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Exploring the flavors, preparation technique and nutritional benefit of indigenous fermented food of Meitei community

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Abstract

The Indian state of Manipur is a significant part of the Indo-Burma biodiversity hotspot. With a long history of maintaining their culture and customs, the Indo-Mongoloid Meitei depend upon a varied bio-resource system for their livelihood, food, and medicine. Hawaijar, Soibum, Soidon, Hentak, and Ngari are examples of fermented foods that are necessary for traditional ceremonies, rites, and celebrations. These foods have a lot of taste, nutrients, and microorganisms. They also have several health benefits. Traditional fermented dishes from the Meitei people in Manipur are nutrient-dense and flavorful.

Keywords: traditional fermented foods; hawaijar; soibum; soidon; hentak; ngari; Meitei; Manipur

1 Introduction

The seven states that make up the northeastern area of India (Figure 1) are a crucial component of the globally significant Indo-Burma biodiversity hotspot (Myers et al., 2000). One of the native populations of the sub-Himalayan state of Manipur is the Meitei, an Indo-Mongoloid group that speaks the Tibeto-Burman language. The people have a long history of conserving their unique culture and customs, and they are mostly restricted to the lowland valley in the state's center (Singh and Huidrom, 2013). The Meiteis have had an unbreakable link with their diversified bio-resource system for food, medicine, religious rites, livelihood, and other purposes from the beginning of time (Singh, 2011; Singh and Singh, 1996). The main beneficiaries of livelihood creation are in the agricultural, traditional food sectors, and other allied activities (Jain et al., 2011).

Food is a key factor in distinguishing one ethnic group from another. Due to their traditional eating habits and way of life, it is especially notable that ethnic groups who live in urban areas continue to have a strong need for traditional fermented foods (Medhi et al., 2013; Asati and Yadav, 2003). One of the most valuable and ancient methods and cost-effective ways to preserve food is fermentation (Sarkar and Nout, 2014; Das and Deka, 2012; Tamang, 1998) and which is said to improve the nutritional value of any product by increasing the quantity of vitamins and the solubility of proteins (Sohliya et al., 2009).The practice of fermenting has been handed down through the generations in northeastern India, which includes Manipur (Jeyaram et al., 2009). Manipur's folktales from the early monarchical rule highlight the health benefits of fermented foods, which are essential to the community's ancestral food system and cultural identity. Despite rice being the primary meal, fermented foods make up a significant portion of the state's daily dietary intake. Traditional family fermentation is still carried out using simple tools, sometimes involving mixed microbe cultures because of poor hygiene and the use of spontaneous fermentation (Das and Deka, 2012). The five major fermented foods — Hawaijar, Hentak, Ngari, Soibum and Soidon are discussed here.

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The dietary and eating habits of many people throughout the world have been greatly influenced by various fermented foods and drinks (Tanasupawat and Visessanguan, 2014). Since ancient times, fermented foods and drinks have typically been made in the Indian subcontinent using locally grown food crops and earliest method of food technology (Das and Deka, 2012; Roy et al., 2004). Their diversity is striking because of the various geographical conditions, cultural practices, and abundant raw materials, particularly in the northeastern Indian states (Rawat et al., 2018).

2 Significance of fermentation

In general, fermentation is a biochemical process that most microorganisms use to break down into carbohydrates and provide energy in anaerobic environments (Voidarou et al., 2021; Toussaint-Samat et al., 2009; Thomas et al., 2008; Albert et al., 2002). As according to Louis Pasteur *"Fermentation is life in the absence of oxygen"* (Louis Pasteur, 1879). It also helps in preserving a large number of regional crops, ethnic vegetables, and indigenous fruits that are used in the local diet (Jamir and Deb, 2014; Singh et al., 2007).

It is one of the techniques for post-harvest management that adds value while lowering post-harvest losses (Soibam et al., 2017). It not only preserves food but also increases sensory quality of food, digestibility by breaking down proteins inside them, allowing for the generation of organic acids, nutritional enrichment such as vitamins, amino acids, and fatty acids (Steinkraus, 2004), a decrease of endogenous toxins, and a reduction in cooking time (Sekar and Kandavel, 2002). The fermentation process also protects the food while producing important enzymes, B vitamins (particularly B-12, which is difficult to get in a vegetarian diet, omega-3 fatty acids, and different probiotic strains (Sathe and Mandal, 2016).

