Preparation of a Fermented Beverage from Jaboticaba Fruit (Myrciaria cauliflora) and Characterization for Its ...

吳惠停、柯文慶

E-mail: 387177@mail.dyu.edu.tw

ABSTRACT

Jaboticaba was used as the raw material in this study. Yeast, acetic acid bacteria, and lactic acid bacteria were individually inoculated to the fruit pulp for the first stage fermentation. After removing particles by pressing, the obtained mash starters were individually mixed with equal weight of jaboticaba pulp and adjusted to 65OBrix with suger for the second stage fermentation. Functionality of the four fermented beverages (including the control group) was investigated and compared to several so called “ enzymatic beverage ” products placed on the market. First stage fermentation by adding biological species promoted antioxidative abilities of the products. The product prepared by adding yeast showed the highest in total phenol content and antioxidative ability (except ferrous chelating). On the other hand, the product prepared by adding lactic acid bacteria had the most consumer acceptability among the products. Various market enzymatic products were divided into three groups according to their prices. The claimed enzymatic activity was related to the content of total phenol rather than their prices. The prepared products via first stage fermentation showed higher total phenol content, scavenging effect on DPPH radical and reducing activity. In addition, only 1,300 CFU/ml in total counts existed in a self-prepared beverage made from vegetable and fruit by fermenting for 5 years. Pasteurization by heating at 60-100°C for 10-60 min resulted in decrease in total counts, but increase in “ a value ” and “ b value ” of appearance color. The promotion on total phenol content and antioxidative ability by heating was an unexpected effect.

Keywords : Jaboticaba、Fermented beverage、Functionality、Thermal effect

Table of Contents

REFERENCES

1.丁燕、趙新節。2003。酚類物質的結構與性質及其與葡萄及葡萄酒的關係。中外葡萄與葡萄酒(1):13-17。 2.王文芹、孔玉涵。2007。國內外發酵食品的發展現狀。發酵科技通訊36(2):2。 3.王勝鴻。1987。台灣庭園的新客 - 稀有果樹嘉寶果。興農223:97-99。 4.王昭君。2000。五種台灣金絲桃屬植物之 pseudohypericin 和 hypericin 含量分析與元寶草粗萃物之體內外抗氧化性以及對acetaminophen所誘發之大鼠急性肝、腎毒性之影響。國立中興大學碩士論文。台中市。 5.中國國家標準。2004。酒類檢驗法－酒精度之測定。總號CNS 14849，類號N6375。經濟部中央標準局印行。 6.中國國家標準。1997。水果及蔬菜製品檢驗法－可滴定酸度之測定，總號8626，類號N6167。經濟部中央標準局印行。 7.司合蓁。2006。干紅葡萄酒關鍵工藝研究。江南大學碩士論文。中國。 8.田永彥。2007。番荔枝分子分類、乳酸菌發酵飲品開發及果酸酯?抑制劑之研究。臺灣大學博士論文。台北市。 9.白鳳翎。2009。微生物的發酵作用對傳統釀造食品安全性的影響。中國釀造(2):3。 10.成黎。2012。傳統發酵食品營養保健功能與質量安全評價。食品科學33(1):280-284。 11.余煥

玲、晏萍。2000。乳酸菌的生理功能及在食品中的應用。飲料工業3(4):4。 12.吳方榮。2005。熱處理對綠豆加工物性及色澤變化之探討。中興大學碩士論文。台中市。 13.吳宜錚。2010。鳳梨果皮及果肉釀造果醋及澄清之研究。國立嘉義大學碩士論文。嘉義市。 14.吳歌。2006。外國四大名醋。科學之友(10):1。 15.杜燦屏、朱仕正、陳擁軍、Yongjun, C。2008。內源性自由基與生命科學相關的若干物理有機化學問題。中國科學基金22(3):3。 16.杜鵬、霍貴成。2004。傳統發酵食品及其營養保健功能。中國釀造2004(3):6-8。 17.呂鋒洲、徐展東。1996。發酵大麥清除超氧陰離子自由基能力的研究。食品科學23(1):10-19。 18.孟德敬。2008。啤酒釀造過程中超氧化物歧化?的研究。江南大學碩士論文。中國。 19.周霞。2011。超氧化物歧化?的功能和應用研究。中國中醫藥資訊3(6):318。 20.范龔健、龔小峰、楊振東、顧振新。2009。紫玉米醋酸發酵過程中色澤變化及其花色?組分分析。南京農業大學學報32(4):176-179。 21.施瑋筑。2008。橄欖果實自然發酵過程中菌相與果汁成分變化之研究。臺灣大學碩士論文。台北市。 22.胡韻笙。2002。發酵乳製品生理活性之研究。中山醫學大學碩士論文。台中市。 23.高麗娜、王軍海。2011。淺談含水果成分的發酵食品。吉林農業C版(4):209。 24.張舒平、李健。2002。南美珍果--嘉寶果。福建果樹(4):3。 25.張暉、姚惠源、姜元榮。2002。γ-氨基丁酸的功能性及其在稻米制品中的富集利用。糧食與飼料工業(8):41-43。 26.陳貞吟。2004。帶狀皰疹後神經痛患者血漿中之抗氧化維生素狀態以及補充維生素C之效果。國立中興大學碩士論文。台中市。 27.曾國書。2009。酪梨乳酸飲料產品開發。臺南科大學報(28): 1-15。 28.黃進發。2001。酵母菌在食品及生物?業之應用。Fungal Science 16(1、2):53-64。 29.黃達明、吳其飛、陸建明、管國強。2003。固態發酵技術及其設備的研究進展。食品與發酵工業29(6):5。 30.董玉新、郭德智。2000。果醋開發及果醋工藝研究。中國釀造(2):3。 31.趙勝娟、孫文峰、劉愛萍、羅紅霞、任發政。2008。益生菌對腸道微生態影響的研究現狀。食品研究與開發29(4):4。 32.