Preparation and Evaluation of Functional Properties of Fermented Vegetable-Fruit Drink

利文耀、柯文慶、謝昌衛

E-mail: 9601185@mail.dyu.edu.tw

ABSTRACT

Vegetables and fruits have very strong antioxidant ability. The content of antioxidant in fresh vegetables and fruits will be reduced during pasteurization and processing. In A.D. 1998, the scholars recommend the advantage of enzyme, so enzyme beverages rise and develop. The regulation of activity measuring and manufacture are not yet to define at present. Traditional enzyme beverages need more time to make product in the manufacture and have more variations to control difficultly during fermentations. The objectives of the study are to build a new-type manufacture of vegetable enzyme beverages that is simple, fast, high enzyme activity and high antioxidant activity, to reduce more variations and the production cost during fermentations, to agree with industry, and to defines the regulation of activity measuring and manufacture clearly. The result is as follows: a. The fruit vegetable juice has enzyme activity (SOD-like is 10.1 U/ml) and antioxidant activity. b. In the experiments of alcoholic, acetic acid and lactic acid fermentation, the enzyme activity, and antioxidant activity of raw materials are enhanced after fermenting. SOD-like activity increases above 20 U/ml; the result of acetic acid fermentation has the highest activity with other fermentations. The SOD-like activity of acetic acid fermentation increases 49.6 U/ml. The alcoholic fermentation has the best result in antioxidant activity, especially in chelating effects on ferrous ions. The chelating effects on ferrous ions activity in acetic acid fermentation increases 0.21 mg/ml. c. In the experiments of (yeast, acetic acid bacteria and lactic acid bacteria) fermentations, the mix micro-flora fermentation (1:2:1) has the best result in the experiments of antioxidant activity and enzyme activity. The SOD-like activity of mix micro-flora increases 28.3 U/ml in 1:2:1 and 19.6 U/ml in 1:1:1. antioxidant activity of raw materials are enhanced after fermenting unless chelating effects on ferrous ions. The results of mix micro-flora fermentations are not better than the results of three kinds of fermentations. The highest SOD-like activity of mix micro-flora fermentation is 40.01 U/ml. The highest SOD-like activity of acetic acid fermentation is 59.20 U/ml.The chelating effects on ferrous ions activity decreases 0.27 mg/ml in mix micro-flora fermentation and increases in alcoholic and acetic acid fermentations. d. The functions of product in the study are better than workshop products. Especially in chelating effects on ferrous ions, the result of product is the best than workshop products 0.01-0.03 mg/ml. The manufactures of workshop products need one to three years, but the product in the experiment only need two weeks. e. The manufacture of vegetable enzyme beverage in the study solves several questions like to need the high investment, advanced equipment and technology, long time and more variations during fermentations. The methods of assaying in the experiment can be the indicator to assay workshop products in the future.

Keywords : enzyme beverage, antioxidant activity, enzyme activity, vegetable juice, fermentation.

Table of Contents

REFERENCES

1. 丁克祥、邱仲峰、呂鋒洲。1996。SOD 生物與醫學淺論。藝軒 圖書出版社 3-12, 19-32, 204-211。 2. 中國國家標準。水果及蔬菜製品