Traditional fermented foods (Ngari, Hentak, Soibum, Soidon and Hawaijar), are connected to functional micro floras that enhance their medicinal, nutritional, and health-promoting properties (Rawat et al., 2018; Nirmala et al., 2014). These microbes are probiotics, which means they are good for the consumer's health and an important part of the gut microbiota. Fermented foods offer beneficial health effects as nutraceutical agents. They also help to maintain the healthy microbiota composition in celiac disease, which is critical for disease resistance and physiological balance (Rawat et al., 2018).

Numerous studies have shown that supplementing probiotics with food has health benefits such as lower blood cholesterol, improved gastrointestinal function, increased immunity, and a lower risk of colon cancer (Sathe Mandal, 2016; Thakur et al., 2016; Sonar et al., 2015; Singh et al., 2014; Sonar and Halami, 2014; Das and Deka, 2012; Jeyaram et al., 2010; Sarojnalini and Suchitra, 2009; Jeyaram et al., 2008; Thapa et al., 2004) due to their high bioactive component content, which includes antioxidants.

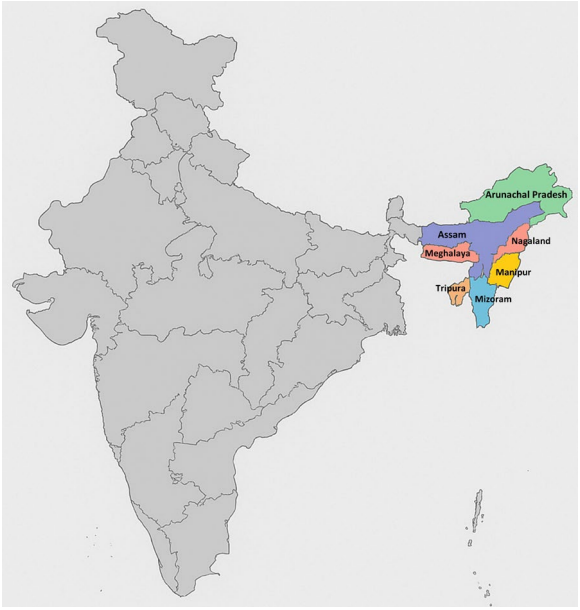

Figure 1 *Map of the north-eastern states of India, adapted from Bhattacharya and Deka (2023)*

3 Cultural significance

Traditional fermented foods play a significant role in the cultural and social life of the people of Manipur. The indigenous traditional fermented foods are essential for customary ceremonies, rituals, rites, feasts, and celebrations (Soibam et al., 2017; Ayam et al., 2012). A significant amount of the daily diet around in Manipur is made up of different fermented foods and the practice of fermenting has been handed down through the generations in northeastern India (Jeyaram et al., 2009).

Manipur's soybean product, Hawaijar is known for its sweetness and stickiness, is a popular home staple. It is recognized for its distinct organoleptic qualities. These foods are often sold in local markets, not only serve as daily staples but also has an economic, social, and cultural impact on the culture and traditions of the Indian state of Manipur. Hawaijar production gives revenue to a large number of rural people in Manipur (Das and Deka, 2012; Premarani and Chhetry, 2011). It is used by Manipur residents as a low-cost, high-protein diet (Devi and Kumar, 2012). Furthermore, there have been reports of its therapeutic potential in terms of anticancer, antiosteoporosis, and

hypocholesterolemic properties (Somishon and Thahira Banu, 2013). The fermented fish (Ngari), a staple of all Manipuri cuisine, is substituted with traditional Hawaijar meals on certain days, while some individuals prefer to follow a vegetarian diet or abstain from non-vegetarian items due to Sanskritization. Utsav, the customary feast dedicated to the gods, usually includes Hawaijar cuisine, where only vegetables are allowed and fish and other animals are prohibited (Devi and Suresh Kumar, 2012). Although Hawaijar is often consumed on a regular basis by all of Manipur's ethnic groupings, the Meitei people particularly appreciate it. When combined with steamed rice and other traditional dishes, it is eaten raw as a side dish (ametpa) with salt, onion, and green chili or umorok (the king chili). Chagempomba, a particular Manipuri dish, is made with hawaijar, rice, and other veggies (Premarani and Chhetry, 2010).

