利用微生物法從蝦殼廢棄物製備胜肽鈣和幾丁質

邱聖峰(5140)

2024/05/01

大綱

摘要

蝦蟹甲殼類為臺灣重要的水產品，其產值約佔水產品的 10%，蝦類利用時約產生50%的廢棄物，其中富含幾丁質、礦物質與蛋白質。根據聯合國 17 項永續發展目標中的綠色環保與永續發展，將這些生物資源進一步回收再利用有其必要性。本計畫以綠色環保的微生物法和氣爆膨發法，發酵蝦殼廢棄物製備胜肽鈣和幾丁質，並利用複合菌株兩步驟發酵提升萃取效率；另外氣爆膨發經證實可將孔洞結構撐大形成多孔化之物質，增加菌株發酵之表面積，再分別收集發酵之上清液產物(胜肽與鈣)，進一步使胜肽與鈣離子螯合，最後測定胜肽鈣的螯合能力及幾丁質之產率與基本物化性質。本研究探討，蝦殼粉(SP)與膨發蝦殼粉(EP)以 *B. subtilis* BCRC 10255 發酵 60 小時之組別有最好的效果，代號分別為 SPBS 及 EPBS，去蛋白質率(DP)分別為 82.16%及 82.91%，游離胺基態氮(Amino-N)分別為 9.10 mg/100 mL 及 8.45 mg/100 mL，胜肽含量分別為 0.665 mg/g 及 0.585 mg/g，因此選擇 SPBS 與 EPBS 作為乳酸發酵組別，並以 4% *L. rhamnoides* 發酵製備鈣，40-60 mesh 之 SP 與 EP 先以 10% *B. subtilis* BCRC 10255 發酵 60 小時，再用 4% *L. rhamnoides* BCRC 10940 發酵 96 小時，產物代號分別為 FSP 與 FEP，總可滴定酸(total titratable acid, TTA)含量分別為 1.67%及 0.84%，去礦物質率(DM)分別為 71.52%及 57.77%。螯合實驗最終以 pH 8、40 °C、加熱 90 分鐘、胜肽與鈣質量比 5:1 有最好的鈣結合能力，並比較 SP 與 EP 之 Raw 與 3-10 k 之螯合率分別提升 39.4%及 39.9%，以及製備胜肽鈣之複合物在 UV-Vis、螢光、SEM、FTIR、XRD 下未有明顯差異，因此得出氣爆膨發之組別可能受到抑菌物質或高溫高壓之影響，導致效果不如預期。

參考文獻

Baakdah, M. M., & Tsopmo, A. (2016). Identification of peptides, metal binding and lipid peroxidation activities of HPLC fractions of hydrolyzed oat bran proteins. *Journal of Food Science and Technology*, *53*(9), 3593-3601.

Bao, Z., Zhang, P., Sun, N., & Lin, S. (2021). Elucidating the calcium-binding site, absorption activities, and thermal stability of egg white peptide–calcium chelate. *Foods*, *10(11)*, 2565.

Cai, X., Yang, Q., Lin, J., Fu, N., & Wang, S. (2017). A specific peptide with calcium-binding capacity from defatted Schizochytrium sp. protein hydrolysates and the molecular properties. *Molecules*, *22*(4), 544.

Dolphin, A. C. (2013). The alpha2delta subunits of voltage-gated calcium channels. *Biochimica et Biophysics Acta*, 1828(7), 1541–1549.

Heaney, R. P., Rafferty, K., Dowell, M. S., & Bierman, J. (2005). Calcium fortification systems differ in bioavailability. *Journal of the American Dietetic Association*, *105*(5), 807-809.

Hidalgo, I. J., Raub, T. J., & Borchardt, R. T. (1989). Characterization of the human colon carcinoma cell line (Caco-2) as a model system for intestinal epithelial permeability. *Gastroenterology*, *96*(2), 736-749.

Hou, H., Wang, S., Zhu, X., Li, Q., Fan, Y., Cheng, D., & Li, B. (2018). A novel calcium-binding peptide from Antarctic krill protein hydrolysates and identification of binding sites of calcium-peptide complex. *Food Chemistry*, 243, 389-395.

Mays, S., & Brickley, M. B. (2018). Vitamin D deficiency in bioarchaeology and beyond: The study of rickets and osteomalacia in the past. *International Journal of Paleopathology*, *23*, 1-5.

Nara, M., Morii, H., & Tanokura, M. (2013). Coordination to divalent cations by calcium-binding proteins studied by FTIR spectroscopy. *Biochimica et Biophysica Acta (BBA) - Biomembranes*, *1828(10)*, 2319–2327.

Ottolia, M., Torres, N., Bridge, J. H., Philipson, K. D., & Goldhaber, J. I. (2013). Na/Ca exchange and contraction of the heart. *Journal of Molecular and Cellular Cardiology*, *61*, 28–33.

Peng, Z., Hou, H., Zhang, K., & Li, B. (2017). Effect of calcium-binding peptide from Pacific cod (*Gadus macrocephalus*) bone on calcium bioavailability in rats. *Food Chemistry*, *221*, 373-378.

Teng, H., Qian, Y., Fan, X., Cao, H., Tian, Y., & Chen, L. (2022). Nutritional properties of Europen eel (*Anguilla anguilla*) bone peptide-calcium and its apoptosis effect on Caco-2 cells. *Food Science and Human Wellness*, *11*(6), 1482-1490.

Wu, W., He, L., Liang, Y., Yue, L., Peng, W., Jin, G., & Ma, M. (2019). Preparation process optimization of pig bone collagen peptide-calcium chelate using response surface methodology and its structural characterization and stability analysis. *Food Chemistry*, *284*, 80-89.

Zhang, L., Lin, Y., & Wang, S. (2018). Purification of algal calcium-chelating peptide and its physical chemical properties. *Journal of Aquatic Food Product Technology*, *27*(4), 518-530.