

# The Beneficial Effects of Natto on Human Health

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## ABSTRACT

Natto is a traditional Japanese fermented food made by fermenting boiled soy beans with *Bacillus natto*. It is sticky and has strong smell and taste. Once fermented, Natto will produce a plenty of active components, including protein, linolenic acid, isoflavones, folic acid, lecithin, vitamin B1、B2、E、K、, calcium, zinc, magnesium, potassium, iron..etc. Further, a fibrinolytic enzyme found in natto is called nattokinase. Nattokinase is reported to reduce and prevent blood clot. Natto is a functional food, and full of physiological functions including thrombolysis, diabetic prevention, osteoporosis, anti-hypertension, carcinogen inhibition for the human body, physiology regulation, and gastrointestinal protection.

Keywords : Natto ; nattokinase ; *Bacillus natto*

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## REFERENCES

- JTTAS 編。1994。納豆 機能特性及 治療, 預防 研究I天然物。生理機能素材研究委員會, 東京, 日本。
- JTTAS 編。1995。納豆 機能特性及 治療, 預防 研究II天然物。生理機能素材研究委員會, 東京, 日本。
- 編集。1975。納豆沿革史。全?納豆協同組合連合?恁C日本, 東京。
- 牛??咩B尾崎良克。1980。Bacillus subtilis Bacillus natto 生物?睬漫坻甬O抗菌性 ?k 研究。日本細菌??妍x 35:625-36。
- 太田靜行。1985。天然物中酸化防止劑。New Food Industry 27:63-72。
- 中野政弘。1967。發酵食品。光琳書院。東京。
- 日本全國納豆協同組合聯合會。2005。納豆新藥效。青春出版社。台北, 台灣。
- 王文獻。1996。最新解剖生理學。合記圖書出版社。台北, 台灣。
- 江晃榮。2005。納豆激酶? C世茂出版社。台北, 台灣。
- 李淑芬。1997。鹼性發酵食品。食品工業月刊 29(8):17-25。
- 呂鋒洲。2002。發酵大豆抗癌新希望。元氣齋出版社。台北, 台灣。
- 吳侑軒。2004。液態黑納豆對於皮膚保健之研究。靜宜大學應用化學研究所碩士論文。台中, 台灣。
- 李淑芬。1997。鹼性發酵食品。食品工業月刊 29(8):17-25。
- 林麗菁。2004。納豆枯草菌之液態培養及其產生納豆激酶? 好敦Q。屏東科技大學食品科學系碩士論文。屏東, 台灣。
- 林定國、黃暉光。1994。如何攝取食物纖維。生活醫學書房。台北, 台灣。
- 細井孝之。1996。骨粗鬆症 成因 1 K 不足 可能性。Medical Tribune, 5/16。
- 許元?丑C2005。納豆菌發酵製品介紹及國內研發現況。農業生技產業季刊3:45-52
- 許元?丑C2003。現代生物科技的新寵兒-神奇納豆菌。生物產業14(1):53-59
- 黃天守。1994。生理學手冊。合記圖書出版社。台北, 台灣。
- 彭英毅。1996。解剖生理學-人體構造與功能。南山堂出版社。台北, 台灣。
- 潘子明、謝依庭, 2003。乳酸菌降血壓之功效。生物產業 14(4) :302-309
- 黃卓治、黃世昌、張文重, 1977。納豆菌之研究 引絲納豆之製造。屏東農專學報 18:76-80。
- 須見洋行。1993。納豆治百病。培琳出版社, 台北, 台灣。
- 渡邊篤二、海老根英雄、太田輝夫, 1970。大豆食品。光琳書院。東京。
- 廖曉玲。2002。新世紀醫學-納豆天然的藥用食品。安立出版社。台北, 台灣。
- 顏水泉。1999。中國解剖生理學。睿煜出版社。屏東, 台灣。
- 蘇遠志。2003。納豆菌代謝產物的開發與應用。生物產業14(2):117-30。
- Akimoto, T., Yamada, S. and Matsumoto, I. 1990. The relation between protease and -glutamyltranspeptidase activities and qualities of natto. Nippon Shokuhin Kogyo

