利用納豆菌、酵母菌及米麴菌發酵糙米

彭信蒼、王正仁

E-mail: 9607895@mail.dyu.edu.tw

摘 要

糙米是營養豐富的食物，可以促進新陳代謝，預防動脈硬化、癌症、心血管疾病和貧血症，但糙米因被周邊纖維組織包埋，不易被人體消化吸收，且風味不佳；若經長時間蒸煮，則其營養素因過度加熱而損失。但若利用納豆菌(Bacillus subtilis var. natto)及米麴菌(Aspergillus oryzae)的多種水解酵素分泌能力及釀酒酵母菌(Saccharomyces cerevisiae)的風味產生能力，當能解決糙米的難消化問題，保存糙米的營養，提高消化性，並提升多樣的風味與保健成分。 因此，本研究的目的是以熟糙米為原料，利用多菌株發酵技術，生產機能性發酵糙米，並對發酵糙米進行機能性成分分析，以建立發酵糙米的生產依據。 菌種的製備方式及接種量對發酵影響的結果顯示，以酵母麥芽精培養液(yeast and malt extract broth,YMB)當作製備培養液且個別製備菌種時，再以10%的接種量接至糙米中發酵，可得較高納豆菌孢子數、酵母菌數及葡萄糖胺含量。糙米中的水添加量比例對糙米發酵的影響顯示，以1:0.9的比例進行發酵可以得到最多的納豆菌孢子數。而不管以單菌、雙菌或三菌發酵，納豆菌孢子數均可達108 CFU/g，酵母菌亦可達108 CFU/g，尤其當酵母菌與米麴菌一起發酵時，酵母菌數更可高達109 CFU/g。米麴菌只有與納豆菌同時發酵時，葡萄糖胺的含量較低，其餘皆可達3 mg/g。超氧歧化?(superoxide dismutase)活性以酵母菌與米麴菌一起發酵時最高，有33 U/g。自由基清除率則以單一米麴菌或酵母菌與米麴菌及三菌發酵時最高，可達30%以上。糙米中蛋白?活性以三菌同時發酵最高，達13.42 U/g。添加葡萄糖或酵母粉則對菌數或其他成分無顯著助益。