Ngari is the Meiteis' most significant fermented food product. Meiteis' regular meals are never complete without Ngari, which is often served as spicy chutney (Ironba, ametpa, kangsoi, singju, etc.) or as a component in the majority of daily dishes. Freshwater fish species, *Puntius sophore* and *Tenualosa ilisha*, locally termed 'Phabou nga' and 'Ilisha' respectively, are used in the making of 'Ngari' (Soibam and Ayam, 2018).

During post-pregnancy, all Meitei women eat Hentak instead of Ngari for improved health and faster recover as it includes high calcium content, which is necessary for nursing. (Devi et al., 2024). However, Hentak prepared from *Colisa fasciatus*/*Trichogaster fasciata* (Ngapemma) or with *A. macrorrhiza* (Hongu in Manipuri) is not ingested during pregnancy. Onion can also be used in place of *Alocasia macrorrhiza* (Hongu in Manipuri) or *Colocasia esculenta* to make Hentak; however, using onion shortens storage period (Soibam and Ayam, 2018).

4 Uses in Manipur cuisine

Hawaijar has a distinct flavor and scent and has been enjoyed as a staple in every home. It is present in almost all of Manipur's distinctive meals. It is commonly used as a seasoning for vegetables. It is taken directly or used as a flavoring element in vegetable dishes to make them softer and more pleasant (Premarani and Chhetry, 2008, 2011). Hawaijar, rice, and other veggies are used to make chagempomba, a distinctive Manipuri dish. It is sometimes eaten as an accompaniment in the form of Ametpa, a paste made with salt and chilli. To improve the flavor, Ngari, a fermented fish, is added (Premarani and Chhetry, 2010). It may be consumed cooked, raw, with salt and chilli, etc. (Devi and Suresh Kumar, 2012).

Soidon is a staple of the Meitei people's traditional cuisine and one of their favorite ethnic dishes. It is mostly eaten as an ethnic meal called eromba, which is prepared by mixing it with Ngari (fermented fish), yendem (*Colocasia gigantea* petiole), chilli, and cooked mashed potatoes. Sometimes, it is prepared with fish, vegetables, and potatoes to create kangou, a regional meal (Wahengbam et al., 2020).

Hentak is blackish in color, soft paste, ball-shaped, and has an unusual flavor. Hentak is used in iromba and vegetable curry after being roasted. Hentak can be prepared as the primary ingredient or as a component of a curry. It may also be made into spicy chili chutney, roasted, or steamed and eaten straight (Devi et al., 2024).

5 Indigeneous fermented foods and their functions

Manipuri cuisine relies heavily on fermented foods, such as Hawaijar (fermented soybean), Soibum, Soidon (fermented bamboo shoot), Hentak (fermented fish) and Ngari (fermented fish). These foods are prized for ancient preservation methods, which predate contemporary refrigeration processes, in addition to their distinctive flavors. For the fermentation various fermentation techniques have been used, including soybean (Hawaijar), bamboo shoots (Soibum, Soijin, or Soidon), and tiny fish (Ngari or Hentak) (Singh, 2003).

Steincraus (1995) explains that traditional food fermentation offers the following functions:

1. Enrich diet with diverse tastes, smells, and textures in food substrates.
2. Fermentation methods, including lactic acid, alcoholic, acetic acid, and alkaline, may preserve large amounts of food.
3. Biologically enriching dietary substrates with protein, vital amino acids, fatty acids, and vitamins.
4. Detoxification during the food fermentation process.
5. A decrease in cooking time and fuel requirements.

5.1 Hawaijar

Hawaijar is an alkaline (pH ~ 8.6) (Appaiah et al., 2011) sticky fermented soybean dish. Its alkaline character is attributed to the proteolytic activity of bacteria from the genus *Bacillus*, especially *B. subtilis* and related species (Tamang, 2015). During fermentation, these bacteria hydrolyze soybean proteins to release amino acids and ammonia. Ammonia subsequently reacts with water to form

ammonium and hydroxide ions, thereby elevating the pH above neutral (Okoro et al., 2022).