劉友接、傅加興、林旗華、李憲庭、陳吉昌。2011。“莎芭拉”嘉寶果引種表現及栽培技術要點。中國南方果樹40(4):97-99。 33.劉麗娟、黃潔妤、黃俊傑、李秀娟、黃士懿。2010。補充抗氧化維生素C及E對慢性阻塞性肺疾病患者體內抗氧化狀況的影響:一個平行雙盲前導性試驗。臺灣營養學會雜誌35(2):65-76。 34.鄭巧惠。2008。鳳梨果皮乳酸發酵液之製備及其抗氧化活性探討。國立臺灣海洋大學碩士論文。基隆市。 35.鄭淑蕙。2008。紫菜乳酸發酵飲料之製備及其抗氧化活性評估。國立臺灣海洋大學碩士論文。基隆市。 36.魯戰會、彭荷花、李裡特。2006。傳統發酵食品的安全性研究進展。食品科技31(6):1-6。 37.駱超超、盧志勇、于微、王青竹、高學軍。2011。幾種益生菌發酵谷物飲料制作工藝研究。東北農業大學學報42(5):127-129。 38.羅恩康。2011。加熱處理對臺灣市售蔬菜抗氧化力的影響。臺灣大學碩士論文。台北市。 39.蘇義舜。2009。石蓮花發酵產品開發及其抗氧化能力探討。國立嘉義大學碩士論文。嘉義市。 40.AOAC. 1984. Official Methods of Analysis. 11th ed. Association of OfficialAnalytical Chemists, Washington, DC. USA. 41.AOAC. 1984. Official Methods of Analysis. 14th ed. Association of OfficialAnalytical Chemists, Washington, D.C.USA. 42.AOAC. 1995a. Official Methods of Analysis. 16th ed. Association of OfficialAnalytical Chemists, Washington, D.C.USA. 43.AOAC. 2000. Official Methods of Analysis 17th ed. Association of Official Analytical Chemists, Washington, D.C.USA. 44.AOAC . 940.09 Total Solids in Cordials and Liqueurs. 45.AOAC. 1984. Official Methods of Analysis. 17th ed. Association of OfficialAnalytical Chemists, Washington, D.C.USA. 46.Abe, L. T., Lajolo, F. M., & Genovese, M. I. 2012. Potential dietary sources of ellagic acid and other antioxidants among fruits consumed in Brazil: jabuticaba (Myrciaria jaboticaba (Vell.) Berg). [Research Support, Non-U S Gov't]. J Sci Food Agric, 92(8):1679-1687. 47.Alm, L. 1982. Effect of Fermentation on Lactose, Glucose, and Galactose Content in Milk and Suitability of Fermented Milk Products for Lactose Intolerant Individuals. Journal of Dairy Science, 65(3):346-352. 48.Arsova-Sarafinovska, Z., Eken, A., Matevska, N., Erdem, O., Sayal, A., Savaser, A., Aydin, A. 2009. Increased oxidative/nitrosative stress and decreased antioxidant enzyme activities in prostate cancer. Clinical Biochemistry. 42(12): 1228-1235. 49.Aruoma, O. I., & Halliwell, B. 1995. Chap.13 - DNA Damage by Free Radicals: Carcinogenic Implications. In B. David & G. W. Paul (Eds.),Immunopharmacology of Free Radical Species. p. 199-214. 50.Asquieri, E.R., Damiani, C.,Candido, M.A.,Assis, E.M. 2004. Vino de jabuticaba (Myrciaria cauliflora Berg): estudio de las caracteristicas fisico-quimicas y sensoriales de los vinos tinto seco y dulce, fabricados con la fruta integral. Alimentaria: revista de tecnologia e higiene de los alimentos. p.111-122 51.Barros, R. S., Finger, F. L., & Magalhaes, M. M. 1996. Changes in non-structural carbohydrates in developing fruit of Myrciaria jaboticaba. Scientia Horticulturae. 66(3 – 4):209-215. 52.Bayerle-Eder, M., Pleiner, J., Mittermayer, F., Schaller, G., Roden, M., Waldhausl, W., Wolzt, M. 2004. Effect of systemic vitamin C on free fatty acid-inducedlipid peroxidation. Diabetes & Metabolism. 30(5):433-439. 53.Blaiotta, G., Di Capua, M., Coppola, R., & Aponte, M. 2012. Production of fermented chestnut purees by lactic acid bacteria. International Journal of FoodMicrobiology. 158(3):195-202. 54.Boari Lima, A. J., Duarte Correa, A., Carvalho Alves, A. P., Patto Abreu, C. M., & Dantas-Barros, A. M. 2008. Chemical characterization of the jabuticaba fruits (Myrciaria cauliflora Berg) and their fractions. Archivos latinoamericanos denutricion. 58(4):416-421. 55.Bolzan, A. D., Bianchi, M. S., & Bianchi, N. O. 1997. Superoxide Dismutase, Catalase and Glutathione Peroxidase Activities in Human Blood: Influence of Sex,Age and Cigarette Smoking. Clinical Biochemistry. 30(6):449-454. 56.Buonocore, G., Perrone, S., & Tataranno, M. L. 2010. Oxygen toxicity: chemistry and biology of reactive oxygen species.Seminars in Fetal and Neonatal Medicine,. 