 2005;99(2):144-53.

[18] Bensky D, Clavey S, Stöger E, Gamble A. *Chinese herbal medicine: Materia medica* 3rded: Eastland Press, Seattle 2004.

[19] Kawagishi H, Fukuhara F, Sazuka M, Kawashima A, Mitsubori T, Tomita T. 5′-Deoxy-5′-methylsulphinyladenosine, a platelet aggregation inhibitor from *Ganoderma lucidum*. *Phytochem* 1993;32(2):239-41.

[20] Shimizu A, Yano T, Saito Y, Inada Y. Isolation of an inhibitor of platelet aggregation from a fungus, *Ganoderma lucidum*. *Chem Pharm Bull (Tokyo)* 1985;33(7):3012-5.

[21] Fukuzawa M, Yamaguchi R, Hide I, Chen Z, Hirai Y, Sugimoto A, *et al.* Possible involvement of long chain fatty acids in the spores of *Ganoderma lucidum* (Reishi Houshi) to its anti-tumor activity. *Biol Pharm Bull* 2008; 31(10):1933-7.

[22] Cao QZ, Lin ZB. *Ganoderma lucidum* polysaccharides peptide inhibits the growth of vascular endothelial cell and the induction of VEGF in human lung cancer cell. *Life Sci* 2006;78(13):1457-63.

[23] Cheng KC, Huang HC, Chen JH, Hsu JW, Cheng HC, Ou CH, *et al.* *Ganoderma lucidum* polysaccharides in human monocytic leukemia cells: from gene expression to network construction. *BMC Genomics* 2007;8:411-28.

[24] Lin ZB, Zhang HN. Anti-tumor and immunoregulatory activities of *Ganoderma lucidum* and its possible mechanisms. *Acta Pharmacol Sin* 2004; 25(11):1387-95.

[25] Pang X, Chen Z, Gao X, Liu W, Slavin M, Yao W, *et al.* Potential of a novel polysaccharide preparation (GLPP) from Anhui-grown *Ganoderma lucidum* in tumor treatment and immunostimulation. *J Food Sci* 2007;72(6):S435-42.

[26] Sliva D. *Ganoderma lucidum* (Reishi) in cancer treatment. *Integr Cancer Ther* 2003;2(4):358-64.

[27] Wang SY, Hsu ML, Hsu HC, Tzeng CH, Lee SS, Shiao MS, *et al.* The anti-tumor effect of *Ganoderma lucidum* is mediated by cytokines released from activated macrophages and T lymphocytes. *Int J Cancer* 1997;70(6):699-705.

[28] Weng CJ, Yen GC. The *in vitro* and *in vivo* experimental evidences disclose the chemopreventive effects of *Ganoderma lucidum* on cancer invasion and metastasis. *Clin Exp Metastasis* 2010;27(5):361-9.

[29] Yuen JW, Gohel MD. Anticancer effects of *Ganoderma lucidum*: A review of scientific evidence. *Nutr Cancer* 2005;53(1):11-7.

[30] Guo CY, Ji SZ, Ping CX. Modulatory effect of *Ganoderma lucidum* polysaccharides on serum antioxidant enzymes activities in ovarian cancer rats. *Carbohydr Polymer* 2009;78(2):258-62.

[31] Ping CX, Yan C, Bing LS, Guo CY, Yun LJ, Ping LL. Free radical scavenging of *Ganoderma lucidum* polysaccharides and its effect on antioxidant enzymes and immunity activities in cervical carcinoma rats. *Carbohydr Polymer* 2009; 77(2):389-93.

[32] Oh KW, Lee CK, Kim YS, Eo SK, Han SS. Antiherpetic activities of acidic protein bound polysacchride isolated from *Ganoderma lucidum* alone and in combinations with acyclovir and vidarabine. *J Ethnopharmacol* 2000;72(1-2): 221-7.

[33] Eo SK, Kim YS, Lee CK, Han SS. Possible mode of antiviral activity of acidic protein bound polysaccharide isolated from *Ganoderma lucidum* on herpes simplex viruses. *J Ethnopharmacol* 2000;72(3):475-81.