The terms 'hawai', which means pulses, and 'jar' which is a shortened form of the word 'achar' which means pickle, are the origins of its name. As it is alkaline, it gives a subtle odor, and tastes like ammonia. It is believed that the Brahmin community of Manipur prepared and devoured this delicacy first (Kabui et al., 2024).

Preparation:

Locally grown small soybeans are collected, washed, shade-dried, soaked overnight, boiled for two to three hours until soft and any excess water is drained and rinsed with tap water. After being washed, the soy was wrapped in fig (*Ficus hispida*) or Ashee heibong leaves (Figure 2). Two strains of *Bacillus subtilis* found on *Ficus hispida* leaves are responsible for fermentation. One strain that was present in the fermenting seeds produced a white colony that was regularly rounded. This strain has the ability to initiate fermentation. A white, creamy colony with an uneven border is a feature of another strain that is found in *Ficus hispida* leaves (Irabanta and Umabati, 1995; Gurumayum, 1994). The wrapped soybeans are then allowed to ferment for four to five days in the winter and two to three days in the summer (25–40° C) (Tamang and Jyoti, 2015) in a lined bamboo basket, locally known as lubak. The product had matured when sticky, white, slimy substances with a strong ammoniacal smell appeared. The preparation process aligned with the findings of Keishing et al. (2015) and Kabui et al. (2024) as well as Premarani and Chhetry (2011). The shelf life of Hawaijar is only three to four days. For long-term storage, the product is therefore occasionally sun-dried (Premarani and Chhetry, 2010). According to similar observations, the product has a short shelf life of three to four days at room temperature due to its high moisture content. The product is dried in the sun using the conventional method (Appaiah et al., 2011).

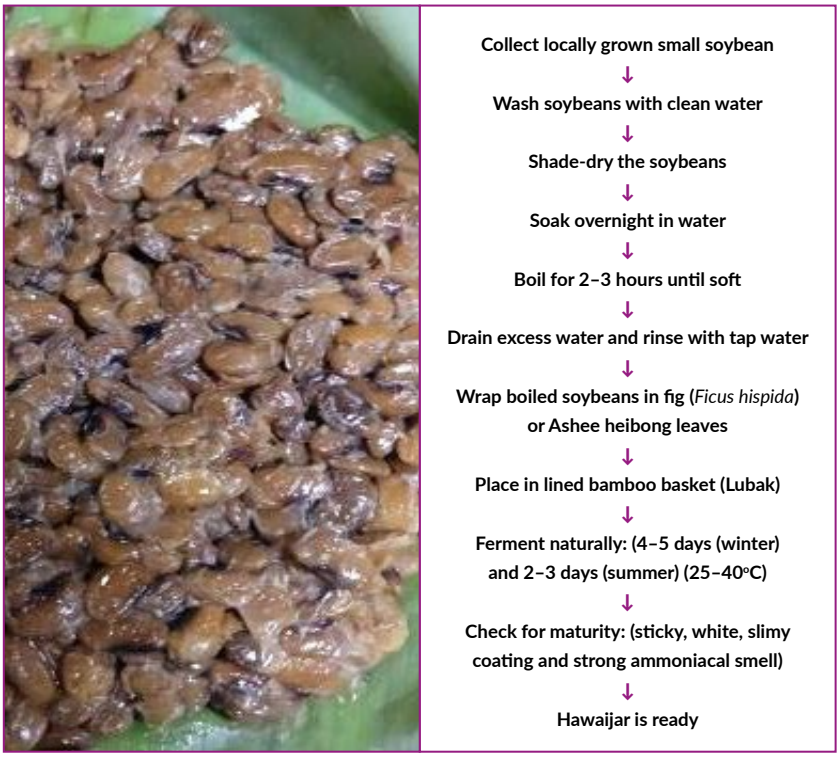

Figure 2 *Flowchart illustrating the preparation process of Hawaijar with a representative photograph of the final product*

5.2 Hentak

Hentak is a traditionally fermented paste made out of specific local fish species name *Esomus danricus* in Manipur (Sarojnalini and Singh, 1988). It has a soft paste, a ball form, a blackish color, and an odd flavor. Hentak is roasted and used to make vegetable curry and iromba. Because it includes a lot of calcium, which is necessary for nursing, postpartum mother choose Hentak over Ngari (Devi et al., 2024).

