



EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

12 July 2011
EMA/HMPC/571121/2010
Committee on Herbal Medicinal Products (HMPC)

List of references supporting the assessment of *Glycyrrhiza glabra* L. and/or *Glycyrrhiza inflata* Bat. and/or *Glycyrrhiza uralensis* Fisch, radix

Draft

The Agency acknowledges that copies of the underlying works used to produce this monograph were provided for research only with exclusion of any commercial purpose.

Agarwal A, Gupta D, Yadav G, Goyal P, Singh PK, Singh U. An evaluation of the efficacy of licorice gargle for attenuating postoperative sore throat: a prospective, randomized, single-blind study. *Anesth Analg*. 2009, 109: 77-81.

Arase Y, Ikeda K, Murashima N, Chayama K, Tsubota A, Koida I, et al. The Long Term Efficacy of Glycyrrhizin in Chronic Hepatitis C Patients. *Cancer* 1997, 79(8): 1494-500.

Armanini D, Fiore C, Mattarello MJ, Bielenberg J, Palermo M. History of the endocrine effects of licorice. *Exp Clin Endocrinol Diabetes* 2002, 110: 257-261.

Armanini D, Nacamulli D, Francini-Pesenti F, Battagin G, Ragazzi E, Fiore C. Glycyrrhetic acid, the active principle of licorice, can reduce the thickness of subcutaneous thigh fat through topical application. *Steroids* 2005, 70: 538-542.

Asl MN, Hosseinzadeh H. Review of pharmacological effects of *Glycyrrhiza* sp. and its bioactive compounds. *Phytother Res* 2008, 22: 709-24.

Baker ME. Licorice and enzymes other than 11 beta-hydroxysteroid dehydrogenase: an evolutionary perspective. *Steroids* 1994; 59: 136-41.

Bardhan KD, Cumberland DC, Dixon RA, Holdsworth CD. Clinical trial of deglycyrrhizinised liquorice in gastric ulcer. *Gut* 1978, 19: 779-782.

Barnes J, Anderson LAA, Phillipson JD. Herbal Medicines 2nd ed. Pharmaceutical Press: London, 2002, 325-329.

Biondi DM, Rocco C, Ruberto G. Dihydrostilbene derivatives from *Glycyrrhiza glabra* leaves. *J Nat Prod* 2005, 68: 1099-1102.