檢驗法－可滴定酸度之測定， 1997，總號8626，類號N6167。經濟部中央標準局印行。 3. 中國國家標準。酒類檢驗法－酒精度之測定，2004，總號CNS 14849，類號N6375。經濟部中央標準局印行。 4. 朱燕華。1998。類黃酮之介紹。食品工業 30(9):1-5。 5. 李凰綺。2003。抗氧化劑抑制香菸引發脂質過氧化的評估。私 立輔仁大學 食品營養學系碩士論文。 6. 李福臨。2001。食醋與醋酸菌之研究近況。食品工業 33(3): 1-6。 7. 林讚峰。1994。酵母菌對酒類香氣生成之貢獻。製酒科技專論 彙編 16:1-54。 8. 林讚峰。1990。醋酸菌的檢定及分類。食品工業 31 (10):41-48。 9. 林麗芳。1986。殺菁條件對棠梨果汁品質的影響。中國園藝 32:252-259。 10. 林明慧。2003。乳酸菌調節免疫功能之探討。國立中興大學 食 品科學系碩士論文。 11. 林俊杰、黃及時。1995。酵母之發酵力與其酒精耐性。製酒科 技專論彙編 17:78-89。 12. 林耕年。1988。釀造學(全)。復文書局。 13. 胡學智。1999。食醋和檸檬酸的保健功能。江蘇調味副食品 4: 2-4。 14. 胡鳳綬。1988。酒類中之香氣成分。製酒科技專論彙編 10: 139-174。 15. 胡鳳綬。1993。酒中之酯類香氣成分。製酒科技專論彙編 15: 311-315。 16. 徐清萍，敖宗華，陶文沂。2003。食醋功能研究進展 (上)。 中國調味料 12:11-14。 17. 許夏芬、張肇麟、朱燕華。2000。數種蔬菜中類黃酮含量及抗 氧化性分析。台灣農業化學與食品科學 38:377-387。 18. 許元勳。1999。微生物來源天然抗氧化劑之篩選研究 (上)。 生物產業 10(1):12-18。 19. 梁佑慎。2005。市售新鮮蔬果抗氧化力之研究。國立屏東科技 大學 熱帶農業暨國際合作學系碩士論文。 20. 張為憲。1995。食品化學。華香園出版社。 21. 張嘉琪。2000。以HPLC 法及光譜法測定蜂膠中之類黃酮物 質。國立屏東科技大學 食品科學系碩士論文。 22. 張婷婷。2004。中式半乾式香腸內源酵素性及非酵素性抗氧化 物於乾燥及貯藏期間之抗氧化穩定性。國立嘉義大學 動物科 學所碩士論文。 23. 陳怡君。2002。乳酸發酵綜合果蔬汁試製之研究。國立中興大 學 食品暨應用生物科技學系碩士論文。 24. 陳清泉、林欣榮、陳素月、曾淑滿、程竹青。1990。柳橙果汁 熱加工條件之探討。食品科學 17:283-297。 25. 陳清泉、林上玄、尤新輝、程竹青。1993。還原紅葡萄果汁及 還原澄清蘋果汁熱加工及儲藏過程中酚類化合物含量變化。食 品科學 20:381-393。 26. 陳如茵、吳家駒、蔡美珠、錢明賽。2000。貯藏及熱加工對蕃 茄抗氧化性之影響。台灣農業化學與食品科學 38:353-360。 27. 陳麗玲。2003。醋酸菌菌種分類鑑定之研究。食品工業 35 (7): 18-27。 28. 楊智源、顏國欽。1998。以反應曲面法探討殺菁條件對胡蘿蔔 泥品質之影響。食品科學 25:679-689。 29. 廖啟成。1998。乳酸菌之分類利用。食品工業 30:1-10。 30. 暢天獅、劉俊果、張桂、邊紅杰、王興梅。2002。乳酸菌在酸 性環境中的生理變化及pHin 的調控機制。中國乳品工業 30(2):7-10。 31. 趙文婉、張珍田、周淑姿。2002。淺談植物類化學物質對抗自 由基之機制。食品工業 34 (2):49-59。 32. 趙克然, 楊毅軍, 曹道俊, 胡淼琳。2002。氧自由基與臨床， 初版。合記出版社。 33. 劉伯康。1997。數種傳統食用植物抗氧化性之研究。國立中興 大學 食品科學系碩士論文。 34. 劉光誠譯。1982。介紹日本幾種健康飲料。食品科學 4:12。 35. 劉益善。2001。葡萄酒釀製之品質與控制。製酒科技專論彙編 23:81-103。 36. 歐陽港生。1991。中國傳統蒸餾酒的色香味及品評。製酒科技 專論彙編 13:67-78。 37. 鄭玉磬。1981。淺談食品色素。科學月刊 12(12):19-22。 38. 賴敏男。1976。食醋之製造。食品工業 8 (2):21-24。 39. 錢明賽。1998。蔬果中之抗氧化物質。食品工業 30(8):21-34。 40. 羅珮文。2001。台灣數種特有水果抗氧化活性及清除自由基能 力之評估。私立輔仁大學 食品營養學系碩士論文。 41. 鍾培芳、陳惠英、顏國欽。2000。加熱處理對茶飲料抗氧化特 性之影響。台灣農業化學與食品科學 38:120-125。 42. AOAC. 2000. Official Methods of Analysis. 17th ed. Association of Official Analytical Chemists, Washington, DC. 43. AOAC. 1984. Official Methods of Analysis. 11th ed. Association of Official Analytical Chemists, Washington, DC. 44. Adams, M. R. 1985. Vinegar. Microbiology of fermented foods. Hand book. p. 1-47. 45. Ahsan, H., A, Ali. and R, Ali. 2003. Oxygen free radicals and systemic autoimmunity. Clin. Exp. Immunol. 131:398-404. 46. Akira, N. and Kiyoshi, E. 1988. Effect of prolonged vinegar feeding on postprandial blood glucosein response in rats. J. Jpn. Soc. Nutr. Food Sci. 41:487-489. 47. Almansa, M.S., del Rio, L.A. and Sevilla, F. 1994. Characterization of iron-containing superoxide dismutase from a higher plant, Citrus limonum. Physiol Plant 90:339-347. 48. Altman, S. A., Zastawny, T. H., Randers-Eichhorn, L., Cacciuttolo, M. A., Akman, S. A., Dizdaroglu, M. and Rao, G. 1995. Formation of DNA-protein cross-links in cultured mammalian cells upon treatment with iron ions. Free Rad. Biol. Med. 19:897-902. 49. Amerine, MA., Berg, HW., Kunkee, RE., Ough, CS., Singleton, VL. and Webb, AD. 1980. The Technology of Wine Making. 4th ed. Connecticut:AVI. 50. Angelo, AJS. 1996. Lipid oxidation in food. Crit. Rev. Food Sci. Nutr. 36 (3):175-224 . 51. Arouma, O. I. 1994. Nutrition and health aspects of free radicals and antioxidants. Food Chem. Toxic. 32:671-683. 52. Ausubel, F. M., Brent, R., Kingston, R. E., Moore, D. D., Seidman, J. G., Smith, J. A. and Struhl, K. 1987. Culture of Saccharomyces cerevisiae. Current Protocols in Molecular Biology. Chapter 13. Wiley. New York. 53. Barefoot, S. F. and Nettles, C. G. 1993. Antibiosis revisited: bacteriocins produced by dairy starter cultures. J. Dairy. Sci. 74:409-413. 54. Bannister, J.V. and Bannister, W.H. 1984. Isolation and characterization of SOD. Methods Enzymol. 105:88-93. 55. Bartosz, G. 2003. Generation of reactive oxygen species in biological systems. Comments Toxicol. 9:5-21. 56. Beauchamp, C. and Fridovich, I. 1971. Superoxide dismutase: improved assays and an assay applicable to acrylamide gels. Anal. Biochem. 