Preparation:

To get rid of the frequently occurring species, the initial stage is hand sorting. Following a thorough cleaning, draining, and sun-drying process, the fish, *Esomus danricus*, is crushed into a fine powder using a wooden pastel/malate (Suk in Manipuri) and a wooden mortar (Sumban in Manipuri). The *Alocasia macrorhiza* petioles are cleaned with water, chopped into pieces, and then exposed to the sun for an hour. A well homogenized paste is then made by crushing the cut pieces with the fish powder and an equal weight. They are made into little balls and then stored in earthen pots. After two weeks of fermentation, it is now ready to use (Figure 3).

These are kept for a few months until they solidify, at which point they are made into a paste with a small

amount of water and kept in balls (Figure 3) (Jeyaram et al., 2009). The clay pot for Hentak is smaller than the Ngari (Soibam and Ayam, 2018).

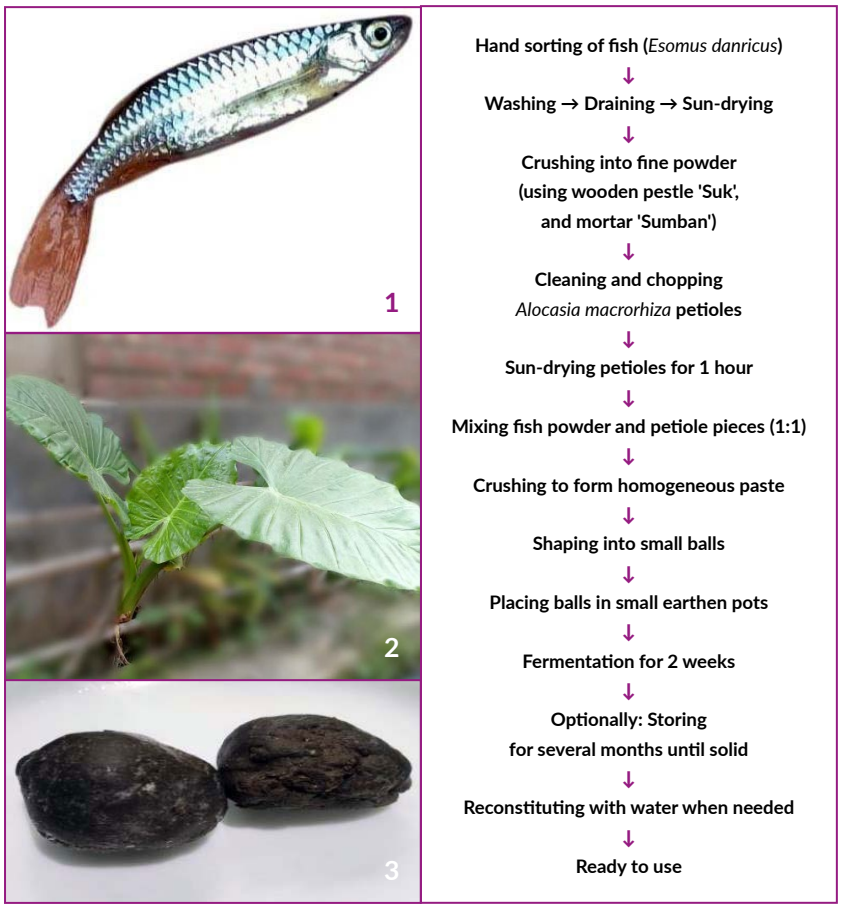

Figure 3 Flowchart illustrating the preparation process of Hentak with a representative photographs of 1) fish Esomus danricus, *2) plant* Alocasia macrorhiza, *3) final product Hentak balls*

5.3 Ngari

Ngari is the Meiteis' most significant fermented food product. Meiteis' regular meals are never complete without Ngari or as a component in the majority of daily dishes. Freshwater fish species, *Puntius sophore* and *Tenualosa ilisha*, locally termed 'Phabou nga' and 'Ilisha' respectively, are used in the making of Ngari (Soibam and Ayam, 2018).