- Blumenthal M, editor. The ABC Clinical Guide to Herbs. 1st ed. American Botanical Council, Austin, Texas 2003, 2076-2081.
- Blumenthal M, Goldberg A, Brinkmann J, editors. Herbal Medicine: Expanded Commission E Monographs. Boston (MA): *Integrative Medicine Communications*; 2000.
- Bouras P, Skouroliakou M, Tsonas S. Licorice: a traditional herb and its modern effects on humans. *EHP* 2001, 7: 135-140.
- British Herbal Pharmacopoeia. Bournemouth: British Herbal Association 1990, vol. 1.
- Brown P, Salmon PR, Thien-Htut, Read AE. Double-blind trial of carbenoxolone sodium capsules in duodenal ulcer therapy, based on endoscopic diagnosis and follow-up. *Br Med J.* 1972; 3: 661-664.
- Cantelli-Forti G, Maffei F, Hrelia P, Bugamelli F, Bernardi M, D'Intino P, et al. Interaction of licorice on glycyrrhizin pharmacokinetics. *Environmental Health Perspectives* 1994, 102: 65-68.
- Cassileth BR, Barazzuol JD. Herbal products and other supplements problems of special relevance to surgery. *J Pelvic Surgery* 2001, 7: 21-26.
- Chang Y-P, Cheng C-J, Lin S-H. Licorice-induced hypokalemic paralysis in a patient with chronic atopic dermatitis. *J Med Sci* 2006, 26: 129-132.
- Cheng CJ, Chen YH, Chau T, Lin SH. A hidden cause of hypokalemic paralysis in a patient with prostate cancer. *Support Care Cancer* 2004, 12(11): 810-2.
- Chin Y, Jung H-A, Liu Y, Su BN, Castoro JA, Keller WJ, Pereira MA, Kinghorn AD. Anti-oxidant Constituents of the Roots and Stolons of Licorice (*Glycyrrhiza glabra*). *J Agric Food Chem* 2007, 55: 4691-4697.
- Cinati J, Morgenstern B, Bauer G, Chandra P, Rabenau H, Doerr HW. Glycyrrhizin, an active component of liquorice roots, and replication of SARS-associated coronavirus. *Lancet* 2003; 361: 2045-2046.
- Cumming AM, Boddy K, Brown JJ, Fraser R, Lever AF, Padfield PL, Robertson JI. Severe hypokalaemia with paralysis induced by small doses of liquorice. *Postgrad Med J.* 1980; 56: 526-529.
- Davis EA, Morris DJ. Medicinal uses of licorice through the millennia: the good and plenty of it. *Molecular and Cellular Endocrinology* 1991, 78: 1-6.
- Dembinska-Kiec A, Pallapies D, Simmet T, Peskar BM, Peskar BA. Effect of carbenoxolone on the biological activity of nitricoxide: relation to gastroprotection. *J Pharmacol* 1991, 104: 811-816.
- de Klerk GJ, Nieuwenhuis MG, Beutler JJ. Hypokalaemia and hypertension associated with use of liquorice flavoured chewing gum. *Br Med J.* 1997; 314: 731-732.
- De Simone F, Aquino R, De Tommasi N, Mahmood N, Piacente S, Pizza C. Anti-HIV aromatic compounds from higher plants. In: Tringali C editor. *Bioactive Compounds from Natural Sources: Isolation, Characterization and Biological Properties*, Taylor and Francis: New York 2001, 325.
- Deutscher Arzneimittel-Codex (DAC) 2009 – Ergänzungsbuch zum Arzneibuch – Band 1; ABDA Bundesvereinigung Deutscher Apothekerverbände; Govi Verlag Pharmazeutischer Verlag GmbH; Eschborn Deutscher Apotheker Verlag – Stuttgart 2008: D-095, 20.
- Dhingra D, Sharma A. Antidepressant-like activity of *Glycyrrhiza glabra* L. in mouse models of immobility tests. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 2006, 30: 449-454.
- Doll R, Langman MJS, Shawdon HH. Treatment of gastric ulcer with carbenoxolone: antagonistic effect of spironolactone. *Gut* 1968, 9: 42-45.

- Elinav E, Chajek-Shaul T. Licorice consumption causing severe hypokalemic paralysis. *Mayo Clin Proc* 2003 Jun, 78(6): 767-8.
- Engqvist A, von Feilitzen F, Einar P, Reichard H. Double-blind trial of deglycyrrhizinated liquorice in gastric ulcer. *Gut* 1973, 14: 711-715.
- ESCOP (European Scientific Cooperative on Phytotherapy): *Liquiritiae radix*. In: Monographs on the medicinal uses of plant drugs. Argyle House, ESCOP, Exeter, UK; 2003.
- European Pharmacopoeia 7th edition: Liquorice root - *Liquiritiae radix* 01/2010: 0277 (under minor revision).
- European Pharmacopoeia 7th edition: Liquorice dry extract for flavouring purposes - *Liquiritiae extractum siccum ad saporandum* 04/2008: 2378 (under revision).
- European Pharmacopoeia 7th edition: Liquorice ethanolic liquid extract, standardised - *Liquiritiae extractum fluidum ethanolicum normatum* 01/2011: 1536 (under minor revision).
- H. Feldman H, Gilat T. A trial of deglycyrrhizinated liquorice in the treatment of duodenal ulcer *Gut* 1971, 12: 449-451.
- Fenwick GR, Lutomski J, Nieman C. Liquorice, *Glycyrrhiza glabra* L. Composition, uses and analysis. *Food Chemistry* 1990, 38: 119-143.
- Fiore C, Eisenhut M, Ragazzi E, Zanchin G, Armanini D. A history of the therapeutic use of liquorice in Europe. *J Ethnopharmacol.* 2005, 99: 317-324.
- Fiore C, Eisenhut M, Krausse R, Ragazzi E, Pellati D, Armanini D, Bielenberg J. Antiviral effects of *Glycyrrhiza* species. *Phytother Res.* 2008, 22: 141-148.
- Francini-Pesenti F, Puato M, Piccoli A, Brocadello F. Liquorice-induced hypokalaemia and water retention in the absence of hypertension. *Phytother Res* 2008, 22(4): 563-5.
- Fraser PM, Doll R, Langman MJ, Misiewicz JJ, Shawdon HH. Clinical trial of a new carbenoxolone analogue (BX24), zinc sulphate, and vitamin A in the treatment of gastric ulcer. *Gut* 1972;13: 459-463.
- Fugh-Berman A. Herb-drug interactions. *Lancet.* 2000, 355: 134-138.
- Fuhrman B, Buch S, Vaya J et al. Licorice extract and its major polyphenol glabridin protect low-density lipoprotein against lipid peroxidation: in vitro and ex vivo studies in humans and in atherosclerotic apolipoprotein E-deficient mice. *Am J Clin Nutr* 1997, 66: 276-275.
- Fuhrman B, Volkova N, Kaplan M, Presser D, Attias J, Hayek T, Aviram M. Antiatherosclerotic Effects of Licorice Extract Supplementation on Hypercholesterolemic Patients: Increased Resistance of LDL to Atherogenic Modifications, Reduced Plasma Lipid Levels, and Decreased Systolic Blood Pressure. *Nutrition* 2002, 18: 268 -273.
- Fukai T, Marumo A, Kaitou K, Kanda T, Terada S, Nomura T. Antimicrobial activity of licorice flavonoids against methicillin-resistant *Staphylococcus aureus*. *Fitoterapia* 2002, 73: 536-539.
- Gerritsen KG, Meulenbelt J, Spiering W, Kema IP, Demir A, van Driel VJ. An unusual cause of ventricular fibrillation. *Lancet* 2009, 373: 1144.
- Ghielmini C, Hoffmann A. [A case from practice (171). Pseudohyperaldosteronism in licorice abuse]. *Schweiz Rundsch Med Prax.* 1990, 79: 472-473.
- Glycyrrhiza glabra*. Monograph. *Alternative Medicine Review* 2005, 10: 230-237.