關鍵詞 : 米麴菌 ; 酵母菌 ; 心血管 ; 消化性

目錄

參考文獻

1. 王三朗。1996。水產資源利用學。高立圖書出版社。 2. 中國國家標準。CNS13446。 3. 中國國家標準。N1126。 4. 方維倫。1989。應用微生物。復文書局出版。 5. 王麗蓉。2004。製麴與酒母製備條件對清酒釀造之影響。國立中興大學食品科技系碩士論文。台中。 6. 李幸芬。2006。同時利用納豆菌及寡孢根黴菌發酵黃豆。私立大葉大學分子生物科技學系碩士論文。彰化。 7. 何明根。1984。台灣發展米糠油工業可行性之研究。先鋒企業管理發展中心出版。台北。 8. 陳賢哲。1982。植酸及肌酸的製造應用。食品工業14(2):23-27。 9. 須見洋行。1993。納豆治百病。培琳出版社。台北。 10. 黃卓治、辛志勳、張文重。1977。納豆菌之研究:納豆菌培養條件之檢討。屏東農專學報18:69-75。 11. 曾慶瀛、余哲仁、、洪沄利。1994。烏豆、薏仁和糙米應用於早點穀粉之製造。中華生質能源學會會誌13:102-109。 12. 雷少平。1980。米糠油中米糠醇對烏腳病之膳食之研究。國立台灣大學農業化學研究所碩士論文。 13. 劉馨璘。2005。Bacillus subtilis var. natto及Rhizopus microsporus var oligosporus 混合發酵對種皮黑豆機能性成分生成之影響。私立大葉大學生物產業科技學系碩士論文。彰化。 14.鄭心嫻、謝明哲、朱哲輝。1991。白米、糙米及添加聚糊精的白米飲食對青年男子代謝的影響。中華民國營養學會雜誌 16:157-175。 15.鍾青萍、余世望、梁牲媛。2001。納豆菌的抗菌作用及培養基的優化。食品工業科技5:20-22。 16. Abe, Y., Umemura, S., Sugimoto, K. I., Hirawa, N., Yokoyama, N., Yokoyama, T., Iwai, J. and Ishii, M. 1995. Effect of green tea rich in γ-aminobutyric acid on blood pressure of dahl salt sensitive rats. American Journal of Hypertension 8:74-79. 17. Aoki, H., Furuya, Y., Endo, Y. and Fujimoto, K. 2003. The production of a new tempeh-like fermented soybean containing a high level of γ-aminobutyric acid by anaerobic incubation with Rhizopus. Bioscience, Biotechnology and Biochemistry 67(5):1018-1023. 18. Bartnicki, P., Luciak, M., Zbrog, Z. and Tchorzewski, H. 1995. Myoinositol incorporation into lymphocytes of chornic renal failure patients is impairs. Nephrology Dialysis Transplantation 10:637-642. 19. Chaia, A. P., Sead, S. D., Holgado, D. R. and Oliver, G. 1995. Short-chain fatty acids modulate growth of lactobacilli in mixed culture fermentations with propionibacteria. Food Microbiology 26:365-374. 20. Champagne, E. T., Hron, R. J. and Abraham, G. 1991. Stabilizing brown rice product by aqueous ethanol extraction. Cereal chemistry 68:267-271. 21. Desgranges, C., Vergoignan, C., Georges, M. and Durand, A. 1991. Biomass estimation in solid state fermentation. I Manual biochemical methods. Applied Microbiology and Biotechnology 35:200-205. 22. Empson, K. L., Labuza, T. P. and Graf, E. 1991. Phytic acids as a food antioxidant. Journal Food Science 56:560-563. 23. Graf, E. 1983. Applications of phytic acids. JAOCS 60:1861-1868. 24. Gutierrez-Correa, M., Portal, L., Moreno, P. and Tengerdy, P. T. 1999. Mixed culture solid substrate fermentation of Trichoderma reesei with Aspergillus niger on sugar cane bagasse. Bioresource Technology 68:173-178. 25. Hammond, N. 1994. Functional and nutritional characteristics of rice bran extracts. Cereal Foods World 39:752-754. 26. Haq, I. U., Ali, S. and Qadeer, M. A. 2002. Biosynthesis of L-DoPa by Aspergillus oryzae. Bioresource Technology 85:25-29. 27. Inone, K., Shira, T., Ochiai, H., Kasao, M., Kayakawa, k., Kimura, M. and Sansawa, H. 2003. Blood-pressure-lowering effect of a novel fermented milk containing γ-aminobutyric acid (GABA) in mild hypertensives. European Journal of Clinical Nutrition 57:490-495. 28. Kahlon, T. S., Saunders, R. M., Chow, F. I., Chin, M. M. and Betschart, A. A. 1990. Influence of rice bran, oat bran and wheat bran on cholesterol and triglycerides in hamsters. Cereal chemistry 67:439-443. 29. Kawamura, F. and Doi, R. H. 1984. Construction of Bacillus subtilis double mutant deficient in extracellular alkaline and neutral protease. Journal Bacteriology 160:442-444. 30. Kequan, z. and Liangli, Yu. 2004. Effect of extraction solvent on wheat bran antioxidant activity estimation. Lebensm-wiss U-Technology 37:717-721. 31. Kono, I. and Himeno, K. 2000. Changes in γ-aminobutyric acid content during beni-koji making. Bioscience, Biotechnology and Biochemistry. 64(3):617-619. 32. Lee, K. 2005. Comparison of fermentative capacities of lactobacilli in single and mixed culture in industrial media. Process Biochemistry 40:1559-1564. 33. Lin, C. H., Wei, Y. T. and Chou, C. C. 2006. Enhances antioxidative activity of soybean koji prepared with various flamentous fungi. Food Microbiology 23:628-633. 34. Lin, C. W., Yang, J. H. and Su, L. C. 1997. The extraction and properties of superoxide dismutase from porcine blood. Meat Science 46:303-312 35. Maruyama, M. and Sumi, H. 1998. Effect of natto diet on blood pressure. Basic and Clinical Aspects of Japanese Traditional Food Natto 2. 1-3 Japan. 36. Mcandrew, J., Patel, R. P., Jo, H., Cornwell, T., Lincoln, T., Moellering, D., White, C. R. Matalon, S. and Darley-Usmar, U.1997. The interplay of nitric oxide and peroxynitrite with signal transduction pathway: implications for disease. Seminars in Perinatology 21(5):351-366. 37. Mrrsue, T., Tachibana, K. and Funo, Y. 1999. Efficient kefiran production by a mixed cultures of Lactobacillus kefiranofaciens KF-75 and Yeast stains. Seibutsu-kogaku 77:99-103. 38. Ohtsubo, K., Suzuki, K., Yasui, Y. and Kasumi, T. 2005. Bio-functional components in the processed pre-germinated brown rice by twin-screw extruder. Journal of Food Composition and Analysis 18:303-316. 39. Okada, T., Sugishita, T., Murakami, T., Murai, H., Saikusa, T., Horino, T., Onoda, A., Kajimoto, O., Takahashi, R. and Takahashi, T. 2000. Effect of the defatted rice germ enriched with GABA for sleeplessness, depression, autonomic disorder by oral administration. Nippon Shokuhin Kagaku Kogaku Kaishi(in Japanese). 47:596-603. 40. Pandey, S. C., Davis, J. M., Schwertz, D. W. and Pandey, G. N. 1991. Effect of antidepressants and neuroleptics on phosophoinositisde metabolism in human platelets. Journal Pharmaoology and Experimental Therapeutics 256:1010-1018. 41. Patel, S. and Shibamoto, T. 2003. Effect of 20 different yeast strains on the production of volatile components in Symphony wine. Journal of Food Composition and Analysis 16: 469-476. 42. Riel, N. A. W. V., Giuseppin, M. L. F. and Verrips, C. T. 2000. Dynamic Optimal Control of Homeostasis: An Integrative System Approach for Modeling of the Central Nitrogen Metabolism in Saccharomyces cerevisiae. Metabolic Engineering 2: 49-68. 43. Sandhya, C., Sumantha, A., Szakacs, G. and Pandey, A. 2005. Comparative evaluation of neutral protease production by Aspergillus oryzae in submerged and solid-state fermentation. Process Biochemistry 40:2689-2694. 44. Sato, T., Yamada, Y., Ohtani, Y., Mitsui, N., Murasawa, H. and Araki, S. 2001. Production of menaquinone(vitamin k2) by Bacillus subtilis. Journal Ind. Microbiology Biotechnology 62(7):2482-2488. 45. Seymour, L. M., Shoaibi, M. A., Martin, A., Ahmed, A., Elvin, P., Kerr, D. J. and Wakelam, M. J.O. 1996. Vascular endothelial growth factor