15(4):186-190. 57.Burk, R. F., & Hill, K. E. 2010. 4.13 - Glutathione Peroxidases. In A. M. Editor-in-Chief: Charlene (Ed.), Comprehensive Toxicology (Second Edition) p.229-242. 58.Balerdi, C.F.; Rafie, R.; Crane, J. 2006. Jaboticaba (Myrciaria cauliflora, Berg.): a delicious fruit with an excellent market potential. Proceedings of the FloridaState Horticultural Society, Gainesville. v.119, p.66-68. 59.Casado, A., de la Torre, R., Lopez-Fernandez, M. E., Carrascosa, D., Casado, M. C., & Ramirez, M. V. 1995. Superoxide dismutase and catalase blood levels inpatients with malignant diseases. Cancer Letters. 93(2):187-192. 60.Chen, B., & Tang, L. 2011. Protective effects of catalase on retinalischemia/reperfusion injury in rats. Experimental Eye Research. 93(5):599-606. 61.Chen, Y.-T., & Lin, K.-W. 2007. Effects of heating temperature on the total phenolic compound, antioxidative ability and the stability of dioscorin of various yam cultivars. Food Chemistry. 101(3):955-963. 62.Chu, F.-F., Esworthy, R. S., & Doroshow, J. H. 2004. Role of Se-dependent glutathione peroxidases in gastrointestinal inflammation and cancer. Free RadicalBiology and Medicine. 36(12):1481-1495. 63.Clerici, M. T. P. S., & Carvalho-Silva, L. B. 2011. Nutritional

bioactive compounds and technological aspects of minor fruits grown in Brazil. FoodResearch International. 44(7):1658-1670. 64.Cominetti, C., de Bortoli, M. C., Garrido Jr, A. B., & Cozzolino, S. M. F. 2012. Brazilian nut consumption improves selenium status and glutathione peroxidase activity and reduces atherogenic risk in obese women. Nutrition Research. 32(6):403-407. 65.Dhar, S. K., & St. Clair, D. K. 2012. Manganese superoxide dismutase regulation andcancer. Free Radical Biology and Medicine. 52(11 – 12):2209-2222. 66.Droge, W. 2002. Free radicals in the physiological control of cell function.Physiol Rev. 82(1):47-95. 67.Duarte, W. F., Amorim, J. C., de Assis Lago, L., Dias, D. R., & Schwan, R. F. 2011. Optimization of Fermentation Conditions for Production of the Jabuticaba (Myrciaria cauliflora) Spirit Using the Response Surface Methodology. Journal ofFood Science. 76(5):782-790. 68.Duarte, W. F., Dias, D. R., Oliveira, J. M., Teixeira, J. A., de Almeida e Silva, J. B., & Schwan, R. F. 2010. Characterization of different fruit wines made from cacao, cupuassu, gabiroba, jaboticaba and umbu. LWT - Food Science and Technology.43(10):1564-1572. 69.Duarte, O., Huete, M. and Ludders, P. 1997. Extending storage life of jaboticaba (myrciaria cauliflora (mart.) berg) fruits. ActaHort. 452:131-136 70.De Jesus, N., A. B. Martins, E. J. de Almeida, J. B. Vieira, R. Devos, E. J. Scaloppi; R. Aparecida, and R. F. Cunha. 2004. Caracterizacao de quatro grupos de jaboticabeira, nas condicoes de Jaboticabal. SP. Revista Brasileira de Fruticultura. 26(3):1-8. 71.Decker, E. A., and Welch, B. 1990. Role of ferritin as a lipid oxidation catalyst inmuscle food. J. Agric. Food Chem. 38:674. 72.Einbond, L. S., Reynertson, K. A., Luo, X.-D., Basile, M. J., & Kennelly, E. J.2004. Anthocyanin antioxidants from edible fruits. Food Chemistry. 84(1):23-28. 73.El-Ghaish, S., Ahmadova, A., Hadji-Sfaxi, I., El Mecherfi, K. E., Bazukyan, I., Choiset, Y., Haertle, T. 2011. Potential use of lactic acid bacteria for reduction of allergenicity and for longer conservation of fermented foods. Trends in FoodScience & Technology. 22(9):509-516. 74.El-Nahas, S. M., Mattar, F. E., & Mohamed, A. A. 1993. Radioprotective effectof vitamins C and E. Mutation Research Letters. 