- Gopal MS. In Vitro Antifungal and Antibacterial Activities of Root Extract of Glycyrrhiza Glabra. *Journal of Applied Sciences Research*, 2009, 5: 1436-1439.
- Gupta VK, Fatima A, Faridi U, Negi AS, Shanker K, Kumarb JK, et al. Antimicrobial potential of *Glycyrrhiza glabra* roots. *Journal of Ethnopharmacology* 2008, 116: 377–380.
- Haraguchi H. Antioxidative plant constituents. In: Tringali C editor. *Bioactive Compounds from Natural Sources: Isolation, Characterization and Biological Properties*, Taylor and Francis: New York 2001, 348–352.
- Hasegawa J, Suyama Y, Kinugawa T, Morisawa T, Kishimoto Y. Echocardiographic findings of the heart resembling dilated cardiomyopathy during hypokalemic myopathy due to licorice-induced pseudoaldosteronism. *Cardiovasc Drugs Ther* 1998, 12(6): 599-600.
- Hayashi H, Hiraoka N, Ikeshiro Y, Yamamoto H, Yoshikawa T. Seasonal variation of glycyrrhizin and isoliquiritigenin glycosides in the root of *Glycyrrhiza glabra* L. *Biol Pharm Bull* 1998, 21: 987–989.
- Heikens J, Fliers E, Endert E, Ackermans M, van Montfrans G. Licorice-induced hypertension--a new understanding of an old disease: case report and brief review. *Neth J Med*. 1995, 47(5): 230-234.
- Hollanders D, Green G, Woolf IL, Boyes BE, Wilson RY, Cowley DJ, Dymock IW. Prophylaxis with deglycyrrhizinised licorice in patients with healed gastric ulcer. *Br Med J*. 1978, 1: 148.
- Horwich L, Galloway R. Treatment of gastric ulceration with carbenoxolone sodium: clinical and radiological evaluation. *Br Med J*. 1965, 2: 1274-1277.
- Hundertmark S, Dill A, Buhler H, Stevens P, Looman K, Ragosch V, et al. 11 β -Hydroxysteroid dehydrogenase type 1: a new regulator of fetal lung maturation. *Hormone and Metabolic Research* 2002, 34: 537–544.
- Ikken Y, Morales P, Martinez A, Marin ML, Haza AI and Cambero MI. Antimutagenic Effect of Fruit and Vegetable Ethanolic Extracts against *N*-Nitrosamines Evaluated by the Ames Test. *J. Agric Food Chem* 1999, 47: 3257-3264.
- Isbrucker RA, Burdock GA. Risk and safety assessment on the consumption of Licorice root (*Glycyrrhiza* sp.), its extract and powder as a food ingredient, with emphasis on the pharmacology and toxicology of glycyrrhizin. *Regular Toxicol Pharmacol*. 2006, 46: 167-92.
- Ishida, S., Kinoshita, M., Sakiya, Y., Taira, Z., Ichikawa, T. Glycyrrhizin binding site on human serum albumin. *Chemical & Pharmaceutical Bulletin* 1992, 40: 275–278.
- Ishiguchi T, Mikita N, Iwata T, Nakata H, Sato H, Higashimoto Y, Fujimoto H, et al. Myoclonus and metabolic alkalosis from licorice in antacid. *Intern Med* 2004, 43(1): 59-62.
- Ishii and Fujii. Effects of Fm 100, a fraction of licorice root, on serum gastrin concentration in rats and dogs. *Japan. J. Pharmacol*. 1982, 32: 23-27.
- Itami T, Ema M, Kanoh S, 1985. Effect of disodium glycyrrhizinate on pregnant rats and their offspring. *Journal of the Food Hygienic Society of Japan* 1985, 26: 460–464.
- Jeon JH, Park D, Shin S, Kang DH, Moon SH, Kim YB. Effect of green tea and licorice extracts on cyclophosphamide teratogenicity. *Abstracts / Reproductive Toxicology* 2007, 24: 57–80.
- Jeong HG, You HJ, Park SJ, Moon AR, Chung YC, Kang SK, Chun HK. Hepatoprotective effects of 18 β -glycyrrhetic acid on carbon tetrachloride-induced liver injury: inhibition of cytochrome P450 2E1 expression. *Pharmacol Res*. 2002, 46: 221-227.

