

Tempeh

(Wellyzar Sjamsuridzal)



Where is it predominantly made and used?

Tempeh is a fermented food whose origin is Java Island, Indonesia. The production of tempeh has spread all over Indonesia and has become popular worldwide. For most Javanese, tempeh seems to be essential to their daily diet, because it has high nutritive value, is tasty, and is the cheapest source of protein.

What are its ingredients?

Tempeh is a compact, white, cake-formed product, prepared mainly from dehulled boiled soybeans.

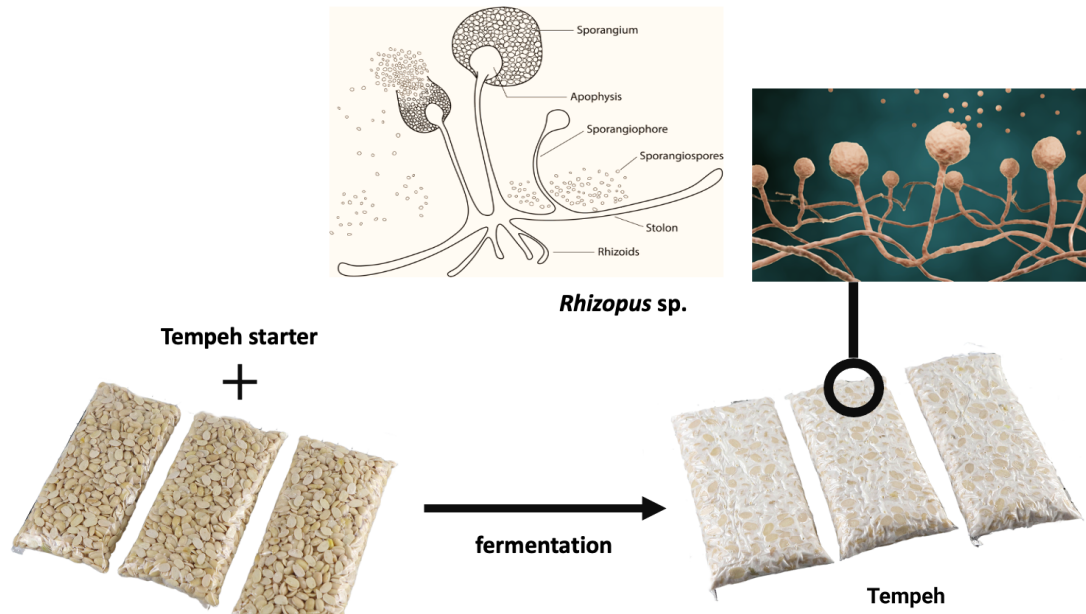
How do we make it?

Tempeh is prepared from dehulled boiled soybeans through fungal solid state fermentation with *Rhizopus* spp. as inoculum or starter. Tempeh starter can be mixed with cooked rice powder, rice bran powder, and/or wheat bran powder as inoculum. The mold used for inoculation may be a single culture of *Rhizopus microsporus* or mixed cultures of *R. microsporus*, *R. delemar*, *R. arrhizus*, and *R. stolonifer*.

The steps in making tempeh include cleaning raw soybeans, soaking overnight at 25-30°C, dehulling, washing, boiling for 30-90 minutes, draining, cooling by evaporation until 20-30°C, inoculation with fungal starter, packaging, and incubation at 24-48 hours at 25-30°C to allow fungal growth. Tempeh can be wrapped in leaves, especially banana leaves, or perforated plastic bags (polyethylene).

The texture of tempeh should be compact and not disintegrate upon cutting with knife. The color should be white due to the growth of the fungal mycelium of *Rhizopus* spp. The flavor of tempeh should be meaty, mushroom-like, and nutty. The odor of tempeh should be fresh and without any hint of ammonia.

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Microbiology of the process

Tempeh is produced through the cooperative work of microorganisms. The fermentation can be considered to proceed in three phases.

In the first phase, fermentation begins during soaking of the beans and involves acid forming bacteria, especially lactic acid bacteria, which lower the pH (increases the acidity) of the soybeans. The low pH condition prevents the growth of undesirable bacteria and is required for an optimum condition for the second or main fermentation, which is made by the mold.

The second phase is characterised by extensive growth of the added mold, during which the hyphae penetrate into the soybeans, and secrete enzymes that degrade polymeric proteins and lipids into soluble materials that make soybeans more digestible. The enzymatic processes also remove anti-nutritive factors, decompose phytic acid, and metabolize oligosaccharides.

During the third phase of the fermentation, the pH increases due to the production of ammonia as a result of protein digestion. Once the pH is close to neutral, other bacteria grow and produce some beneficial compounds, including vitamin B₁₂.

The period of fermentation at 30°C lasts from 24 to 72 hr which produces tempehs with acceptable texture. Fermentation for 48 hr results in the highest level of tenderness whereas over-fermentation (more than 72 hr) can gradually promote the production of bitter-tasting amino acids and degradation of umami-tasting compounds.



Tempeh chips

Tempeh Mendoan



Fried Tempeh

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How/when do we use and enjoy it?

Tempeh is sold without pasteurization, so fresh tempeh has a relatively short shelf-life. Before consumption it is cooked or fried in a variety of dishes. Due to its meat-like consistency and high protein content, tempeh has been eaten like meat in the Western diet, for example, as burger patties, sausages, nuggets, and in stews.

Variations, regional variations

Traditional tempeh production methods, especially in cottage industries, vary greatly across different locations in Indonesia, producing tempeh with various local tastes and flavors. Variations also depend on the raw materials used to prepare tempeh. Tempeh made from soybeans is called *tempe kedelai*; from sword beans, *tempe koro*; from velvet beans, *tempe benguk*; from *Leucaena leucocephala*, *tempe lamtoro*; from pigeon peas, *tempe gude*; and from waste tofu, *tempe gembus*. The most popular tempeh material is soybeans, so the word tempeh usually refers to soybean tempeh.

The method for preparing the tempeh starter inoculum also varies by locality. In the traditional process, the previous batch of tempeh, or the mold grown and dried on *Hibiscus tiliaceus* leaves (*daun Waru*), is used to carry the tempeh inoculum as a natural starter (known as *usar* in Indonesia).

Beneficial properties

Tempeh is rich in nutrients and active substances. The active substances, which consist of anti-infective hypolipidic substances, antioxidants such as isoflavones, antibacterial substances, unsaturated fatty acids, ergosterol, and vitamins, are potentially beneficial for health and are reported to benefit gut health, cancer, cognitive function, lung health, cardiovascular health, anemia, liver health, bone health, type 2 diabetes mellitus, obesity, skeletal muscle recovery, and malnutrition.

Tempeh is also used for food applications, such as a meat alternative and extender, as a flavoring ingredient (seasoning powder), that is incorporated in carbohydrate foods, such as pasta and noodles to increase the protein content and amino acids quality. It is also used in bakeries, dietary supplements, beverages, emergency food, foods for infants and the elderly.

Cultural roots and importance

Tempeh originated in Central or East Java four centuries ago and the production process has been passed from generation to generation among the Javanese people. It is an important aspect of their tradition and culture. As the cheapest source of protein, tempeh is consumed in a greater quantities than other protein sources and, for most Javanese, tempeh seems to be inseparable from their daily menu.