[34] Kim YS, Eo SK, Oh KW, Lee C, Han SS. Antiherpetic activities of acidic protein bound polysacchride isolated from *Ganoderma lucidum* alone and in combinations with interferons. *J Ethnopharmacol* 2000;72(3):451-8.

[35] Park EJ, Ko G, Kim J, Sohn DH. Antifibrotic effects of a polysaccharide extracted from *Ganoderma lucidum*, glycyrrhizin, and pentoxifylline in rats with cirrhosis induced by biliary obstruction. *Biol Pharm Bull* 1997;20(4):417-20.

[36] Zhang GL, Wang YH, Ni W, Teng HL, Lin ZB. Hepatoprotective role of *Ganoderma lucidum* polysaccharide against BCG-induced immune liver injury in mice. *World J Gastroenterol* 2002;8(4):728-33.

[37] Hikino H, Konno C, Mirin Y, Hayashi T. Isolation and hypoglycemic activity of ganoderans A and B, glycans of *Ganoderma lucidum* fruit bodies. *Planta Med* 1985;51(4):339-40.

[38] Hikino H, Ishiyama M, Suzuki Y, Konno C. Mechanisms of Hypoglycemic Activity of Ganoderan B: A Glycan of *Ganoderma lucidum* Fruit Bodies. *Planta Med* 1989;55(5):423-8.

[39] Zhang HN, Lin ZB. Hypoglycemic effect of *Ganoderma lucidum* polysaccharides. *Acta Pharmacol Sin* 2004;25(2):191-5.

[40] Zhou ZY, Tang YP, Xiang J, Wua P, Jin HM, Wang Z, *et al.* Neuroprotective effects of water-soluble *Ganoderma lucidum* polysaccharides on cerebral ischemic injury in rats. *J Ethnopharmacol* 2010;131(1):154-64.

[41] Lin CH, Hsiao YM, Ou CC, Lin YW, Chiu YL, Lue KH, *et al.* GMI, a *Ganoderma* immunomodulatory protein, down-regulates TNFα-induced expression of MMP-9 via NF-κB pathway in human alveolar epithelial A549 cells. *J Agric Food Chem* 2010;58(22):12014-21.

[42] Miyasaka N, Inoue H, Totsuka T, Koike R, Kino K, Tsunoo H. An immunomodulatory protein, Ling Zhi-8, facilitates cellular interaction through modulation of adhesion molecules. *Biochem Biophys Res Commun* 1992; 186(1):385-90.

[43] van der Hem LG, van der Vliet JA, Bocken CF, Kino K, Hoitsma AJ, Tax WJ. Ling Zhi-8: Studies of a new immunomodulating agent. *Transplant* 1995; 60(5):438-43.

[44] Yeh CH, Chen HC, Yang JJ, Chuang WI, Sheu F. Polysaccharides PS-G and protein LZ-8 from Reishi (*Ganoderma lucidum*) exhibit diverse functions in regulating murine macrophages and T lymphocytes. *J Agric Food Chem* 2010; 58(15):8535-44.

[45] Weng Y, Xiang L, Matsuura A, Zhang Y, Huang Q, Qi J. Ganodermasides A and B, two novel anti-aging ergosterols from spores of a medicinal mushroom *Ganoderma lucidum* on yeast via *UTH1* gene. *Bioorg Med Chem* 2010; 18(3):999-1002.

[46] Chen NH, Zhong JJ. Ganoderic acid Me induces G_1 arrest in wild-type p53 human tumor cells while G_1/S transition arrest in p53-null cells. *Process Biochem* 2009;44(8):928-33.

[47] Chen NH, Liu JW, Zhong JJ. Ganoderic acid T inhibits tumor invasion *in vitro* and *in vivo* through inhibition of MMP expression. *Pharmacol Rep* 2010; 62(1):150-63.