- Kim HJ, Seo SH, Lee B-G, Lee YS. Identification of tyrosinase inhibitors from *Glycyrrhiza uralensis*. *Planta Med.* 2005, 71: 785–787.
- Kim KR, Jeong CK, Park KK, Choi JH, Park JH, Lim SS, Chung WY. Anti-inflammatory effects of licorice and roasted licorice extracts on TPA-induced acute inflammation and collagen-induced arthritis in mice. *J Biomed Biotechnol.* 2010, 2010: 709378.
- Kinoshita T, Tamura Y, Mizutani K. The isolation and structure elucidation of minor isoflavonoids from licorice of *Glycyrrhiza glabra* origin. *Chem Pharm Bull* 2005, 53: 847– 849.
- Kiso Y, Tohkin M, Hikino H, Hattori M, Sakamoto T, Namba T, Mechanism of antihepatotoxic activity of glycyrrhizin, I: Effect on free radical generation and lipid peroxidation. *Planta Med.* 1984, 50: 298–302.
- Kobayashi S, Miyamoto T, Kimura I, Kimura M,. Inhibitory effect of isoliquiritin, a compound in licorice root, on angiogenesis *in vivo* and tube formation *in vitro*. *Biological & Pharmaceutical Bulletin* 1995, 18: 1382–1386.
- Kobayashi M, Fujita K, Katakura T, Utsunomiya T, Pollard RB, Suzuki F. Inhibitory effect of glycyrrhizin on experimental pulmonary metastasis in mice inoculated with B16 melanoma. *Anticancer Res.* 2002, 22: 4053-4058.
- Kobuke T, Inai K, Nambu S, Ohe K, Takemoto T, Matsuki K, et al. Tumorigenicity study of disodium glycyrrhizinate administered orally to mice. *Food and Chemical Toxicology* 1985, 23: 979–983.
- Langman MJ, Knapp DR, Wakley EJ. Treatment of chronic gastric ulcer with carbenoxolone and gefarnate: a comparative trial. *Br Med J.* 1973, 3: 84-86.
- Larkworthy W, Holgate PF, McIllmurray MB, Langman MJ. Deglycyrrhizinised liquorice in duodenal ulcer. *Br Med J.* 1977, 2: 1123.
- Latif SA, Semafuko WE, Morris DJ. Effects of carbenoxolone administered acutely to adrenalectomized rats (in vivo) on renal and hepatic handling of corticosterone by 11 beta-hydroxysteroid dehydrogenase. *Steroids* 1992, 57: 494-501.
- Li JR, Wang YQ, Deng ZZ. Two new compounds from *Glycyrrhiza glabra*. *J Asian Nat Prod Res* 2005, 7: 677–680.
- Mantovani A, Ricciardi C, Stazi AV, Macri C, Piccioni A, Badellino E, De Vincenzi M, Caiola S, Patriarca M. Teratogenicity study of ammonium glycyrrhizinate in the Sprague–Dawley rat. *Food and Chemical Toxicology* 1988, 26, 435–440.
- Mitscher LA, Drake S, Gollapudi SR, Harris JA, Shankel DM. Isolation and identification of higher plant agents active in antimutagenic assay systems: *Glycyrrhiza glabra*. *Basic Life Sci.* 1986, 39: 153-165.
- Moghadamnia AA, Motallebnejad M, Khanian M. The Efficacy of the Bioadhesive Patches Containing Licorice Extract in the Management of Recurrent Aphthous Stomatitis. *Phytother. Res.* 2009, 23: 246–250.
- Montgomery RD, Lawrence IH, Manton DJ, Mendl K, Rowe P. A controlled trial of carbenoxolone sodium capsules in the treatment of duodenal ulcer. *Gut* 1968, 9: 704-706.
- Mumoli N, Cei M. Licorice-induced hypokalemia. *Int J Cardiol* 2008, 124(3): 42-4.
- Näf R, Jaquier A. New lactones in liquorice (*Glycyrrhiza glabra* L.). *Flavour Fragr J* 2006, 21: 193–197.
- Nomura T, Fukai T, Akiyama T. Chemistry of phenolic compounds of licorice (*Glycyrrhiza* species) and their estrogenic and cytotoxic activities. *Pure Appl Chem* 2002, 74: 1199–1206.

