Soy Sauce Production:
From A Craft- to a Science-Based System

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Soy Sauce

- Traditional Oriental food condiment
- Internationally known
- Popularly consumed
- Growing market opportunities
- Production contributes to livelihoods of small producers and processors

Source: FAOSTAT
Current Markets for Soy Sauce

Source: FAO Stat
Producers and Exporters of Soy Sauce

Source: FAO STAT
Soy Sauce Production

1. Flour
   - Roast

2. Soybean
   - Soak in running water 1-2 hrs
   - Boil or steam

3. Seed Mold
   - A. oryzae
   - (10^6 spores/g dry weight)

4. Salt Brine
   - 22-25% (w/w)

5. Koji
   - 40-48 hrs
   - Soybean: wheat flour and/or rice flour = 7:1 by weight

6. Mash (moromi)

7. Matured mash

8. Filtrate (unrefined soy sauce)
   - Pasteurise
   - Bottle
   - Soy sauce

9. Residue
   - Pasteurise
   - Bottle
   - Soybean paste
Traditional Open-Air Fermentation of Koji

Time Frame for Proteolysis: 7 days

Soy:Wheat (7:1) + A. Oryzae
Improved Inoculant

- *Aspergillus flavus var. columnaris*
  - superior protease production
  - no detectable aflatoxin production
  - Good taste and aroma of the product
  - Soy-sauce with increased (6%) soluble protein
  - Time frame for proteolysis reduced to 40 hours
Technological Innovation

- Bioreactor with controlled temperature and humidity.

Fig. 2. The koji chamber developed by Chain, Thailand. (a) The chamber. (b) Interior of a koji chamber with the temperature probe inserted in the koji (photos courtesy of Mr. L. Linechanoenkriat, Chain).
Traditional *Moromi* Fermentation

- Earthenware jars
  - with no temperature or aeration control.
- Limited production capacity
Larger Scale Moromi Fermentation Tank
Technological Innovation

- Moromi fermentation tank with aeration system

Increased efficiency of fermentation

Aeration System inside tank
Drivers of the Innovation

- Market demand for soy sauce
- Organization within the Thai soy sauce industry
- Research support from an international organization, the Thai government and the Thai soy Sauce Industry
Impact of the Innovation

- Economic gain for the soy sauce industry
- More consistent product
- Safer product
- Market Access