[48] Gao JJ, Min BS, Ahn EM, Nakamura N, Lee HK, Hattori M. New triterpene aldehydes, lucialdehydes A-C, from *Ganoderma lucidum* and their cytotoxicity against murine and human tumor cells. *Chem Pharm Bull (Tokyo)* 2002;50(6):837-40.

[49] Harhaji Trajković LM, Mijatović SA, Maksimović-Ivanić DD, Stojanović ID, Momcilović MB, Tufegdzić SJ, *et al.* Anticancer properties of *Ganoderma lucidum* methanol extracts *in vitro* and *in vivo*. *Nutr Cancer* 2009;61(5):696-707.

[50] Li CH, Chen PY, Chang UM, Kan LS, Fang WH, Tsai KS, *et al.* Ganoderic acid X, a lanostanoid triterpene, inhibits topoisomerases and induces apoptosis of cancer cells. *Life Sci* 2005;77(3):252-65.

[51] Lin SB, Li CH, Lee SS, Kan LS. Triterpene-enriched extracts from *Ganoderma lucidum* inhibit growth of hepatoma cells via suppressing protein kinase C, activating mitogen-activated protein kinases and G_2-phase cell cycle arrest. *Life Sci* 2003;72(21):2381-90.

[52] Weng CJ, Chau CF, Hsieh YS, Yang SF, Yen GC. Lucidenic acid inhibits PMA-induced invasion of human hepatoma cells through inactivating MAPK/ ERK signal transduction pathway and reducing binding activities of NF-κB and AP-1. *Carcinog* 2008;29(1):147-56.

[53] Weng CJ, Chau CF, Yen GC, Liao JW, Chen DH, Chen KD. Inhibitory effects of *Ganoderma lucidum* on tumorigenesis and metastasis of human hepatoma cells in cells and animal models. *J Agric Food Chem* 2009;57(11):5049-57.

[54] Wu TS, Shi LS, Kuo SC. Cytotoxicity of *Ganoderma lucidum* triterpenes. *J Nat Prod* 2001;64(8):1121-2.

[55] Xie JT, Wang CZ, Wicks S, Yin JJ, Kong J, Li J, *et al. Ganoderma lucidum* extract inhibits proliferation of SW 480 human colorectal cancer cells. *Exp Oncol* 2006;28(1):25-9.

[56] Yang HL. Ganoderic acid produced from submerged culture of *Ganoderma lucidum* induces cell cycle arrest and cytotoxicity in human hepatoma cell line BEL7402. *Biotechnol Lett* 2005;27(12):835-8.

[57] Yue QX, Cao ZW, Guan SH, Liu XH, Tao L, Wu WY, *et al.* Proteomics characterization of the cytotoxicity mechanism of ganoderic acid D and computer-automated estimation of the possible drug target network. *Mol Cell Proteomics* 2008;7(5):949-61.

[58] Min BS, Gao JJ, Hattori M, Lee HK, Kim YH. Anticomplement activity of terpenoids from the spores of *Ganoderma lucidum*. *Planta Med* 2001;67(9): 811-4.

[59] Seo HW, Hung TM, Na M, Jung HJ, Kim JC, Choi JS, *et al.* Steroids and triterpenes from the fruit bodies of *Ganoderma lucidum* and their anti-complement activity. *Arch Pharm Res* 2009;32(11):1573-9.

[60] Kohda H, Tokumoto W, Sakamoto K, Fujii M, Hirai Y, Yamasaki K, *et al.* The biologically active constituents of *Ganoderma lucidum* (Fr.) Karst. Histamine release-inhibitory triterpenes. *Chem Pharm Bull (Tokyo)* 1985; 33(4):1367-74.

[61] Dudhgaonkar S, Thyagarajan A, Sliva D. Suppression of the inflammatory response by triterpenes isolated from the mushroom *Ganoderma lucidum*. *Int Immunopharmacol* 2009;9(11):1272-80.

[62] Ko HH, Hung CF, Wang JP, Lin CN. Antiinflammatory triterpenoids and steroids from *Ganoderma lucidum* and *G. tsugae*. *Phytochem* 2008;69(1):234-9.