Gakkaishi 37:872-877. 29. Bennett, J.L., Doyle, L., Shaw, J., Doran, B.R.H., Keenan, D.J.M., Douglas, J.T. 1996. Aprotinin prevents fibrin formation in cardiac surgery. *JACC* 232A. 30. Blomback, B. 2000. Fibrin formation in whole blood. *Thrombosis Research* 99:307-10. 31. Fujii, H. 1962. On the formation of mucilage by *Bacillus natto*. Part I. Factors affecting the formation of mucilage. *Nippon Nogeikagaku Kaishi* 37:615-618. 32. Fujita, M., Nomura, K., Hong, K., Ito, Y., Asada, A., Nishimuro, S. 1993. Purification and characterization of a strong fibrinolytic enzyme (nattokinase) in the vegetable cheese natto, a popular soybean fermented food in Japan. *Biochemical and Biophysical Research Communications* 197:1340-47. 33. Fukushima, D. 1986. Soy sauce and other fermented foods of Japan. In: *Mycologia 79 Memoir*. APS Press, Nr 11, St Paul, MN, pp.121-149. 34. Hoffmeister, H.M., Szabo, S., Helber, U., Seipel, L. 2001. The thrombolytic paradox. *Thrombosis Research* 103:S51-5. 35. Iijima, A., Sasaki, H., Wakamatsu, H., Watanabe, S. and Maeda, Y. 1999. Microcalorimetric analysis of fermentation of natto, a traditional Japanese food. *Nippon Shokuhin Kagaku Kogaku Kaishi* 46:279-284. 36. Ito, T., Sugawara, E., Sakurai, Y., Takeyama, S., Uchizawa, H., Odagiri, S. 1987. Culture media for pyrazines production by commercial natto *Bacillus* (*Bacillus natto*). *Nippon Nogeikagaku Kaishi* 61:963-965. 37. Ito, T., Sugawara, E., Miyahara, J., Sakurai, Y., Odagiri, S. 1989. Effect of amino acids as nitrogen sources on microbiological formation of pyrazines. *Nippon Shokuhin Kogyo Gakkaishi* 36:762-764. 38. Kanno, A., Takamatsu, H., Takano, N., Akimoto, T. 1984. Determination of several volatile components produced by *Bacillus natto* in commercial natto. 39. Katz, E., Demain, A. 1977. The peptide antibiotics of *Bacillus*: Chemistry, biogenesis, and possible function. *American Society of Microbiology* 41:449-74. 40. Kiers, J.L., Laeken, V., Rombouts, F.M., Nout, M.J.R. 2000. In vitro digestibility of *Bacillus* fermented soya bean. *International Journal of Food Microbiology* 60:163-9. 41. Kosuge, T., Zenda, H., Tsuji, K., Yamamoto, T., Narita, H. 1971. Studies on flavor components of foodstuffs. Part 1. Distribution of tetramethylpyrazine in fermented foodstuffs. *Agric. Biol. Chem.* 34:693-696. 42. Kudo, T. 1990. War farin antagonism of natto and increase in serum vitamin K by intake of natto. *Artery* 17:189-201. 43. Lijnen, H.R., Cock, F.D., Hoef, B.V., Schlott, B., Coollen, D. 1994. Characterization of the interaction between plasminogen and staphylokinase. *Eur. J. Biochem.* 224:143-149. 44. Matsuo, M., Nsksmurs, N., Dhidoji, Y. Muto, Y., Esaki, H. and Osawa, T. 1997. Antioxidant mechanism and apoptosis induction by 3-hydroxyanthranilic acid, an antioxidative in Indonesian food tempeh, in the human hepatoma-derived cell line, HuH-7. *J. Nut. Sci. and Vit.* 43:249-259. 45. Maruyama, M., Sumi, H. 1998. Effect of natto diet on blood pressure. *Basic and Clinical Aspects of Japanese Traditional Food Natto II*. 1-3. Japan. 46. Obata, Y., Matano, K. 1959. Studies on the flavor of natto. Part 1. Identification of volatile acidic compounds by paper chromatography. *Nippon Nogeikagaku Kaishi* 33:567-569. 