301(2):143-147. 75.Fardet, A., Rock, E., & Remesy, C. 2008. Is the in vitro antioxidant potential of whole-grain cereals and cereal products well reflected in vivo? Journal of Cereal Science. 48(2):258-276. 76.Fattman, C. L., Schaefer, L. M., & Oury, T. D. 2003. Extracellular superoxide dismutase in biology and medicine. Free Radical Biology and Medicine. 35(3):236-256. 77.Ferrari, R., Ceconi, C., Curello, S., Ghielmi, S., & Albertini, A. 1989. Superoxide dismutase: Possible therapeutic use in cardiovascular disease. PharmacologicalResearch, 21, Supplement. 2(0):57-65. 78.Gutierrez, L. E.; Cezar, W. P, Jr; Ferrari, S. E.; Guimaraes, G. L., 1976. Soluble carbohydrates in fruits. Pomegranate, mango, banana, Myrciaria cauliflora, lemon, pineapple, orange and Eugenia tomentosa. Anais da Escola Superior de Agricultura ” Luiz de Queiroz ” . 33:167-172. 79.Garcia-Alonso, M., Minihane, A.-M., Rimbach, G., Rivas-Gonzalo, J. C., & de Pascual-Teresa, S. 2009. Red wine anthocyanins are rapidly absorbed in humans and affect monocyte chemoattractant protein 1 levels and antioxidant capacity ofplasma. The Journal of Nutritional Biochemistry. 20(7):521-529. 80.Gonzalez-Castejon, M., & Rodriguez-Casado, A. 2011. Dietary phytochemicals and their potential effects on obesity: A review. Pharmacological Research. 64(5):438-455. 81.Hsieh, M.-L., & Chou, C.-C. 2006. Mutagenicity and antimutagenic effect of soymilk fermented with lactic acid bacteria and bifidobacteria. InternationalJournal of Food Microbiology. 111(1):43-47. 82.Jawad, A. H., Alkarkhi, A. F. M., Jason, O. C., Easa, A. M., & Nik Norulaini, N. A. 2013 Production of the lactic acid from mango peel waste – Factorial experiment.Journal of King Saud University - Science. 25(1):39-45. 83.Jung, Y.-M., Lee, S.-H., Lee, D.-S., You, M.-J., Chung, I. K., Cheon, W. H., Ku, S.-K. 2011. Fermented garlic protects diabetic, obese mice when fed a high-fatdiet by antioxidant effects. Nutrition Research. 31(5):387-396. 84.Joyner, G. 2006. The Jaboticaba. 119:66-68. 85.Julkunen-Titto, R. 1985. Phenolic constituents in the levels of northern willows:Methods for precursors of clarified apple juice sediment. J. Food Sci. 33:254-257. 86.Kalt, W., McDonald, J. E., & Donner, H. 2000. Anthocyanins, Phenolics, and Antioxidant Capacity of Processed Lowbush Blueberry Products. Journal of FoodScience. 65(3):390-393. 87.Kawase, M., He, F., Kubota, A., Hiramatsu, M., Saito, H., Ishii, T., Akiyama, K. 2009. Effect of fermented milk prepared with two probiotic strains on Japanese cedar pollinosis in a double-blind placebo-controlled clinical study. InternationalJournal of Food Microbiology. 128(3):429-434. 88.Kehrer, J. P., & Lund, L. G. 1994. Cellular reducing equivalents and oxidativestress. Free Radical Biology and Medicine. 17(1):65-75. 89.Kim, N. Y., Song, E. J., Kwon, D. Y., Kim, H. P., & Heo, M. Y. 2008. Antioxidant and antigenotoxic activities of Korean fermented soybean. Food and ChemicalToxicology. 46(3):1184-1189. 90.Kinouchi, F. L., Maia, D. C. G., de Abreu Ribeiro, L. C., Placeres, M. C. P., de Valdez, G. F., Colombo, L. L., Carlos, I. Z. 2012. A soy-based product fermented by Enterococcus faecium and Lactobacillus helveticus inhibits thedevelopment of murine breast adenocarcinoma. Food and Chemical Toxicology.50(11):4144-4148. 91.Kish, S. J., Morito, C., & Hornykiewicz, O. 1985. Glutathione peroxidaseactivity in Parkinson's disease brain. Neuroscience Letters. 58(3):343-346. 92.Kornhauser, C., Garcia-Ramirez, J. R., Wrobel, K., Perez-Luque, E.