- Numazaki. Glycyrrhizin therapy for viral infections. *African Journal of Biotechnology* 2003, 2: 392-393.
- Paolini M, Barillari J, Broccoli M, Pozzetti L, Perocco P, Cantelli-Forti G, Effect of liquorice and glycyrrhizin on rat liver carcinogen metabolizing enzymes. *Cancer Letters* 1999, 145: 35-42.
- Paolini M, Pozzetti L, Sapone A, Cantelli-Forti G. Effect of licorice and glycyrrhizin on murine liver CYP-dependent monooxygenases. *Life Sciences* 1998: 62, 571-582.
- PDR® (Physician's Desk Reference) for Herbal Medicines, 3rd ed. Thomson Healthcare Inc. Montvale, NJ 2004 [ISBN 1-56363-678-6] 510-519.
- Ploeger B, Mensinga T, Sips A, Meulenbelt J, DeJongh J. A human physiologically-based model for glycyrrhizic acid, a compound subject to presystemic metabolism and enterohepatic cycling. *Pharmaceutical Research* 2000, 17: 1516-1525.
- Russo S, Mastropasqua M, Mosetti MA, Peregani C, Paggi A. Low doses of liquorice can induce hypertension encephalopathy. *Am J Nephrol* 2000, 20: 145-148.
- Sabbioni C, Mandrioli R, Ferranti A, Bugamelli F, Saracino MA, Cantelli Forti G, Fanali S, Raggi MA, Separation and analysis of glycyrrhizin, 18-glycyrrhetic acid and 18-glycyrrhetic acid in liquorice roots by means of capillary zone. *Electrophoresis Journal of Chromatography A* 2005, 1081: 65-71.
- Saeedi M, Morteza-Semnani K, Ghoreishi MR. The treatment of atopic dermatitis with licorice gel. *J Dermatol Treat* 2003, 14: 153-157.
- Segal R, Pisanty S, Wormser R, Azaz E, Sela MN. Anticariogenic activity of licorice and glycyrrhizine I: Inhibition of *in vitro* plaque formation by *Streptococcus mutans*. *Journal of Pharmaceutical Sciences* 1985, 74: 79-81.
- Seki H, Ohyama K, Sawai S, Mizutani M, Ohnishi T, Sudo H, et al. Licorice beta-amyrin 11-oxidase, a cytochrome P450 with a key role in the biosynthesis of the triterpene sweetener glycyrrhizin. *Proc Natl Acad Sci U S A*. 2008, 105: 14204-9.
- Sharaf A., Gomaa N, Oestrogenic activity of different plants, *Qual. Plant. Mater. Veg.* 1971, 20: 271-277.
- Shinwari ZK, Khan I, Naz S, Hussain SA, Assessment of antibacterial activity of three plants used in Pakistan to cure respiratory diseases *African. Journal of Biotechnology* 2009, 8: 7082-7086.
- Shiota G, Harada K, Ishida M, Tomie Y, Okubo M, Katayama S, Ito H, Kawasaki H. Inhibition of hepatocellular carcinoma by glycyrrhizin in diethylnitrosamine-treated mice. *Carcinogenesis* 1999, 20: 59-63.
- Souness GW, Morris DJ. 11-Dehydrocorticosterone in the presence of carbenoxolone is a more potent sodium retainer than corticosterone. *Steroids* 1993, 58: 24-28.
- Stewart PM. 11 beta-Hydroxysteroid dehydrogenase: implications for clinical medicine. *Clin Endocrinol (Oxf)*. 1996, 44: 493-499.
- Strandberg TE, Järvenpää AL, Vanhanen H, McKeigue PM. Birth outcome in relation to licorice consumption during pregnancy. *Am J Epidemiol* 2001, 153: 1085-1088.
- Strandberg TE, Andersson S, Jarvenpaa AL, McKeigue PM. Preterm birth and licorice consumption during pregnancy. *American Journal of Epidemiology* 2002, 156: 803-805.
- Tacconi P, Paribello A, Cannas A, Marrosu MG. Carpal tunnel syndrome triggered by excessive licorice consumption. *J Peripher Nerv Syst* 2009, 14(1): 64-5.

