平成14年度 文化政策学部長特別研究 成果報告書
「遠州地方の伝統的食文化の継承と地域活性化に関する研究」

Handbook of Vegetable Preservation and Processing
（青果物の加工と貯蔵ハンドブック）

☆青果物の加工、貯蔵法の理論と実際を記述したハンドブック。
乾燥、凍結、缶詰、塩蔵、発酵など。
ニューヨークのMarcel Dekker社から出版。

☆米屋は、アジアの大豆発酵食品の担当で、日本の味噌、納豆、醤油、インドネシアのテンペについて執筆。その中で、当地域の伝統食品である浜納豆に関する部分はこれまで外国で出版されたものとしては極めて珍しく、日本古来の食文化をニューヨークから世界に発信する意義は大きい。

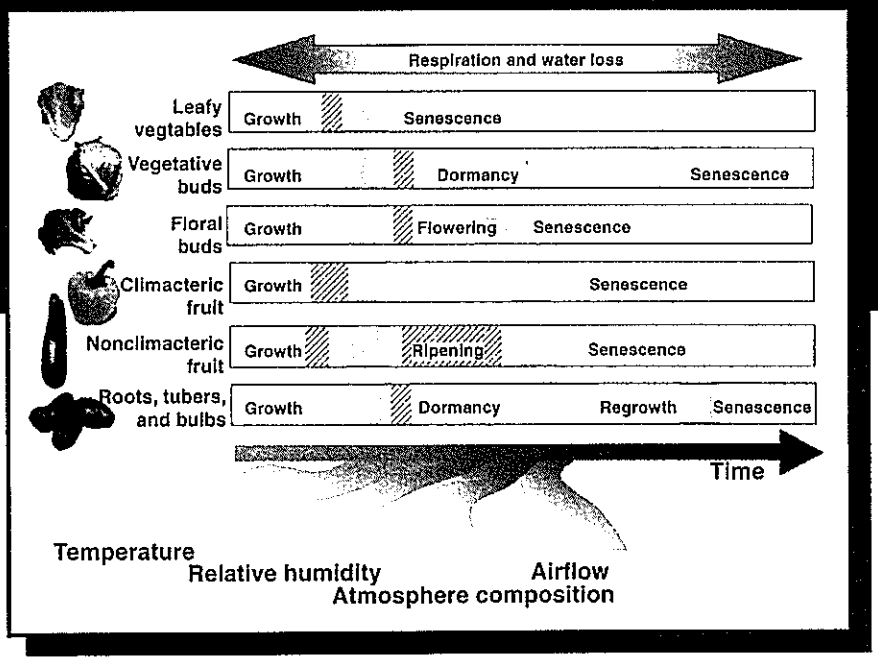
☆現在、日本食は栄養成分のバランスの良さから、理想的な健康食として欧米などから注目されており、日本の食文化を国内だけでなく世界に情報発信していくことは重要である。このことは、海外から日本を目指して来る外国人観光客の数が、日本から海外に出て行く観光客の３分の１程度に過ぎないというインバランスの是正にもつながると考えられる。
勿論、食は海外からみた日本の魅力を高めるための一部分ではあるが、あらゆる領域で日本を知ってもらうための努力と情報発信は重要である。そのための手段として英語で発信するということは、英語が今では世界の共通言語といってよい状況下では不可欠である。

☆今回の執筆は、編者の１人であるハワイ大学のＮｉｐ教授から依頼されたもの。
前任校である静岡県立大学短期大学部から、昭和６２年に海外研修制度でハワイ大学に派遣されて以来、共同研究や家族ぐるみの親交があった。
また、発酵食品を研究する際のバイブル的な存在である「Handbook of Indigenous Fermented Foods」という本を出している出版社ということもあって、英語表現に苦闘しながら書いた。出版されてみると同じシリーズの出版物ということが分かって嬉しく感じた。

☆静岡、愛知で味噌、納豆、醤油の製造現場を取材するなかで、この地域のものづくり、食文化の素晴らしさをいろいろと学ぶことが出来た。作る側と消費する側との距離が大きくなり過ぎて生じる不安と反省から、地産地消運動が盛り上がってきているが、私たちは今一度、先輩たちが作り続けてきた伝統食品を見つめ直してもよいのではないかと思う。

静岡文化芸術大学文化政策学部　　米屋武文（よねやたけふみ）

Handbook of Vegetable Preservation and Processing



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Fermented Soy Products: Tempeh, Nattos, Miso, and Soy Sauce

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I. INTRODUCTION

In Asian countries, the soybean has been processed into various products, such as tofu, tempeh, miso, nattos (Itohiki-natto and Hama-natto), soy sauce, and other related products. These products are used as protein supplements, vegetables, or seasoning ingredients in meal preparation. Of these products, tofu, tempeh, and natto are often consumed as vegetables and/or as protein supplements, whereas miso and soy sauce are used as seasonings. Tofu and its related products will be covered in a separate chapter of this book. This chapter will discuss five kinds of fermented soy products: tempeh, Itohiki-natto, Hama-natto, miso, and soy sauce.