-L., Garay-Sevilla, M. E., & Wrobel, K. 2008. Serum selenium and glutathione peroxidase concentrations in type 2 diabetes mellitus patients. Primary CareDiabetes. 2(2):81-85. 93.Kwon, D. Y., Daily Iii, J. W., Kim, H. J., & Park, S. 2010. Antidiabetic effects of fermented soybean products on type 2 diabetes. Nutrition Research. 30(1):1-13. 94.Lucke, F.-K. 1994. Fermented meat products. Food Research International.27(3):299-307. 95.Larrosa, M., Garcia-Conesa, M. T., Espin, J. C., & Tomas-Barberan, F. A. 2010. Ellagitannins, ellagic acid and vascular health. Molecular Aspects of Medicine. 31(6):513-539. 96.Lazze, M. C., Pizzala, R., Savio, M., Stivala, L. A., Prosperi, E., & Bianchi, L. 2003. Anthocyanins protect against DNA damage induced by tert-butyl-hydroperoxide in rat smooth muscle and hepatoma cells. Mutation Research/Genetic Toxicology and Environmental Mutagenesis. 535(1):103-115. 97.Lee, J. H., Khor, T. O., Shu, L., Su, Z.-Y., Fuentes, F., & Kong, A.-N. T. 2012. Dietary phytochemicals and cancer prevention: Nrf2 signaling, epigenetics, and cell death mechanisms in blocking cancer initiation and progression.Pharmacology & Therapeutics.137(2):153-71. 98.Leiherer, A., Mundlein, A., & Drexel, H. 2012. Phytochemicals and their impacton adipose tissue inflammation and diabetes. Vascular Pharmacology. 58(1-2):3-20. 99.Lin, H.-W., Chang, T.-J., Yang, D.-J., Chen, Y.-C., Wang, M., & Chang, Y.-Y. 2012. Regulation of virus-induced inflammatory response by β-carotene inRAW264.7 cells. Food Chemistry. 134(4):2169-2175. 100.Liu, C.-h., Xue, Y.-r., Ye, Y.-h., Yuan, F.-f., Liu, J.-y., & Shuang, J.-l. 2007. Extraction and Characterization of Antioxidant

Compositions From Fermented Fruit Juice of Morinda citrifolia (Noni). Agricultural Sciences in China. 6(12):1494-1501. 101.Loo, G. 2003. Redox-sensitive mechanisms of phytochemical-mediated inhibition of cancer cell proliferation (review). The Journal of NutritionalBiochemistry. 14(2):64-73. 102.Morton, J. 1987. Jaboticabas. In: Fruits of warm climates. Julia F. Morton, Miami, FL. p. 371 – 374. 103.Mootoo, A. and G. Henry. 1996. Introducing the jaboticaba, a relatively newcomer to the Caribbean. Postharvest and Fruit Agronomy Units, Research Division,Ministry of Agriculture, Land and Marine Resources, Trinidad, p. 2.. 104.Magallhaes, M. M., Barros, R. S., & Finger, F. L. 1996. Changes in structural carbohydrates in developing fruit of Myrciaria jaboticaba. Scientia Horticulturae. 66(1 – 2):17-22. 105.Mainardi, T., Kapoor, S., & Bielory, L. 2009. Complementary and alternative medicine: Herbs, phytochemicals and vitamins and their immunologic effects.Journal of Allergy and Clinical Immunology. 123(2):283-294.e210. 106.Martinez-Cayuela, M. 1995. Oxygen free radicals and human disease. Biochimie. 77(3):147-161. 107.Matsumoto, K., Takada, T., Shimizu, K., Moriyama, K., Kawakami, K., Hirano,K., Nomoto, K. 2010. Effects of a probiotic fermented milk beverage containing Lactobacillus casei strain Shirota on defecation frequency, intestinal microbiota, and the intestinal environment of healthy individuals with soft stools.Journal of Bioscience and Bioengineering. 110(5):547-552. 108.Miller, N. J., & Rice-Evans, C. A. 1997. The relative contributions of ascorbicacid and phenolic antioxidants to the total antioxidant activity of orange and applefruit juices and blackcurrant drink. Food Chemistry. 60(3):331-337. 109.Minamiyama, Y., Takemura, S., Yoshikawa, T., & Okada, S. 2003. Fermentedgrain products, production, properties and benefits to health.Pathophysiology.9(4):221-227. 