[63] Adams M, Christen M, Plitzko I, Zimmermann S, Brun R, Kaiser M, *et al.* Antiplasmodial lanostanes from the *Ganoderma lucidum* mushroom. *J Nat Prod* 2010;73(5):897-900.

[64] Su CY, Shiao MS, Wang CT. Differential effects of ganodermic acid S on the TXA_2-signaling pathways in human platelets. *Biochem Pharmacol* 1999; 58(4):587-95.

[65] El-Mekkawy S, Meselhy MR, Nakamura N, Tezuka Y, Hattori M, Kakiuchi N, *et al.* Anti-HIV-1 and anti-HIV-1-protease substances from *Ganoderma lucidum*. *Phytochem* 1998;49(6):1651-7.

[66] Li YQ, Wang SF. Anti-hepatitis B activities of ganoderic acid from *Ganoderma lucidum*. *Biotechnol Lett* 2006;28(11):837-41.

[67] Min BS, Nakamura N, Miyashiro H, Bae KW, Hattori M. Triterpenes from the spores of *Ganoderma lucidum* and their inhibitory activity against HIV-1 protease. *Chem Pharm Bull (Tokyo)* 1998;46(10):1607-12.

[68] Miyamoto I, Liu J, Shimizu K, Sato M, Kukita A, Kukita T, *et al.* Regulation of osteoclastogenesis by ganoderic acid DM isolated from *Ganoderma lucidum*. *Eur J Pharmacol* 2009;602(1):1-7.

[69] Fatmawati S, Shimizu K, Kondo R. Inhibition of aldose reductase *in vitro* by constituents of *Ganoderma lucidum*. *Planta Med* 2010;76(15):1691-3.

[70] Liu J, Kurashiki K, Shimizu K, Kondo R. 5α-Reductase inhibitory effect of triterpenoids isolated from *Ganoderma lucidum*. *Biol Pharm Bull* 2006;29(2): 392-5.

[71] Liu J, Shiono J, Shimizu K, Kukita A, Kukita T, Kondo R. Ganoderic acid DM: Anti-androgenic osteoclastogenesis inhibitor. *Bioorg Med Chem Lett* 2009;19(8):2154-7.

[72] Wu YW, Fang HL, Lin WC. Post-treatment of *Ganoderma lucidum* reduced liver fibrosis induced by thioacetamide in mice. *Phytother Res* 2010;24(4): 494-9.

[73] Hajjaj H, Macé C, Roberts M, Niederberger P, Fay LB. Effect of 26-oxygenosterols from *Ganoderma lucidum* and their activity as cholesterol synthesis inhibitors. *Appl Environ Microbiol* 2005;71(7):3653-8.

[74] Li C, Li Y, Sun HH. New ganoderic acids, bioactive triterpenoid metabolites from the mushroom *Ganoderma lucidum*. *Nat Prod Res* 2006;20(11):985-91.

[75] Breitmaier E. Terpenes: Importance, general structure, and biosynthesis. In: *Terpenes: Flavors, fragrances, pharmaca, pheromones*: Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim 2006:1-9.

[76] Hattori M. Recent studies on the bitter principles of *Ganoderma lucidum*-isolation of novel triterpenes, their biological activity and pharmacokinetics. *Proc Int Symposium Ganoderma Sci* 2001; Auckland, New Zealand; 2001. p. 27-9.

[77] Gao JJ, Min BS, Akao T, Meselhy MR, Nakamura N, Hattori M. Enzyme immunoassay for the quatitative determination of ganoderic acid A from *Ganoderma lucidum*. *J Trad Med* 2001;18(4):154-60.

[78] Xue BB, Guo XY, Che QM. Determination of ganoderic acids in rat plasma after oral administration of total triterpenoids from *Ganoderma lucidum*. *J Chin Pharmaceut Sci* 2008;17(3):236-40.