44:276-287. 57. Beyer, W., Imlay, J. and Fridovich, I. 1991. Superoxide dismutases. Prog Nucl Acid. Res. Mol. Biol. 40:221-248. 58. Bloom, B.R. 1989. New approaches to vaccine development. Rev. Infect. Dis. 11:460-466. 59. Boersma, W.J.A., Zegers, N.D., Van Den Bogaerdt, A., Leer, R.J., Bergmans, A., Pouwels, P.H., Posno, M. and Classen, E. 1994. Development of safe oral vaccines based on Lactobacillus as a vector with adjuvant activity. Internal. Conger. Biotech UK. Brighton. 43-46. Proc. ICHEM. 2nd. 60. Bors, W., Heller, W., Michel, C. and Saran, M. 1990. Flavonoids as antioxidants: determination of radical-scavenging efficiencies. Methods Enzymol 186:343-355. 61. Boulton, R.B., Singleton, V.L., Bisson, L.F. and Kundee, R.E. 1996. Principles and practices of winemaking. Champman & Hall. New York. 62. Bray, R.C., Cockle, S.A., Fielden, E.M., Roberts, P.B., Rotulio, G. and Calabrese, L. 1974. Reduction and inactivation of superoxide dismutase by hydrogen peroxide. Biochem. J. 139: 43-48. 63. Bryngelsoon, S., Dimberg, LH. and Kamal-Eldin, A. 2002. Effects of commercial processing on levels of antioxidants in oat (Avena sativa L.). J. Agric. Food Chem. 50 (7):1890-1896. 64. Cadenas, E. 1995. Mechanisms of oxygen activation and reactive oxygen activation and reactive oxygen species detoxification. In ”Oxidative stress and antioxidant defenses in biology” 1-61. Chapman and Hall. New York. USA. 65. Cao, G., E, Sofic. and R. L. Prior. 1996. Antioxidant capacity of tea and common vegetables. J. Agric. Food Chem. 44: 3426-3431. 66. Castelli, T. 1941. Temperature

chimismo dei blastomiceti. Ann. Microbiol 2: 8-22. 67. Catherine, A., Rice-Evans, NS., Nicholas, JM. and George, P. 1997. Antioxidant properties of phenolic compounds. Trends. Plant Sci. 2:152-159. 68. Chang, S., Tan. C., Frankel, E.N. and Barrett, D.M. 2000. Low-density lipoprotein antioxidant activity of phenolic compounds and polyphenol oxidase activity in selected clingstone peach cultivars. J. Agric. Food Chem.48:147-151. 69. Chance, B., Sies, H. and Boveris, A. 1979. Hydroperoxide metabolism in mammalian organs. Physiol. Rev. 59:527-605. 70. Classen, E., Pouwels, P.H., Posno, M. and Boersma, W.J.A. 1994a. Development of safe oral vaccines based on Lactobacillus as a vector. In: Kurstak, E. (Ed), Recombinant Vacines: New Vaccinology. Ont. Comp. Virology Org. Montreal. In press. 71. Classen, E., Kottenhagen, M.J., Pouwels, P.H., Posno, M., Boersma, W.J.A. 38. and Lucas, C.J. 1994b. Use of Lactobacillus, a GRAS (Generally Recognized As Safe) organism, as a base for a new generation of " oral " live vaccines. In: Talwar, G.P. et al. Recombinant and Synthetic Vacines. Narosa Publishing House, New Delhi, India. pp. 407-412. 72. Collins, EB. and Aramaki, K. 1980. Production of hydrogen peroxide by Lactobacillus acidophilus. J. Dairy Sci. 63:353-357. 73. Cook, NC. and Samman, S. 1996. Flavonoids: chemistry , metabolism, cardioprotective effects, and dietary sources. J. Nutr. Biochem. 7:66-76. 74. Crawford, DL., Sinnhuber, RO. and Aft, H. 1961. The effect of methylation upon the antioxidant and chelation capacity of guercetin and dihydroguercetin a lard substrate. J. Food Sci. 26:139-142. 75. Decker, E. A., and Welch, B. 1990. Role of ferritin as a lipid oxidation catalyst in muscle food. J. Agric. Food Chem. 38:674. 76. Deguchi, Y., Morishita, T. and Mutai, M. 1985. Comparative studies on synthesis of water-soluble vitamins among human species of bifidobacteria. Agric. Biol. Chem. 49:13-19. 77. Deshpande, SS., Cheryan, M. and Salunkhe, DK. 1989. Tannin analysis of food products. Crit. Rev. Food Sci. Nutr. 24:401- 449. 