110.Mondola, P., Bifulco, M., Seru, R., Annella, T., Ciriolo, M. R., & Santillo, M.2000. Presence of CuZn superoxide dismutase in human serum lipoproteins.FEBS Letters. 467(1):57-60. 111.Monji, A., Morimoto, N., Okuyama, I., Yamashita, N., & Tashiro, N. 1994.Effect of dietary vitamin E on lipofuscin accumulation with age in the rat brain.Brain Research. 634(1):62-68. 112.Moyer, M. S. 2007. Lactose Intolerance. In C. G. Lynn, Md, M. K. Jeffrey & M.D. Cynthia Christy (Eds.), Pediatric Clinical Advisor (Second Edition) p. 331. Philadelphia: Mosby. 113.Muller, F. L., Song, W., Liu, Y., Chaudhuri, A., Pieke-Dahl, S., Strong, R., an Remmen, H. 2006. Absence of CuZn superoxide dismutase leads to elevated oxidative stress and acceleration of age-dependent skeletal muscle atrophy. Free Radical Biology and Medicine. 40(11):1993-2004. 114.Nicholls, P. 2012. Classical catalase: Ancient and modern. Archives of Biochemistry and Biophysics. 525(2):95-101. 115.O'Toole, D. K. 2004. SOYBEAN. Soy-Based Fermented Foods. In W.Editor-in-Chief: Colin (Ed.), Encyclopedia of Grain Science. p. 174-185. 116.Oliver, G., Nunez, M., & Gonzalez, S. N. 1999. Fermented foods Fermented Vegetable Products. In K. R. Editor-in-Chief: Richard (Eds.), Encyclopedia of Food Microbiology. p. 739-744. 117.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. 118.Pacher, P., Schulz, R., Liaudet, L., & Szabo, C. 2005. Nitrosative stress andpharmacological modulation of heart failure. Trends in PharmacologicalSciences. 26(6):302-310. 119.Palozza, P. 2005. Can β-carotene regulate cell growth by a redox mechanism?An answer from cultured cells. Biochimica et Biophysica Acta (BBA) – MolecularBasis of Disease. 1740(2):215-221. 120.Papi, A., Chicca, M., Pandit, A., & Caramori, G. 2006. Oxidants And Antioxidants | Antioxidants, Nonenzymatic. In J. L. Geoffrey & D. S. Steven(Eds.), Encyclopedia of Respiratory Medicine. p. 266-271. Oxford:Academic Press. 121.Patel, S. P., Pradeep, A. R., & Chowdhry, S. 2009. Crevicular fluid levels of plasma glutathione peroxidase (eGPx) in periodontal health and disease. Archives of Oral Biology. 54(6):543-548. 122.Plagemann, I., Krings, U., Berger, R. G., & Marostica, M. R. 2012. Volatileconstituents of jabuticaba (Myrciaria jaboticaba (Vell.) O. Berg) fruits. Journal of Essential Oil Research. 24(1):45-51. 123.Pocernich, C. B., Cardin, A. L., Racine, C. L., Lauderback, C. M., & Allan Butterfield, D. 2001. Glutathione elevation and its protective role in acrolein-induced protein damage in synaptosomal membranes: relevance to brain lipid peroxidation in neurodegenerative disease. Neurochemistry International.39(2):141-149. 124.Pochard, P., Gosset, P., Grangette, C., Andre, C., Tonnel, A.-B., Pestel, J., & Mercenier, A. 2002. Lactic acid bacteria inhibit TH2 cytokine production bymononuclear cells from allergic patients. Journal of Allergy and Clinical Immunology. 110(4):617-623. 125.Polo, A. S., & Murakami Iha, N. Y. 2006. Blue sensitizers for solar cells: Natural dyes from Calafate and Jaboticaba. Solar Energy Materials and Solar Cells. 90(13):1936-1944. 126.Ren, J., Li, Q., Wu, S., Li, S.-Y., & Babcock, S. A. 2007. Cardiac overexpression of antioxidant catalase attenuates aging-induced cardiomyocyterelaxation dysfunction. Mechanisms of Ageing and Development. 128(3):276-285. 127.Reynertson, K. A., Wallace, A. M., Adachi, S., Gil, R. R., Yang, H., Basile, M.J., Kennelly, E. J. 2006. Bioactive depsides and anthocyanins fromjaboticaba (Myrciaria cauliflora).