47. Obata, Y. and Matano, K. 1959. Studies on the flavor of natto. Part 2. On the change of diacetyl contents during the course of natto manufacture. *Nippon Nogeikagaku Kaishi* 33:569-571. 48. Saito, T., Iso, N., Mizuno, H., Kaneda, H., Suyama, Y., Kawamura, S. and Osawa, S. 1974. Conformational change of a natto mucin in solution. *Agric. Biol. Chem.* 38:1941-1946. 49. Snyder, H.E., Kwon, T.W. 1987. Soybean Utilization. AVI Book, New York. 50. Steinkraus, K.H. 1983. Indigenous fermented amino acid/peptide sauces and pastes with meatlike flavors: Chinese soy sauce, Japanese shoyu, Japanese miso, southeast Asian fish sauces and pastes and related foods. In: Steinkraus, K.H.(Ed.), *Handbook of Indigenous Fermented Foods Microbiology series*. Marcel Dekker, New York, USA, pp.530-547. 51. Sugawara, E., Ito, T., Odagiri, S., Kubota, K., Kobayashi, A. 1985. Comparison of compositions of odor components of natto and cooked soybeans. *Agric. Biol. Chem.* 49:311-317. 52. Sumi, H., Hamada, H., Tsushima, H., Mihara, H., Muraki, H. 1987. A novel fibrinolytic enzyme (nattokinase) in the vegetable cheese natto; a typical and popular soybean food in the Japanese diet. *Experientia* 43:1110-11. 53. Sumi, H., Hamada, H., Nakanishi, K., Hiratani, H. 1990. Enhancement of the fibrinolytic activity in plasma by oral administration of nattokinase. *Acta Haematol* 84:139-43. 54. Sumi, H., Banba, T., Kisimoto, N. 1996. Strong Pro-urokinase activators Proved in japanest soybean cheese natto. *Nippon shokhin Kagaku Kogaku Kaishi* 43(10): 1124~1127. 55. Sumi, H. 1997. Antibacterial Activity of *Bacillus natto*-Growth inhibition against *Escherichia coli* 0157. *Bioindustry* 14:47. 56. Sumi, H., Ohosugi, T. 1999. Anti-bacterial component dipicolic acid measured in natto and *Bacillus natto*. *Nippon Nogeikagaku Kaishi* 73:31-33. 57. Tanaka, T., Shoji, Z. 1993. Analysis of volatile compounds in the natto-fermenting room by gas chromatograph mass spectrometry. *Nippon Shokuhin Kogyo Gakkaishi* 40:656-660. 58. Tanaka, T., Muramatsu, K., Kim, H., Watanabe, T., Takeyasu, M., Kanai, Y., Kiuchi, K. 1998. Comparison of volatile compounds from chungkuk-jang and itohiki- natto. *Biosci. Biotechnol. Biochem.* 62:1440-1444. 59. Taira, H., Suzuki, N., Tsukamoto, C., Kainuma, Y., Tanaka, H. and Saito, M. 1987. Quality of soybean seeds grown in Japan. Part 15. Suitability for natto processing of small seed cultivars and quality of the natto. *Rep. Natl. Food Res. Int.* 51:48-58. 60. Tomohiro, H., Akio, A., Kan, K., Shuichi, K. 1999. Changes in fecal microflora induced by intubation of mice with *Bacillus subtilis* (natto) spores are dependent upon dietary components. *Can. J. Microbiol./Rev. can. microbiol.* 45(1): 59-66. 61. Tsukamoto, Y., Ichise, H., Kakuda, H., Yamaguchi, M. 2000. Intake of fermented soybean (natto) increases circulating vitamin K2 (menaquinone-7) and gamma-carboxylated osteocalcin concentration in normal individuals. *Journal of Bone & Mineral Metabolism.* 18(4):216-22. 62. Wilson, L.A. 1995. Soy foods. In: Erickson, D.R. (Ed.). *Practical Handbook of Soybean Processing and Utilization*. AOCS Press, Champaign, IL, and United Soybean Board, St. Louis, MO. pp.428-459. 63. Yokota, T., Hattori, T., Ohishi, H., Watanabe, K., Hasegawa, K. 1996. The effect of antioxidant-containing fraction from fermented soybean food on atherosclerosis development in cholesterol-fed rabbits. *Lebensm-Wissu-Technol* 29:751-75.