78. Dewanto, V., Wu, X., Adom, KK. and Liu, RH. 2002. Thermal processing enhances the nutritional value of tomatoes by increasing total antioxidant activity. J. Agric. Food Chem. 50:3010-3014. 79. Fang, Y. Z., S. Yang. and G, Wu. 2002. Free radicals, antioxidants, and nutrition. Nutrition 18:872-879. 80. Fester, T. and Schuster, W. 1995. Potato mitochondrial manganese superoxide dismutase is an RNA-binding protein. Biochem. Mol. Biol. Int. 36:67-75. 81. Flohe, L. and W, A. Gunzler. 1984. Assays of glutathione peroxidase. Methods Enzymol. 105:114-121. 82. Frazier, WC. and Westhoff, DC. 1988. Microorganisms important in food microbiology. In: Frazier WC, Westhoff DC, eds. Food Microbiology. 4th edn. New York: McGraw-Hill Book Co. 83. Frank, JF. and Marth, EH. 1988. Fermentations. In: Wong NP, Jenness R, Keeney M, Marth EH, eds. Fundamentals of dairy chemistry. 3rd edn. New York: van Nostrand Reihold Co. 655-738. 84. Fridovich, I. 1975.Superoxide dismutases. Annu. Rev. Biochem. 44: 147-159. 85. Fridovich, I.1986. Biological effects of the superoxide radical. Arch Biochem Biophy. 247:1-11. 86. Fridovich, I. 1995. Superoxide radical and superoxide dimutases. Annu. Rev. Biochem. 64:97-102. 87. Gerritse, K. Posno, M., Schellekens, M.M., Boersma, W.J.A., and Classen, E. 1990. Oral administration of TNP-Lactobacillus conjugates in mice: a model for evaluation of mucasal and systemic immune responses and memory formation elicited by transformed lactobacilli. Res. Microbiol. 141:955-962. 88. Gerster, H. 1996. Intermediate cancer biomarkers and their use in β-carotene studies in humans. Int. J. Vitam. Nutr. Res. 66:3-18. 89. Gordon, M. H. 1990. The mechanism of antioxidant action in vitro. Chapter l, in Food Antioxidant, B. J. F. Hudson (Ed.), P. l-18. Elsevier Applied Science, London and New York. 90. Goldin, B. R. and Gorbach, S. L. 1984. The effect of milk and lactobacilli feeding on human intestinal bacterial enzyme activity. Am. J. Clin. Nutr. 39:756-761. 91. Gregory, EM. and Fridovich, I. 1974. Oxygen metabolism in Lactobacillus plantarum. J. Bacteriol. 117:166-169. 92. Greenway, W., Scaysbrook, T. and Whatley, FR. 1990. The composition and plant origins of propolis: a report of work at Oxford. Bee. World. 71:107-118. 93. Grunewald, K. K. 1982. Serum cholesterol levels in rats fed skim milk fermented by a Lactobacillus acidophilus. J. Food Sci. 47: 2078-2079. 94. Hahlbrock, K. and Wellmann, E. 1970. Light-induced flavone biosynthesis and activities in phenyl-alanine-ammonia lyase and UPD-apiose synthetase in cell suspension cultures of Petroselinum hortense . Planta 94:236-239. 95. Halliwell, B. and Gutteridge, J. M. C. 1999. The chemistry of free radicals and related reactive species. Chapter 2, In " Free Radicals in Biology and Medicine " eds by B. Halliwell and J. M. C. Gutteridge. 36-104. Clarendon Press, Oxford. 96. Halliwell, B. and J. M. C. Gutter idge. 1999. " Free radical in Biology and Medicine ", 3ed. by B. Haillwell and J. M. C. Gutteridge. Clarendon Press, Oxford. 97. Halliwell, B., M. A. Murcia, S, Chirico. and O. I. Aruoma. 1995. Free radicals and antioxidants in food and in vivo: what they do and how they work. Crit. Rev. Food Sci. Nutr. 35:7-20. 98. Halliwell, B. 1994. Free radicals and antioxidants: a personal view. Nutr. Rev. 52:253-265. 99. Halliwell, B., Aeschbach, R., Loliger, J. and Aruoma, O. I. 1995. The characterization of antioxidants. Food Chem. Toxic. 33: 601-617. 100. Halliwell, B. and Gutteridge, J. M. C. 1998. Free radicals in biology and medicine. Oxford University Press. 548-549. New York. 101. Halliwell, B., Murcia, HA., Chirico, S., and Aruoma, OI. 1995. Free radicals and antioxidants in food and in vivo: what they do and how they work. Crit. Rev. Food Sci. Nutr. 35: 7-20. 