[Research Support, N I H , ExtramuralSupport, U S Gov't, Non-P H S]. J Nat Prod. 69(8):1228-1230. 128.Ricciarelli, R., Argellati, F., Pronzato, M. A., & Domenicotti, C. 2007. Vitamin E and neurodegenerative diseases. Molecular Aspects of Medicine. 28(5 – 6):591-606. 129.Rita, R.-D., Zanda, K., Daina, K., & Dalija, S. 2011. Composition of aroma compounds in fermented apple juice: effect of apple variety, fermentation temperature and inoculated yeast concentration. Procedia Food Science. 1(0):1709-1716. 130.Roberts, R. A., Smith, R. A., Safe, S., Szabo, C., Tjalkens, R. B., & Robertson, F. M. 2010. Toxicological and pathophysiological roles of reactive oxygen andnitrogen species. Toxicology. 276(2):85-94. 131.Rufino, M. d. S. M., Alves, R. E., de Brito, E. S., Perez-Jimenez, J.,Saura-Calixto, F., & Mancini-Filho, J. 2010. Bioactive compounds and antioxidant capacities of 18 non-traditional tropical fruits from Brazil. Food Chemistry. 121(4):996-1002. 132.Rufino, M. S. M., Alves, R. E., Fernandes, F. A. N., & Brito, E. S. 2011. Free radical scavenging behavior of ten exotic tropical fruits extracts. Food Research International. 44(7):2072-2075. 133.Robak, J., and Gryglewski, I. R., 1988. Flavonoids are scavengers of superoxide anions. Biochem Pharmacol. 37:837-841. 134.Sancho, R. A. S., & Pastore, G. M. 2012. Evaluation of the effects of anthocyanins in type 2 diabetes. Food Research International. 46(1):378-386. 135.Santos, D. T., Veggi, P. C., & Meireles, M. A. A. 2010. Extraction of antioxidant compounds from Jabuticaba (Myrciaria cauliflora) skins: Yield, composition andeconomical evaluation. Journal of Food Engineering. 101(1):23-31. 136.Saran, S., Gopalan, S., & Krishna, T. P. 2002. Use of fermented foods to combatstunting and failure to thrive. Nutrition. 18(5):393-396. 137.Schoen, C., Schulz, A.,

Schweikart, J., Schutt, S., & von Baehr, V. 2009.Regulatory effects of a fermented food concentrate on immune functionparameters in healthy volunteers. Nutrition. 25(5):499-505. 138.Sengun, I. Y., & Karabiyikli, S. 2011. Importance of acetic acid bacteria in food industry. Food Control. 22(5):647-656. 139.Shen, C.L., von Bergen, V., Chyu, M.C., Jenkins, M. R., Mo, H., Chen, C.H., & Kwun, I.S. 2012. Fruits and dietary phytochemicals in bone protection. Nutrition Research. 32(12):897-910. 140.Sirtori, C., & Lovati, M. 2001. Soy proteins and cardiovascular disease. Current Atherosclerosis Reports. 3(1):47-53. 141.Steinkraus, K. H. 1994. Nutritional significance of fermented foods. Food Research International. 27(3):259-267. 142.Steinkraus,K. H. 2002. Fermentations in world food processing.Comprehensive Reviews in Food Science and Food Safety. 1(1):23-32. 143.Steinkraus, K. H. 2009. Fermented Foods. In S. Editor-in-Chief:Moselio (Eds.),Encyclopedia of Microbiology (Third Edition) p. 45-53. Oxford: Academic Press. 144.Szweda, P. A., Friguet, B., & Szweda, L. I. 2002. Proteolysis, free radicals, andaging. Free Radical Biology and Medicine. 33(1):29-36. 145.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. 146.Teixeira, G. H., Durigan, J. F., Santos, L. O., Hojo, E. T., & Cunha Junior, L. C. 2011. Changes in the quality of jaboticaba fruit (Myriciaria jaboticaba (Vell) Berg. cv. Sabara) stored under different oxygen concentrations.
