# Tempeh

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**Introduction**

Tempeh is a traditional fermented Indonesian food made from soybeans. Tempeh is produced by solid state fermentation of dehulled acid-soaked soy beans by using the mold Rhizopus spp. Majorly Rhizopus oligosporus used as a tempeh starter culture. Spores of the starter culture forms fine white thread hyphae that gathers on the surface of soybean seeds, and eventually forms into white mycelium. The addition of Rhizopus oligosporus particularly dominates the other fungus and facilitates the production of enzymes. The enzymes like protease, lipase, and amylase are produced during tempeh fermentation that breaks down the protein, fat and carbohydrate and improves the digestibility (Wronkowska et al., 2015). The process of tempeh production which includes soaking, draining, dehulling, boiling, cooling, inoculating, packaging and fermentation. Each and every process parameter of tempeh process influences the fermentation of the final product. Factors such as strength of the microbial flora, incubation time, pH, relative humidity, temperature greatly impacts the tempeh fermentation. Apart from soy bean, black bean, velvet bean, chick pea, lentils can also used (Ahnan-Winarno et al., 2021).

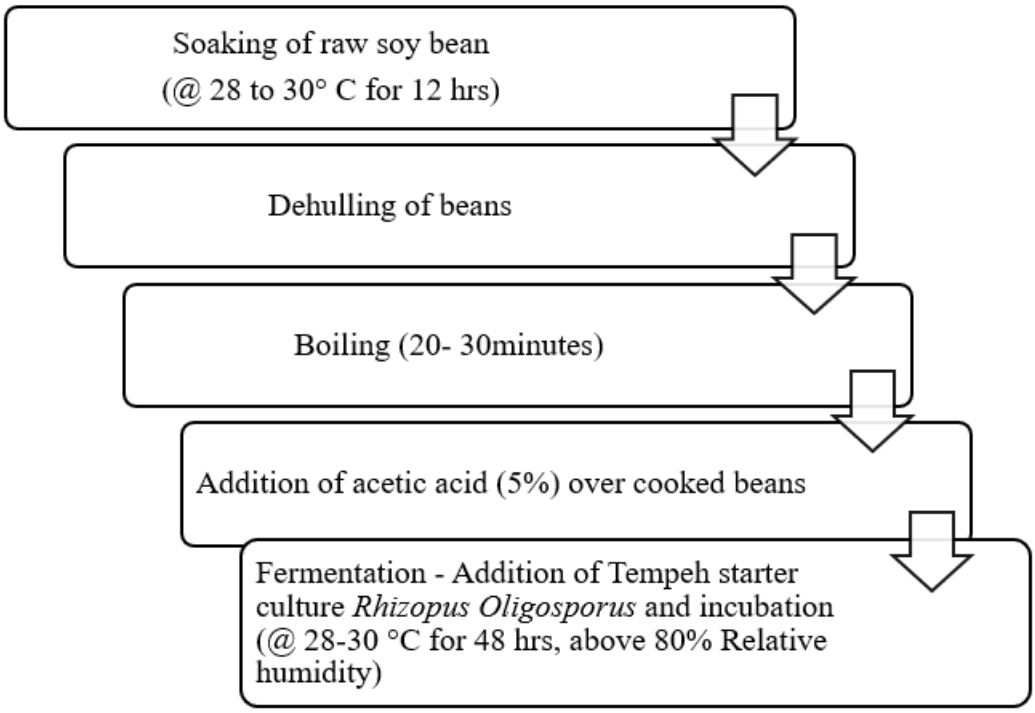


*Figure 1. Tempeh production process*

**Process Cultivation**

The dried matured soybeans are sorted, graded and soaked for overnight. Several studies have reported that 12-18 hr soaking time is the most effective to reduce the levels of phytic acid and proteolytic enzyme inhibitors in legumes which are partly or totally solubilized in soaked water and also enhances the nutrition, bioactive potential and sensory characteristics of tempeh. Then the soaked beans boiled for 20-30 minutes according to the legumes specific. Soaking and cooking greatly impacts on antinutritional factors present in the legumes (Sharma et al.,2013). Addition of white vinegar over the beans that provide acidic environment. Lowering the pH favours the growth of fungus and restrict the pathogens. The starter culture is now inoculated into the beans in a sterile environment. Further, the beans are packed in the sterile perforated pouch or with some traditional banana leaves which helps to maintain humidity and heat. This condition aids in the initiation of fermentation process (Ahnan-Winarno et al., 2021). Generally, the incubation time period of tempeh is about 36 to 48 hr at less than 37ºC. Fermentation results in a solid white cake-like structure. It is further sliced and processed in various ways (Aaslyng et al.,2021).