102. Harvey, R J. 1965. Damage to streptococcus lactis resulting from growth at low pH [J]. J. Bacteriol. 90:1 330. 103. Harman, D. 1957. Prolongation of the normal life span by radiation protection chemicals. J. Gerontol. 12:257-263 104. Hepner, G., Friend, R., Jeor, S., Fusetti, L. and Morin, R. 1979. Hypocholesterolemic effect of yogurt and milk. Am. J. Clin. Nutr. 251:19-24. 105. Hodgson, E.K. and Fridovich, I. 1975. The interaction of bovine erythrocyte superoxide dismutase with hydrogen peroxide: Inactivation of the enzyme. Biochemistry 14: 5294-5303. 106. Husband, A.J. 1993. Novel vaccination strategies for the control of mucosal infection. Vaccine 11:107-112. 107. Inous, M. 1990. Targeting superoxide dismutase by gene and protein engineering. Methods Enzymol 256: 211-222. 108. Jacob, R. A. 1995. The integrated antioxidant system. Nutr. Res. 15:755-766. 109. Jin, L. Z., Ho, Y. W., Abdullah, N. and Jalaudin, S. 1998. Growth performance, insteinal microbial populations and serum cholesterol of broilers fed diets containing Lactobacillus culters. Poultry Sci. 77 (9): 1259-1265. 110. Johar, D., Roth, J. C., Bay, G. H., Walker, J. N., Kroczak, T. J. and Los, M. 2004. Inflammatory response, reactive oxygen species, programmed (necrotic-like and apoptotic) cell death and cancer. Rocz. Akad. Med.Bialymst. 49: 31-39. 111. Jun-ichi, H., Kiyoshi, T., Masayoshi, K., Tohru, K. and Kunio, E. 2004. Biological approach for effective utilization of worthless onions-vinegar production and composting. Resour. Conserv. Recycl. 40:97-109. 112. Kalt, W., McDonald, J.E. and Donner, H. 2000. Anthocyanins, phenolics, and antioxidant capacity of processed lowbush blueberry products.

J. Food Sci. 65:390-393. 113. Kanematsu, S. and Asada, K. 1989. CuZn-Superoxide dismutase in rice: occurrence of an active, monomeric enzyme and two types of isozyme in leaf and non- photosynthetic tissues. Plant Cell Physiol. 30:381-391. 114. Karagiannis, S. and Lanaridis, P. 2000. The Effect of various vinification parameters on the development of several volatile sulfur compounds in Greek white wines of the cultivars Batiki and Muscat of Hamburg. Am. J. Enol. Vitic. 50:334-342. 115. Kaur, C. and Kapoor, H. C. 2001. Antioxidants in fruits and vegetables – the millennium ' s health. Int. J. Food Sci. Technol. 36:703-725. 116. Kishi, M., Fukaya, M., Tsukamoto, Y., Nagasawa, T., Kazushige, T. and Nishizawa, N. 1999. Enhancing effect of dietary vinegar on the intestinal absorption of calcium in ovariectomized rats. Biosci. Biotechnol. Biochem. 63:905-910. 117. Kitagawa, Y., Tanaka, N., Hata, Y., Kusunoki, M., Lee, G.P., Katsube, Y., Asada, K., Aibara, S. and Morita, Y. 1991. Three-dimensional structure of Cu,Zn-superoxide dismutase from spinach at 2.0 A resolution. J. Biochem. 109:477-485. 118. Klaver, F. A. M. and Van Der Meer, R. 1993. The assumedassimilation of cholesterolby lactobacilli and bifidobacterium is due to their bile sale-deconjugation activity. Appl. Environ. Microbiol. 59:1120-1124. 119. Klein, B. P. and A. C. Kurilich. 2000. Processing effects on dietary antioxidants from plant food. Hort Science 35:580-584. 120. Knight, J. A. 1998. Free radicals: their history and current status in aging and disease. Ann. Clin. Lab. Sci. 28:331-346. 121. Kowalski, DP., AW, TY., Park, Y. and Jones, DP. 1992. Postanoxic oxidative injury in rat hepatocytes: lactate-dependent protection against tert-butylhydroperoxide. Free Rad. Biol. Med. 12:205-212. 122. Kurechi, T., Kikugawa, K. and Kato, T. 1980. Studies on the anti-oxidants (XIII): hydrogen-donating capability of anti-oxidants to DPPH. Chem. Pharm. Bull. 28:2089-2093. 123. Lankputhra, W. E. V. and Shah, N. P. 1998. Antimutagenic properties of probiotic bacteria and of organic acid. Mutat. Res. 397:169-182. 