[79] Adamec J, Jannasch A, Dudhgaonkar S, Jedinak A, Sedlak M, Sliva D. Development of a new method for improved identification and relative quantification of unknown metabolites in complex samples: Determination of a triterpenoid metabolic fingerprint for the *in situ* characterization of *Ganoderma* bioactive compounds. *J Sep Sci* 2009;32(23-24):4052-8.

[80] Wachtel-Galor S, Tomlinson B, Benzie IF. *Ganoderma lucidum* ("Lingzhi"), a Chinese medicinal mushroom: Biomarker responses in a controlled human supplementation study. *Br J Nutr* 2004;91(2):263-9.

[81] Wicks SM, Tong R, Wang CZ, O'Connor M, Karrison T, Li S, *et al.* Safety and tolerability of *Ganoderma lucidum* in healthy subjects: A double-blind randomized placebo-controlled trial. *Am J Chin Med* 2007;35(3):407-14.

[82] Kwok Y, Ng KF, Li CC, Lam CC, Man RY. A prospective, randomized, double-blind, placebo-controlled study of the platelet and global hemostatic effects of *Ganoderma lucidum* (Ling-Zhi) in healthy volunteers. *Anesth Analg* 2005;101(2):423-6.

[83] Tang W, Gao Y, Chen G, Gao H, Dai X, Ye J, *et al.* A randomized, double-blind and placebo-controlled study of a *Ganoderma lucidum* polysaccharide extract in neurasthenia. *J Med Food* 2005;8(1):53-8.

[84] Hijikata Y, Yamada S, Yasuhara A. Herbal mixtures containing the mushroom *Ganoderma lucidum* improve recovery time in patients with herpes genitalis and labialis. *J Altern Complement Med* 2007;13(9):985-7.

[85] Hijikata Y, Yamada S. Effect of *Ganoderma lucidum* on postherpetic neuralgia. *Am J Chin Med* 1998;26(3-4):375-81.

[86] Hijikata Y, Yasuhara A, Sahashi Y. Effect of an herbal formula containing *Ganoderma lucidum* on reduction of herpes zoster pain: A pilot clinical trial. *Am J Chin Med* 2005;33(4):517-23.

[87] Gao Y, Zhou S, Chen G, Dai X, Ye J, Gao H. A phase I/II study of a *Ganoderma lucidum* (Curt.:Fr.) P.Karst. (Ling Zhi, Reishi mushroom) extract in patients with chronic hepatitis B. *Int J Med Mushrooms* 2002;4:2321-7.

[88] Gao Y, Lan J, Dai X, Ye J, Zhou S. A phase I/II study of Ling Zhi mushroom *Ganoderma lucidum* (W.Curt.:Fr.) Lloyd (Aphyllophoromycetidae) extract in patients with type II diabetes mellitus. *Int J Med Mushrooms* 2004;6:33-9.

[89] Noguchi M, Kakuma T, Tomiyasu K, Yamada A, Itoh K, Konishi F, *et al.* Randomized clinical trial of an ethanol extract of *Ganoderma lucidum* in men with lower urinary tract symptoms. *Asian J Androl* 2008;10(5):777-85.

[90] Futrakul N, Boongen M, Tosukhowong P, Patumraj S, Futrakul P. Treatment with vasodilators and crude extract of *Ganoderma lucidum* suppresses proteinuria in nephrosis with focal segmental glomerulosclerosis. *Nephron* 2002;92(3):719-20.

[91] Gao Y, Zhou S, Jiang W, Huang M, Dai X. Effects of Ganopoly (a *Ganoderma lucidum* polysaccharide extract) on the immune functions in advanced-stage cancer patients. *Immunol Invest* 2003;32(3):201-15.

[92] Gao Y, Zhou S, Chen G, Dai X, Ye J. A phase I/II study of a *Ganoderma lucidum* (Curt.:Fr.) P.Karst. extract (Ganopoly) in patients with advanced cancer. *Int J Med Mushrooms* 2002;4:207-14.