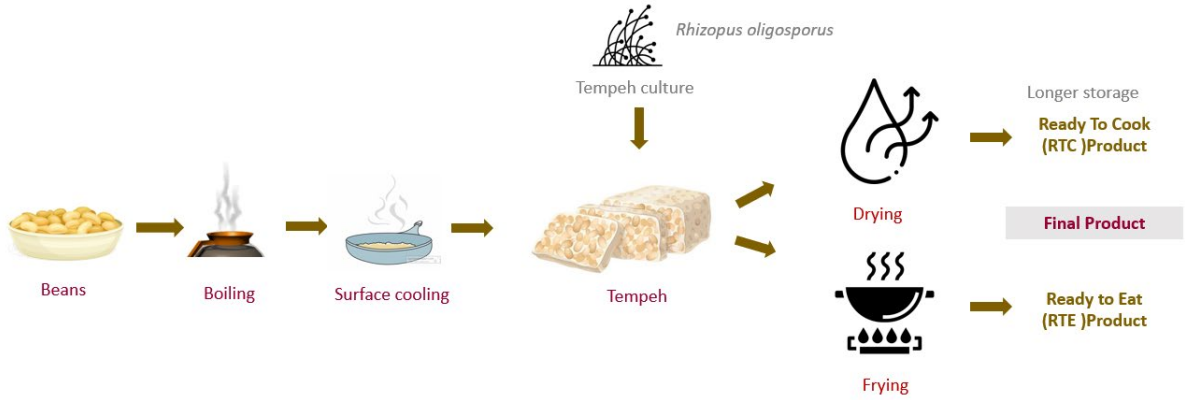


*Figure 2. Graphical representation of the process and its products*

**Nutritional benefits**

Tempeh is a low-cost nutritious food and can be consumed by all socio-economic groups. Fermentation process decreases the anti-nutritional factors and helps in increasing the nutritional quality of the legumes, especially it increases vitamin B12 (Karlund et al.,2020). Fermentation increases the protein digestibility and improves the amino acid profile. Isoflavones and probiotics increases during tempeh fermentation process, that helps in decreasing total cholesterol level, blood glucose level (type 2 diabetes), and body weight (Astawan et al., 2020, Huang et al., 2013).

**Conclusion**

After Covid-19 outbreak, people are much concerned about hygienic practices regarding animal meat consumption. Consumers are moving towards plant-based protein

meat. Sub-continent like India, it is difficult to organize the meat markets which is mostly unorganized and ensuring hygiene practices will be a challenging task from slaughtering to processing meat product. While comparing animal proteins to plant ones, the latter have many potential advantages in the context of providing health benefits, and reducing the adverse impact on the environment. Though it has nutrition rich especially the protein and equally satisfies the animal meat nutrition, tempeh did not resemble like meat analogue which the consumer prefers the palatability the most. But tempeh is the most probably healthier meat substitute like bacon, sandwich fillings, hamburgers etc. Tempeh can be processed into various kinds of products that are believed to be able to compete with existing products. Some unique foods that have been introduced by using tempeh as a main ingredient, products such as tempeh croffles, pizza tempeh, tempeh burgers, tempeh hot puddings, and tempeh pancakes were developed.

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