124. Larson, RA. 1988. The antioxidants of higher plants. Phytochem. 27 (4):969-978. 125. Lefebvre, D., Gabriel, V., Vayssier, Y. and Fontagne-Faucher, C. 2002. Simultaneous HPLC determination of sugars, organic acids and ethanol in sourdough process. Lebensmittel-Wissensschaft 11nd- Technologie 22:145-149. 126. Lin JK. 2000. Mechanisms of cancer chemoprevention by phytochemicals and phytopolyphenols. Food Sci. and Argi. Chem. 2:189-201. 127. Loo, G. 2003. Redox-sensitive mechanisms of phytochemical-mediated inhibition of cancer cell proliferation (Review). J. Nutr. Biochem. 14:64-73. 128. Majamaa, H., Isolauri, M. and Vesikari, T. 1995. Lactic acid bacteria in the treatment of acute rotavirus gastroenteritis. J. Pediatric Gastroenterol. Nutr. 20:333-338. 129. Makris, DP. and Rossiter, JT. 2001. Domestic processing of onion bulbs (Allium cepa) and asparagus spears (Asparagus officinalis) : effect on flavonol content and antioxidant status. J. Agric. Food. Chem. 49:3216-3222. 130. Mandelstam, J., Mcquillen, K. and Dawes, I. 1982. Bacterial growth curve. Biochemistry of Bacterial Growth, 3rd Ed., Chapter 2. Halsted, Oxford, England. 131. Marklund, S. and Marklund, G. 1974. Involvement of the superoxide anion radical in the autoxidation of pyrogallol and a convenient assay for superoxide dismutase. Eur. J. Biochem. 47:469 – 474 132. Marnett, L. J. 2000. Oxyradicals and DNA damage. Carcinogenesis 21:361-370. 133. Masrizal, MA., Giraus, DW. and Driskell, JA. 1997. Retention of vitamin C, iron, and β-carotene in vegetables prepared using different cooking methods. J. Food Qual. 20:403-418. 134. McCord, J.M. and Fridovich, I. 1969. Superoxide dismutase: an enzymatic function for erythrocuprein. J. Biol. Chem. 244: 6049-6055. 135. McCord, J.M. and Fridovich, I. 1970. Utility of superoxide dismutase in studying radical reactions. Anal. Biolchem. 25: 1374-1377. 136. Meckee, T. and J. R. Meckee. 2003. Biochemistry. The Molecular basis of life. pp. 319-328. McGraw. Hill. North America. 137. Meir, S., J. Kanner, B. Akiri. and S. Philosoph-H. 1995. Determination and involvement of aqueous reducing compounds in oxidative defense systems of various sencescing leaves. J. Agric. Food Chem. 43:1813-1819. 138. Michelson, A.M. et al. 1981. Superoxide and superoxide dismutase. Mol. Physiol. 1:71-75. 139. Miller, N.J. and Rice-Evans, C.A. 1997. The relative contributions of ascorbic acid and phenolic antioxidants to the total antioxidant activity of orange and apple fruit juice and blackcurrant drink. Food. Chem. 60:331-337. 140. Muizelaar, J.P., Marmarou, A. and Young, H.F. 1993. Improving the outcome of severe head injury with oxygen radical scavenger polyethylene glycol-conjugated SOD: A Phase II trail. J. Neurosurg 78:375-382. 141. Namiki, M. 1990. Antioxidants / antimutagens in food. Crit. Rev. Food Sci. Nutr. 29:281-300. 142. Nanba, A., Tamura, A. and Nagai, S. 1984. Synergistic effects on acetic acid and ethanol on the growth of Acetobacter sp. J. Ferment. Technol., 62:501-505. 143. Nisperos-Carriedo, M. O., Buslig, B. S. and Shaw, P. E. 1992 Simultaneous detection of dehydroascorbic, ascorbic, and some organic acid in fruits and vegetables by HPLC. J. Agric. Food. Chem. 40:1127-1130. 144. Nykanen L. 1986. Formation and occurrence of flavor compounds in wine and distilled alcoholic beverages. Am. J. Enol. Vitic. 37:84-96. 145. Okamoto, G., Hayase, F. and Kato, H. 1992. Scavenging of active oxygen species by glycated proteins. Biosci. Biotech. Biochem. 56:928-931. 146. Ough, CS. and Amerine, MA. 1967. Studies with controlled fermentation. Effects of fermentation temperature on some volatile compounds in wine. Am. J. Enol. Vitic. 18:149-156.. 