- Turpie AG, Thomson TJ. Carbenoxolone sodium in the treatment of gastric ulcer with special reference to side-effects. *Gut* 1965, 6: 591-594.
- Utsunomiya T, Kobayashi M, Pollard RB, Suzuki F. Glycyrrhizin, an active component of licorice roots, reduces morbidity and mortality of mice infected with lethal doses of influenza virus. *Antimicrob Agents Chemother* 1997, 41: 551-556.
- Van den Bosch AE, Van der Klooster JM, Zuidgeest DM, Ouwendijk RJ, Dees A Severe hypokalaemic paralysis and rhabdomyolysis due to ingestion of liquorice. *Neth J Med* 2005, 63(4): 146-8.
- Van der Zwan A. Hypertension encephalopathy after liquorice ingestion. *Clin Neurol Neurosurg* 1993, 95: 35-7.
- Van Rossum TG, Vulto AG, De Man RA, Brouwer JT, Schalam SW. Review article: Glycyrrhizin as a potential treatment for chronic hepatitis C. *Aliment Pharmacol Ther* 1998, 12: 199-205.
- Van Rossum TG, Vulto AG, Hop WC, Schalm SW. Pharmacokinetics of intravenous glycyrrhizin after single and multiple doses in patients with chronic hepatitis C infection. *Clin Ther.* 1999, 21: 2080-2090.
- World Health Organization 1999. *Glycyrrhiza glabra* monograph.
- Yamaguchi H, Kidachi Y, Kamiie K, Noshita T, Umetsu H, Ryoyama K, Glycyrrhetic Acid Induces Anoikis-Like Death and Cytoskeletal Disruption in the Central Nervous System Tumorigenic Cells. *Biol Pharm Bull* 2010, 33(2): 321-324.
- Yasue H, Itoh T, Mizuno Y, Harada E. Severe hypokalemia, rhabdomyolysis, muscle paralysis, and respiratory impairment in a hypertensive patient taking herbal medicines containing licorice. *Intern Med* 2007, 46(9): 575-8.
- Yoshida S, Takayama Y. Licorice-induced hypokalemia as a treatable cause of dropped head syndrome. *Clin Neurol Neurosurg* 2003, 105: 286-287.
- Yorgun H, Aksoy H, Sendur MA, Ateş AH, Kaya EB, Aytemir K, Oto A. Brugada syndrome with aborted sudden cardiac death related to liquorice-induced hypokalemia. *Med Princ Pract.* 2010, 19: 485-489.
- Zani F, Cuzzoni MT, Daglia M, Benvenuti S, Vampa G and Mazza P. Inhibition of mutagenicity in *Salmonella typhimurium* by glycyrrhiza extract, glycyrrhizinic acid, 18a- and 18b-glycyrrhetic acid. *Plant Med* 1993, 59: 502-507.
- Zhang Q, Ye M, Chemical analysis of the Chinese herbal medicine Gan-Cao (licorice). *Journal of Chromatography A* 2009, 1216: 1954-1969.