

發酵與脫水技術對納豆的酵素活性與機能性成分的影響

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摘要

本研究分成六個實驗以探討發酵與脫水技術對納豆酵素活性與機能性成分的影響。首先，研究不同發酵時間對納豆中大豆蛋白質的影響，結果顯示，蛋白質水解率和TCA可溶性氮隨著發酵時間增加而增加，蛋白質溶解率則先下降然後增加；在未發酵樣品中大豆蛋白之電泳圖可見清晰的片段，而發酵24小時後樣品之大豆蛋白明顯被分解，分子量20 kDa以上大豆蛋白消失不見；必需胺基酸含量經過發酵36小時後下降，而48小時發酵後除histidine含量下降外全部都上升。其次探討干燥方法對納豆酵素活性的影響，納豆分別經烘乾、凍乾及真空乾燥後，測定其凝乳、蛋白、脂解、納豆激等酵素活性和超氧陰離子清除力。結果顯示，乾燥納豆除超氧陰離子清除力下降外，其他酵素活性都和未乾燥納豆相近甚至更高，因此我們認為本研究的乾燥方法適合乾燥納豆粉末的製作。並以相同方法乾燥，分析納豆功能性成分，結果顯示上述乾燥方法不會影響納豆-聚谷氨酸(-PGA)和異黃酮的含量，但是對納豆中血管收縮素轉換抑制能力(ACE-I)有影響。另外探討蒸煮大豆接種*B. subtilis*後，分別在pH值5、7、9，溫度37、40、43，經發酵24、36、48小時後測定納豆的凝乳、蛋白、血管收縮素轉換抑制能力和胺基酸成分。結果發現蒸煮大豆在pH 9、40 發酵36小時後，胺基酸含量較未發酵蒸煮大豆低，因此建議可依不同的目的和所需要的產物來選定不同的發酵條件。研究蒸煮大豆先接種*R. oligosporus*再接種*B. subtilis*兩階段發酵後酵素活性和大豆蛋白的變化，結果得知無論單菌發酵或兩階段發酵，樣品中可溶性氮和蛋白水解率隨著發酵時間而增加；兩階段發酵過程樣品的胺基酸變化無規律性，產品凝乳作用比單菌發酵樣品高；由電泳圖顯示經過24小時兩階段發酵樣品中分子量高過20 kDa 的大豆蛋白消失不見。比較商業凝乳與*B. subtilis*、*R. oligosporus* 發酵所產生的酵素，在純化及凝乳效力的差異，結果顯示商業凝乳所產生的凝乳塊具有最高的黏度及凝乳張力，凝乳時間也最短，由*R. oligosporus*產生的酵素居次。*B. subtilis*產生的酵素具有最強的蛋白水解活性，而商業凝乳的凝乳作用最好。

關鍵詞：血管收縮素轉換抑制能力、枯草芽孢桿菌、生物特性、乾燥方法、酵素活性、發酵條件、異黃酮、商業凝乳、凝乳、納豆、純化、根黴菌、-聚谷氨酸、大豆蛋白、天貝

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