II. TEMPEH

A. Introduction

Tempeh is a very popular fermented soybean-based food, that has been produced by Indonesians for four or five centuries. Tempeh is a white mold-covered cake produced by fungal fermentation of dehulled, hydrated (soaked), and cooked soybeans (1).

Under natural conditions in the tropics, tempeh production involves two distinct fermentations. The first, which occurs during hydration (soaking), is bacterial and results in acidification of the beans. During bacterial acid fermentation, the pH of the beans falls to a range of 4.5 to 5.3, and thus the development of undesirable bacteria that might spoil the tempeh is prevented. The second fermentation is fungal and results in overgrowth of the beans by the mold mycelia. The beans are tied together by the hypha that binds the beans so firmly together that the product can be cut into thin slices (1). Packets of traditional tempeh wrapped in wilted banana leaves or in perforated plastic bags are sold on the market in Indonesia (Fig. 1).

The best quality tempeh is made solely from soybeans, but lower cost and lower quality tempehs may contain young papaw fruit grits, cassava grits, soybean seedcoats, soymilk or tofu (soybean curd) residues (okara), and (rarely) coconut press-cake along with the soybeans.

Tempeh is consumed by slicing it, dipping the slices in soy or fish sauce or in 5 to 10% w/v salt brine, and deep frying. Alternatively, the sliced tempeh can be dipped in a batter made from rice or corn flour and coconut milk, before deep frying, or it may be soaked in tamarind pulp

Figure 6 Itohiki-natto with its viscous, sticky texture.

IV. JAPANESE HAMA-NATTO (DAIFUKUJI-NATTO, DAITOKUJI-NATTO, TERA-NATTO, SHIOKARA-NATTO)

A. Introduction

Hama-natto is another type of fermented soybean, different from Itohiki-natto. The fermentation of Hama-natto is carried out by the mold *Aspergillus oryzae*. The type of Hama-natto originated in China over 2200 years ago was introduced into Japan via Korea during the Nara period (A.D. 710–794) by a Buddhist priest (18). It is now commercially produced in extremely restricted areas of Hamamatsu city, Mikkabi town in Shizuoka Prefecture, and Kyoto city. The taste and flavor resemble miso and shoyu. Its blackish color and relatively high market price (US$2.7 per 100 g) may be the causes of its lack of popularity (Fig. 7).

B. Method of Hama-Natto Production

The technology to produce Hama-natto includes the stages of soaking, cooking, inoculation with starter mold, mycelial fermentation, drying, and second fermentation (aging). The flow diagram in Fig. 8 shows the process of Hama-natto production.

Table 2 Average Composition of Itohiki-Natto (%)

Food	Moisture	Protein	Fat	Carbohydrate	Ash
Natto	59.5	16.5	10.0	12.1	1.9

Source: Ref. 10.

Figure 7 Hama-natto produced in Hamamatsu city, Japan.

Whole dry soybeans are washed and soaked in water for 3 h at room temperature. Large, uniform size beans with smooth surfaces are preferred. The soaked beans are boiled for 5 h or steamed at 121°C for 30 min. After the cooked beans are cooled to approximately 30°C, they are thoroughly mixed with roasted barley flour and starter mold *Aspergillus oryzae* (called tane-koji). In the case of the Yamaya Brewery in Hamamatsu city, the amounts of cooked beans, roasted barley flour, and tane-koji are 1000 kg, 50–60 kg, and 50 g, respectively.