[ResearchSupport, Non-U S Gov't]. J Sci Food Agric. 91(15):2844-2849. 147.Thomas, C. E., & Aust, S. D. 1986. Free radicals and environmental toxins. Annals of Emergency Medicine. 15(9):1075-1083. 148.Tuo, Y. F., Zhang, L. W., Yi, H. X., Zhang, Y. C., Zhang, W. Q., Han, X., Wang, S. M. 2010. Short communication: Antiproliferative effect of wild Lactobacillus strains isolated from fermented foods on HT-29 cells. Journal of Dairy Science. 93(6):2362-2366. 149.Valko, M., Leibfritz, D., Moncol, J., Cronin, M. T. D., Mazur, M., & Telser, J. 2007. Free radicals and antioxidants in normal physiological functions and human disease. The International Journal of Biochemistry & Cell Biology. 39(1):44-84. 150.Valko, M., Rhodes, C. J., Moncol, J., Izakovic, M., & Mazur, M. 2006. Free radicals, metals and antioxidants in oxidative stress-inducedcancer.Chemico-Biological Interactions. 160(1):1-40. 151.Van Hylckama Vlieg, J. E. T., Veiga, P., Zhang, C., Derrien, M., & Zhao, L. 2011. Impact of microbial transformation of food on health — from fermentedfoods to fermentation in the gastro-intestinal tract. Current Opinion in Biotechnology. 22(2):211-219. 152.Veggi, P. C., Santos, D. T., & Meireles, M. A. A. 2011. Anthocyanin extractionfrom Jabuticaba (Myrciaria cauliflora) skins by different techniques: economic evaluation. Procedia Food Science. 1(0):1725-1731. 153.Wang, C.-Y., Wu, S.-j., Fang, J.-Y., Wang, Y.-P., & Shyu, Y.-T. 2012.Cardiovascular and intestinal protection of cereal pastes fermented with lactic acid bacteria in hyperlipidemic hamsters. Food Research International. 48(2):428-434. 154.Wang, S., Zhu, H., Lu, C., Kang, Z., Luo, Y., Feng, L., & Lu, X. 2012. Fermented milk supplemented with probiotics and prebiotics can effectively alter the intestinal microbiota and immunity of host animals. Journal of Dairy Science. 95(9):4813-4822. 155.Ward, P. A., Warren, J. S., & Johnson, K. J. 1988. Oxygen radicals, inflammation, and tissue injury. Free Radical Biology and Medicine. 5(5 – 6):403-408. 156.Warner, H. R. 1994. Superoxide dismutase, aging, and degenerative disease. Free Radical Biology and Medicine. 17(3):249-258. 157.West, B. J., Deng, S., & Jensen, C. J. 2011. Nutrient and phytochemicalanalyses of processed noni puree. Food Research International. 44(7):2295-2301. 158.Weydert, C. J., Waugh, T. A., Ritchie, J. M., Iyer, K. S., Smith, J. L., Li, L., Oberley, L. W. 2006. Overexpression of manganese or copper – zinc superoxide dismutase inhibits breast cancer growth. Free Radical Biology and Medicine. 41(2):226-237. 159.Wood, S. M., Beckham, C., Yosioka, A., Darban, H., & Watson, R. R. 2000. β -Carotene and selenium supplementation enhances immune response in agedhumans. Integrative Medicine. 2(2 – 3):85-92. 160.Wu, S. B., Dastmalchi, K., Long, C., & Kennelly, E. J. 2012. Metabolite Profiling of Jaboticaba (Myrciaria cauliflora) and Other Dark-Colored Fruit Juices.
[Journal article]. J Agric Food Chem. 18:18. 161.Yoshida, H., Sasaki, K., Hirowatari, Y., Kurosawa, H., Sato, N., Furutani, N., &Tada, N. 2004. Increased serum iron may contribute to enhanced oxidation oflow-density lipoprotein in smokers in part through changes in lipoxygenase andcatalase. Clinica Chimica Acta. 345(1 – 2):161-170. 162.Youdim, K. A., & Joseph, J. A. 2001. A possible emerging role ofphytochemicals in improving age-related neurological dysfunctions: a multiplicity of effects. Free Radical Biology and Medicine. 30(6):583-594. 163.Zhang, Y., Tocchetti, C. G., Krieg, T., & Moens, A. L. 2012. Oxidative and nitrosative stress in the maintenance of myocardial function. Free RadicalBiology and Medicine. 53(8):1531-1540. 164.Zhu, Y., Ling, W., Guo, H., Song, F., Ye, Q., Zou, T., Yang, Y. 2012.Anti-inflammatory effect of purified dietary anthocyanin in adults withhypercholesterolemia: A randomized controlled trial. Nutrition, Metabolism andCardiovascular Diseases.