147. Oyauza, M. 1986. Antioxidative activity of browning products of glucosamine fractionated by organic solvent and thin-layer chromatography. Nippon Shokuhin Kogyo Gakkaishi 35:771-775 148. Paolini, M. and Nestle, M. 2003. Pitfalls of enzyme-based molecular anticancer dietary manipulations: food for thought. Mutat. Res. 543:181-189. 149. Perdigon, M., de Macias, M.E.N., Alvarez, S., Oliver, G. and de Ruiz Holgado, A.P. 1988. Systemic augmentation of the immune response in mice by feeding fermented milks with Lactobacillus casei and Lactobacillus acidophilus. Immunology 63:17-23. 150. Pouwels, P.H., Leer, R.J. and Boersma, W.J.A. 1996. The potential of Lactobacillus as a carrier for oral immunization: Development and preliminary characterization of vector systems for targeted delivery 44 of antigens. J. Biotech. 44:183-192. 151. Pratt, DE. and Hudson, BJF. 1990. Natural antioxidants not exploited commercially. In : Hudson BJF editor. Food Antioxidants. Elsevier: Amsterdam. p. 171. 152. Rapisarda, P., Tomaino, A., Cascio, R.L., Bonina, F., Pasquale, A.D. and Saija, A. 1999. Antioxidant effectiveness as influenced by phenolic content of fresh orange juices. J. Agric. Food Chem. 47:4718-4723. 153. Reddy, B.S. and Rivenson, A. 1993. Inhibitory effect of Bifidobacterium longum on colon, mammary and liver carcinogenesis induced by 2-amino-3-methylimidazo[4,5-f]quinoline, a food mutagen. Cancer. Res. 53:3914-3918. 154. Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M. and Rice-Evans, C. 1998. Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free Radical Biology and

Medicine 26:1231-1237. 155. Rice-Evans, CA., Diplock, AT. and Symons, MCR. 1991. Techniques in Free Radical Research, London:ELSEVIER. Laboratory Techniques in Biochemistry and Molecular Biology. 156. Rice-Evans, CA., Miller, NJ. and Paganga, G. 1996. Structure-antioxidant activity relationships of flavonoids and phenolic acids. Free Radical Biol. Med. 20:933-956. 157. Richardson, J.S., Thomas, K.A., Rybin, J.H. and Richardson, D.C. 1975. Crystal structure of bovine CuZn superoxide dismutase at 3 A resolution: Chain tracing and metal ligands. Proc Natl. Acad. Sci. USA. 72: 1349-1353. 158. Rose, A.H. 1977. Scientific basis of alcoholic beverage production. Economic Microbiology 1:10-40. Acadermic Press. London. 159. Rouseff, R. and Nagy, S. 1994. Health and nutritional benefits of citrus fruit components. Food Technol. 48 (11):125-139. 160. Shimada, K., Fujikawa, K., Yahara, K. and Nakamura, T. 1992. Antioxidative properties of xanthan on the autoxidation of soybean oil in cyclodextrin emulsion. J. Agric. Food Chem. 40: 945-948. 161. Shimamura, S., Abe, F., Ishibashi, N., Miyakawa, H., Yaeshima, T. and Mamoru, T. 1990. Endogenous oxygen uptake and polysaccharide accumulation in Bifidobacterium. Agric. Biol. Chem. 54:2869-2874. 162. Shimamura, S., Abe, F., Ishibashi, N., Miyakawa, H., Yaeshima, T., Araya, T. and Tomita, M. 1992. Relationship between oxygen sensitivity and oxygen metabolism of Bifidabacterium species. J. Dairy Sci. 75:3296-3306. 163. Siess, MH. and Vernevaut, MF. 1982. The influence of food flavonoids on the activity of some hepatic microsomal monooxygenases in rats. Food Chem. Toxic. 20:883-889. 164. Simic, M. G. 1988. Mechanisms of inhibition of free-radical processes in mutagenesis and carcinogenesis. Mutat. Res. 202: 377-386. 165. Singleton, VL. and Ough, CS. 1962. Complexity of flavor and blending of wines. J. Food Sci. 27:189-196. 166. Six, P. 1994. Current research in natural food antioxidants. INFORM. 5 (6):679. 167. Skaper, S. D., Fabris, M., Ferrari, V., Carbonare, M. D. and Leon, A. 1997. Quercetin protects cutaneous tissue-associated cell types including sensory neurous from oxidative stress induced by glutathione deleption: cooperative effects of ascorbic acid. Free Radic. Biol. Med. 22:669-678. 