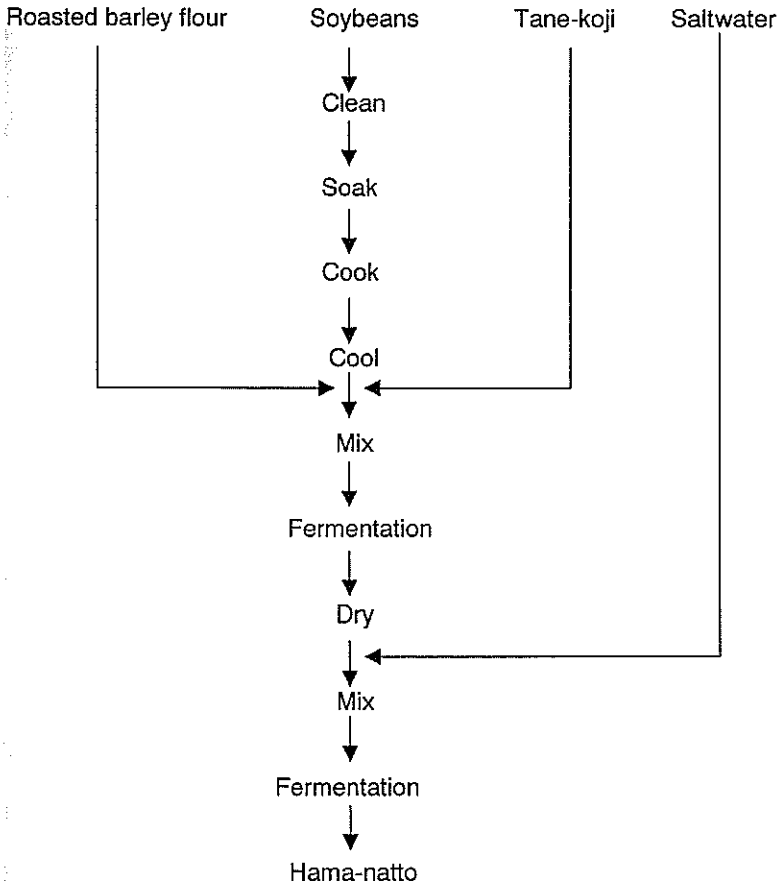

Figure 8 A flow diagram for the production of Hama-natto.

The mixture is spread in a wooden tray and incubated in the fermenting room at 25–30°C for 3–4 days (Fig. 9).

During the fermentation, *A. oryzae* grows on the surface of the beans covered with barley flour, until sporulation occurs.

The molded beans are dried in the sun for approximately 1 week and then mixed with 15% salt water (600–700 liters) and transferred into wooden buckets with ginger and/or Japanese pepper to enhance the flavor of the product.

The mixture is covered with a wooden lid, and a stone weight is put on the lid (Fig. 10). During the second fermentation for 3 to 6 months, the color of the beans changes to black. Hydrolysis of the substrates also occurs, and the resultant flavor resembles miso and shoyu (24).

C. Quality Aspects of Hama-Natto

The composition of Hama-natto is shown in Table 3.

Since Hama-natto contains a high salt concentration, it has an excellent keeping quality for 1 year or longer. It was originally made in Buddhist temples as a protein source for Buddhist monks.

D. Future Outlook

Nowadays, Hama-natto is consumed with tea and alcoholic drinks as a relish or eaten with rice in Japan. If the dark blackish color can be improved, and if the product becomes less costly, it could become a more popular food in Japan.

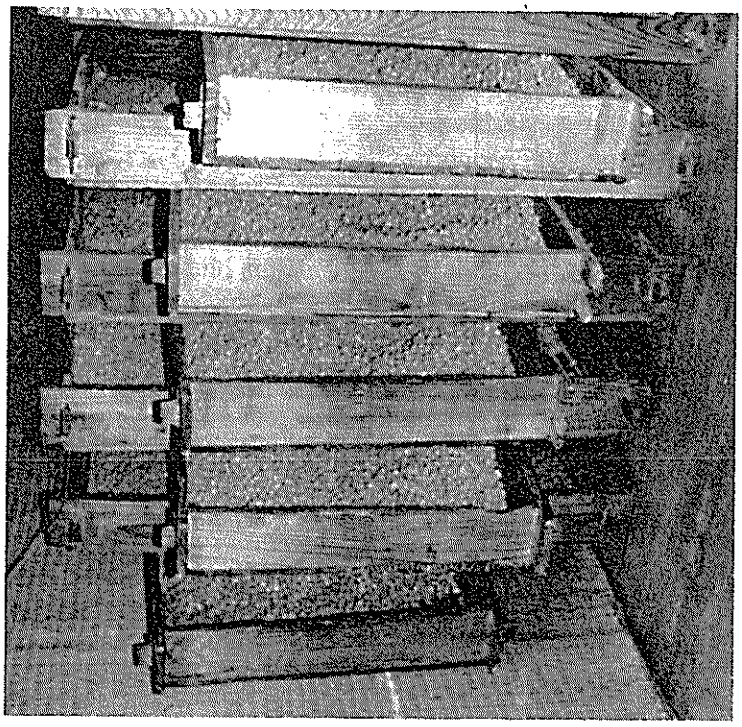

Figure 9 *A. oryzae* is grown on the surface of the mixture of cooked beans and roasted barley flour.