[93] Gao Y, Dai X, Chen G, Ye J, Zhou S. A randomized, placebo-controlled, multicenter study of *Ganoderma lucidum* (W.Curt.:Fr.) Lloyd (Aphylloro-mycetidae) polysaccharides (Ganopoly) in patients with advanced lung cancer. *Int J Med Mushrooms* 2003;5:369-81.

[94] Gao Y, Tang W, Dai X, Gao H, Chen G, Ye J, *et al.* Effects of water-soluble *Ganoderma lucidum* polysaccharides on the immune functions of patients with advanced lung cancer. *J Med Food* 2005;8(2):159-68.

[95] Chen X, Hu ZP, Yang XX, Huang M, Gao Y, Tang W, *et al.* Monitoring of immune responses to a herbal immunomodulator in patients with advanced colorectal cancer. *Int Immunopharmacol* 2006;6(3):499-508.

[96] Oka S, Tanaka S, Yoshida S, Hiyama T, Ueno Y, Ito M, *et al.* A water-soluble extract from culture medium of *Ganoderma lucidum* mycelia suppresses the development of colorectal adenomas. *Hiroshima J Med Sci* 2010;59(1):1-6.

[97] Kim HW, Kim BK. Biomedical triterpenoids of *Ganoderma lucidum* (Curt.:Fr.) P. Karst. (Aphyllophoromycetideae). *Int J Med Mushrooms* 1999;1: 121-38.

[98] Chiu SW, Wang ZM, Leung TM, Moore D. Nutritional value of *Ganoderma* extract and assessment of its genotoxicity and antigenotoxicity using comet assays of mouse lymphocytes. *Food Chem Toxicol* 2000;38(2-3):173-8.

[99] Noguchi M, Kakuma T, Tomiyasu K, Kurita Y, Kukihara H, Konishi F, *et al.* Effect of an extract of *Ganoderma lucidum* in men with lower urinary tract symptoms: A double-blind, placebo-controlled randomized and dose-ranging study. *Asian J Androl* 2008;10(4):651-8.

[100] Yuen MF, Ip P, Ng WK, Lai CL. Hepatotoxicity due to a formulation of *Ganoderma lucidum* (lingzhi). *J Hepatol* 2004;41(4):686-7.

[101] Wanmuang H, Leopairut J, Kositchaiwat C, Wananukul W, Bunyaratvej S. Fatal fulminant hepatitis associated with *Ganoderma lucidum* (Lingzhi) mushroom powder. *J Med Assoc Thai* 2007;90(1):179-81.

[102] Wang XM, Yang M, Guan SH, Liu RX, Xia JM, Bi KS, *et al.* Quantitative determination of six major triterpenoids in *Ganoderma lucidum* and related species by high performance liquid chromatography. *J Pharm Biomed Anal* 2006;41(3):838-44.

[103] Melander A. Influence of food on the bioavailability of drugs. *Clin Pharmacokinet* 1978;3(5):337-51.

[104] U.S. Department of Health and Human Services Food and Drug Administration, Center for Drug Evaluation and Research (CDER), Center for Veterinary Medicine (CVM). *Guidance for Industry Bioanalytical Method Validation* 2001:1-20.

[105] European, Medicines, Agency. *Guideline on the investigation of bioequivalence*. 2008:1-29.

[106] Zhang Q, Zuo F, Nakamura N, Ma CM, Hattori M. Metabolism and pharmacokinetics in rats of ganoderiol F, a highly cytotoxic and antitumor triterpene from *Ganoderma lucidum*. *J Nat Med* 2009;63(3):304-10.

[107] Winstanley PA, Orme ML. The effects of food on drug bioavailability. *Br J Clin Pharmacol* 1989;28(6):621-8.

[108] Toothaker RD, Welling PG. The effect of food on drug bioavailability. *Ann Rev Pharmacol Toxicol* 1980;20:173-99.

[109] Welling PG. Effects of food on drug absorption. *Annu Rev Nutr* 1996;16:383-415.