168. Stiles, ME. and Holzapfel, WH. 1997. Lactic acid bacteria of foods and their current taxonomy. Int. J. Food Microbiol. 36:1-29. 169. Stiles, M. E. 1994. Bacteriocins produced by Leuconostoc species. J. Dairy. Sci. 77:2718-2724. 170. Tainer, J.A., Getzoff, E.D., Beem, K.M., Richar dson, J.S. and Richardson, D.C. 1982. Determination and analysis of the 2 A structure of copper, zinc superoxide dismutase. J. Mol. Biol. 160: 181-217. 171. Tainer, J.A., Getzoff, E.D., Richardson, J.S. and Richardson, D.C. 1983. Structure and mechanism of copper, zinc superoxide dismutase. Nature 306:284. 172. Temple, A. J. 2000. Antioxidants and disease : more questions than answers. Nutr. Res. 20:449-459. 173. Teraguchi, S. and Ono, J. 1987. Oxygen uptake activity and aerobic metabolism of Streptococcus thermophilus STH450. J. Dairy Sci. 70:514-523. 174. Tesfaye, W., M. L. Morales, M. C. Garcia-Parrilla. and A. M. Troncoso. 2002. Wine vinegar : technology, authenticity and quality evaluation. Tre. Food Sci. Technol. 13:12-21. 175. Thakur, C. P. and Jha, A. N. 1981. Influence of milk, yourt and calcium on cholesterol induced atheroesclerosis in rabbits. Atherosclerosis 89:211-215. 176. Tina, L., Cai, Q. and Wei, H. 1998. Alterations of antioxidant enzymes and oxidative damage to macromolecules in different organs of rats during aging. Free Rad. Biol. Med. 24:1477-1484. 177. Torel, J., Cillard, J. and Cillard, P. 1986. Antioxidant activity of flavonoids and reactivity with peroxy radical. Phytochem. 25:383-385. 178. Urso, M. L. and P. M. Clarkson. 2003. Oxidative stress, exercise and antioxidant supplementation. Toxicology 189:41-54. 179. Vance, C.K. and Miller, A.F. 1998. A simple proposal that can explain the inactivity of metal-substituted superoxide dismutases. J. Am. Chem. Soc. 120: 461-467. 180. Van den Berg, R., Haenen, G. R. M. M., Van den Berg, H. and Bast, A. 1999. Applicability of an improved TEAC assay for evaluation of antioxidant capacity measurements of mixtures. Food Chem. 66:511-517. 181. Wagner, B. A., Buettner, G. R. and Burns, C. P. 1994. Free radical-mediated lipid peroxidation in cell: oxidizability is a function of cell bis-allylic hydrogen content. Biochem. 33: 4449-4453. 182. Wang H, Cao G. and Prior RL . 1997. Oxygen radical absorbing capacity of anthocyanins. J Agric Food Chem 45:304-309. 183. Wang, H., G. Cao. and R. L. Prior. 1996. Total antioxidant capacity of fruits. J. Agric. Food Chem. 44:701-705. 184. Wang, HJ. and Murphy, PA. 1994. Isoflavone content in commercial soybean foods. J. Agric. Food Chem. 42: 1666-1671. 185. Wang, X., Culotta, V.C. and Klee, C.B. 1996. Superoxide dismutase protects calcineurin from inactivation. Nature 383: 434-437. 186. Wei, M.Q., Rush, C.M., Norman, J.M., Hafner, L.M., Epping, R.J. and Timms, P. 1995. An improved method for the transformation of Lactobacillus strains using electroporation. J. Microbiol. Meth. 21:97-109. 187. Yamaguchi, R. M. A. Tatsumi, K. Kato., and U. Yoshimitsu. 1988. Effect of metal salts and fructose on the autoxidation of methyl linoleate in emulsions. Agric. Biol. Chem. 52: 849-850. 188. Yu T. W. and Ong C. N. 1999. “ Lag-time measurement of antioxidant capacity using myoglobin and 2,2 ’ -azino-bis (3-ethylbenzthiazoline-6-sulfonic acid): rationale, application, and limitation. ” , Anal. Biochem. 275:217-223. 189. Zhang, X. B. and Ohta, Y. 1991a. Binding of mutagens by fractions of the cell wall skleleton of lactic acid bacteria on mutagens. J. Dairy Sci. 74:1477-1481. 190. Zhu, Q.Y., Zhang, A., Tsang, D., Huang, Y. and Chen, Z.Y. 1997. Stability of green tea catechins. J.Agric. Food Chem. 45:4624-4629.