stimulates protein kinase C-dependent phosphplipase D activity in endothelial cell. Lab. Invest. 75:427-437. 46. Sharma, R. D. and Rukmini, C. 1986. Rice bran oil and hypocholesterolemia in rats. Lipids in Health and Disease 21:715-723. 47. Shelp, B. J., Bown, A. W. and Mclean, M. D. 1999. Metabolism and functions of gamma-aminobutyric acid. Trends in Plant Science 4(11):446-452. 48. Tsuchida, T., Mashiko, K., Yamada, K., Hiratsuka, H., Shimada, T., Itagaki, Y., Fujinuma, H., Samejima, K., Nakamura, T., Hasegawa, T. and Matsubayashi, T. 2003. Clinical study of γ -aminobytyric acid-rich Chlorella for subjects with high-normal blood pressure and mild hypertension. Journal of the Japanese Society for Food Science and Technology engineering 56(2):97-102. 49. Ueno, Y., Hayakawa, K., Takahashi, S. and Oda, K. 1997. Purification and characterization of glutamate decarboxylase from Lactobacillus breris IF012005. Bioscience, Biotechnology and Biochemistry. 61(7):1168-1171. 50. Wang, R., Law, R. C. S. and Webb, C. 2005. Protease production and conidiation by Aspergillus oryzae in flour fermentation. Process Biochemistry 40:217-227.