[110] Charman WN, Porter CJ, Mithani S, Dressman JB. Physiochemical and physiological mechanisms for the effects of food on drug absorption: The role of lipids and pH. *J Pharm Sci* 1997;86(3):269-82.

APPENDIX

Analyte

Analyte is a specific chemical moiety being measured, which can be intact drug, biomolecule or its derivative, metabolite, and/or degradation product in a biologic matrix (serum, plasma, urine, feces, saliva, sputum, and various discrete tissues).

Area under the curve (AUC)

The AUC is a measure of the total amount of intact drug absorbed that reaches the systemic circulation. It is calculated from the integral of total area under the concentration-time curve, from time zero to infinity. The AUC symbol may be qualified by a specific time (AUC_{0-8}), time of last quantifiable concentration (AUC_{0-t}), or infinity ($AUC_{0-\infty}$). AUC is calculated from observed data at specific time points. The unit of $AUC_{0-\infty}$ is a unit of drug concentration multiplied by time (e.g., ng.h/mL).

Bioavailability

The bioavailability of drug is the fraction (F) of the rate and extent of the administered dose that reaches systemic circulation. Bioavailability is defined as unity (or 100%) in the case of intravenous administration. After administration by the other routes, bioavailability is generally reduced by incomplete absorption, first pass metabolism, and any distribution into other tissues that occurs before the drug enters the systemic circulation. To account for differing rates of absorption into the blood, the concentration appearing in the plasma must be integrated over time to obtain an integrated total area under the plasma concentration curve.

Calibration standard

Calibration standard is a biological matrix to which a known amount of analyte has been added or spiked. It is used to construct calibration curves from which the concentrations of analytes in quality control and in unknown study samples are determined.

Elimination half-life ($t_{1/2}$)

$t_{1/2}$ is the time taken for the amount or concentration of a drug in the body to fall by half. The unit for $t_{1/2}$ is the unit of time (e.g., h, min).

Internal standard (IS)

IS is a test compound (e.g., structurally similar analog, stable labeled compound) added to both calibration standards and samples at known and constant concentration to facilitate quantification of the target analyte.

Limit of detection (LOD)

LOD is the lowest concentration of an analyte that the bioanalytical procedure can reliably differentiate from background noise. It is typically defined as a signal-to-noise ratio of at least 3 : 1.

Limit of quantification (LOQ)

LOQ is the lowest concentration of an analyte in a sample that can be quantitatively determined with suitable precision and accuracy. Oftentimes, a signal-to-noise ratio of 10 : 1 is used to determine the LOQ.

Maximum plasma concentration (C_{max})

C_{max} represents the maximal or the peak plasma drug concentration after drug administration. The unit for C_{max} is a concentration unit (e.g., μg/mL, ng/mL)

Pharmacokinetics

Pharmacokinetics is the one of the two basic areas of the pharmacology, in addition to pharmacodynamics. It deals with the quantification of the process of drug absorption, distribution, biotransformation, and excretion. These factors, coupled with prescribed drug dose, determine the time course of drug concentration *in vivo*. Pharmacokinetic studies of drug are clinically useful to predict the intensity of drug effects if the relationship exists between the drug concentrations and pharmacologic or toxic effects of drugs.

Sample

A generic term encompassing controls, blanks, unknowns, and processed samples, as described below:

- ***Blank:*** A sample of a biological matrix to which no analytes have been added that is used to assess the specificity of the bioanalytical method.
- ***Quality control sample (QC):*** A spiked sample used to monitor the performance of a bioanalytical method and to assess the integrity and validity of the results of the unknown samples analyzed in an individual batch.
- ***Unknown:*** A biological sample that is the subject of the analysis.

Standard curve

The relationship between the experiment response value and analytical concentration (also called a calibration curve).

Time to reach the maximum plasma concentration (T_{max})

T_{max} corresponds to the time required to reach the maximum plasma concentration after drug administration. It is a measure of the rate of drug absorption, which exceeds its early disposition. Until a time T_{max} is reached that the rate of elimination matches the rate of absorption. The unit of T_{max} is a unit of time, e.g., h or min.

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