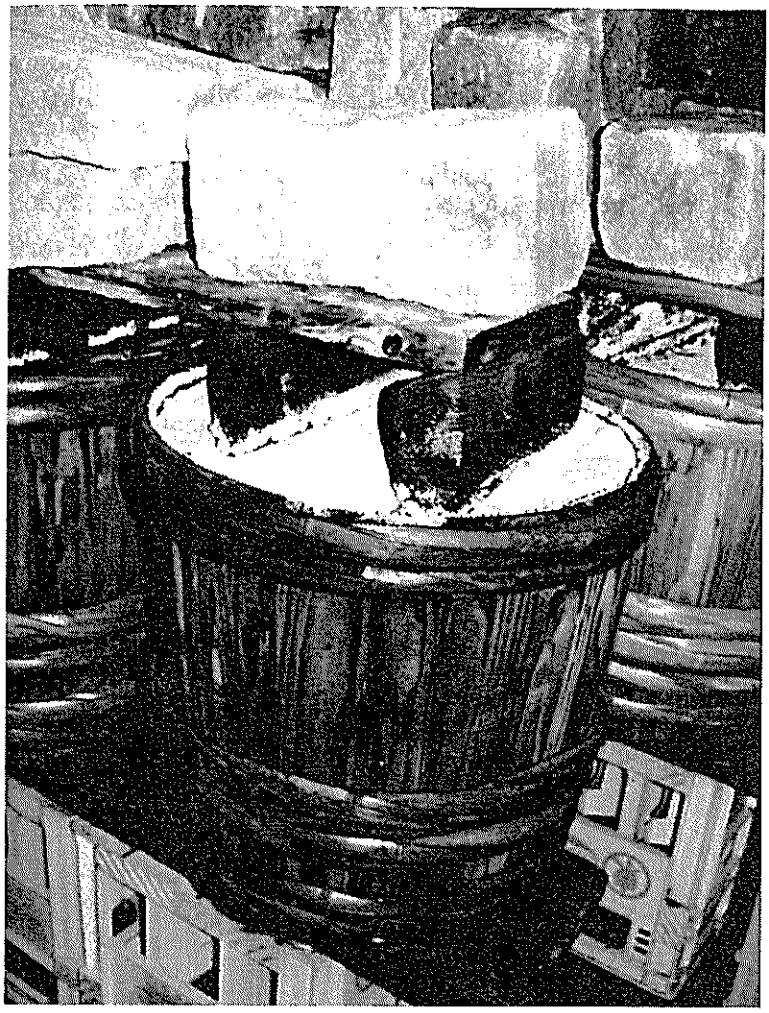

Figure 10 Fermentation (aging) is carried out for 3–6 months.

V. MISO

A. Introduction

Miso is a very popular fermented soybean-based paste food; it has been produced in all parts of Japan for at least 1300 years (28,29). It has now been industrialized, and 1355 manufacturers made 544,000 tons of it in the year 1999 (30).

There are several hundred kinds of miso, depending on the material used and on the different processing conditions. Miso can be classified into three large groups according to the different methods of koji making. Koji is a solid substrate such as rice, barley, or soybeans overgrown with a mold (koji kabi), which is selected to provide the enzymes essential for the fermentation.

Table 3 Composition of Hama-Natto (%)

Food	Moisture	Protein	Fat	Carbohydrate	Ash	Salt
Hama-Natto	24.4	18.6	8.1	31.5	17.4	14.2

Source: Ref. 10.

about the book . . .

Representing the vanguard in the field with research from more than 35 international experts spanning governmental, industrial, and academic sectors, this reference compiles the latest science and technology in the processing and preservation of vegetables and vegetable products—serving as the only guide to compile key tools used in the United States to safeguard and protect the quality of fresh and processed vegetables.

Considers recent issues in vegetable processing safety such as modified atmosphere packaging, macroanalytical methods, and new technologies in microbial inactivation.

A vast and contemporary source sure to assist any food processing professional, the ***Handbook of Vegetable Preservation and Processing*** examines the principles of traditional vegetable processing procedures such as canning, drying, freezing, fermenting, and chemical preservation...the manufacturing processes used for common vegetable products including canned tomatoes and water chestnuts, frozen peas and french fries, mushrooms, herbs, jalapeño peppers, salads, soup, and sauerkraut...the use of vegetable products in dietary supplements and functional foods...and the growing popularity of soy products in America and Western Europe.

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