Preparation:

In and around Imphal and the neighboring districts, the fish are fermented using traditional methods after being imported from Lakhimpur, Assam, and Bangladesh. Sorting (removing undesirable things, such as fibers, weeds, snails, and other unwanted fish), scrubbing thoroughly with water in porous bamboo baskets known locally as 'polang' that have been drained overnight and completely sun-dried (Figure 4). In order to speed up and improve fermentation, the dried 'phabou nga' is put over gunny bags, topped with more gunny bags, and then stamped and beaten with a common long-handled pounding hammer known locally as 'Droomboos/Tamper' to crush or soften the head and bones for faster and better fermentation. In a pot known locally as 'ngari-chafu' crushed and softened dried fish is placed securely without any air spaces by pressing firmly with a wooden pestle or mallet after first pushing with the legs. This process is called 'shuk'. This is accomplished through the use of skilled workers. In order to create an anaerobic environment within the chamber and prevent or reduce wall absorption during fermentation, ngari-chafu is a thick earthen pot that is securely netted with thick, strong iron wires on the outside wall for strength. The interior walls are also occasionally coated with mustard oil. Older pots just need to be oil coated once for optimal fermentation, while new pots need to be oil coated eight to ten times at intervals of one to two weeks. In order to allow fermentation to occur naturally, each pot weighing 45–50 kg is packed tightly, coated with polythene sheet, fish scales, oil slurry, and finally smeared with mud/sand and cow dung slurry. The pots are then kept in the dark at room temperature. After three to six months of fermentation and twelve months of maturation, the product has a noticeable scent. The flavor of the fermented fish peaks around the 12th month, but it is ready to consume as early as the third month (Soibam and Ayam, 2018).

5.4 Soibum

Soibum is a traditional fermented food prepared from young bamboo shoots in Manipur (Figure 5). Soibum is made from succulent bamboo shoots of *Dendrocalamus hamiltonii* (Wanap/ Unap/ Pecha in Manipuri, *Dendrocalamus sikkimensis*, *Dendrocalamus giganteus*, *Melocana bambusoide*, *Bambusa tulda*, and *Bambusa* 'balcona' (Jeyaram et al., 2009)

Import fish from Lakhimpur (Assam) & Bangladesh
↓
Sorting: Remove fibers, weeds, snails, unwanted fish
↓
Scrubbing fish thoroughly with water
↓
Drain fish overnight in porous bamboo baskets ('polang')
↓
Sun-drying fish completely
↓
Place dried fish ('phabou nga') over gunny bags
↓
Cover with more gunny bags
↓
Stamp and beat with long-handled hammer ('Droomboos/Tamper')
↓
Crush/soften head and bones to speed fermentation
↓
Place crushed fish in earthen pot ('ngari-chafu')
↓
Press firmly with wooden pestle/mallet ('shuk')
↓
Ensure no air spaces, pressing with legs
↓
Prepare pot:
Coat interior walls with mustard oil (8–10 times for new pots, once for old)
Secure exterior with iron wires for strength
↓
Pack pot tightly (45–50 kg fish)
↓
Seal pot with: (Polythene sheet/ Fish scales/ Oil slurry)
Mud/sand and cow dung slurry
↓
Crush/soften head and bones to speed fermentation
↓
Keep pots in dark, room temperature
↓
Fermentation period: 3 to 6 months
↓
Maturation: up to 12 months
↓
Product ready to consume from 3 months (but flavor peaks at 12 months)

Figure 4 *Flowchart illustrating the preparation process of Ngari with a representative photographs of 1) porous bamboo basket Polang, 2) final product Ngari*

Preparation:

Traditionally, there are two primary types of fermentation: Andro and Noney/Kwatha. Only in Andro village is the Andro kind of soibum prepared using fed-batch fermentation in a large roasted earthen pot, whereas the Noney/Kwatha form uses a batch fermentation process with a more acidic flavor in a traditionally constructed bamboo chamber. Their flavor and texture are distinct (Jeyaram et al., 2009).

One traditional method (Kwatha/Noney type) involves batch-wise, solid-state fermentation of finely sliced young, soft bamboo shoots for 6 months to a year. This is accomplished by pressing and packing airtight in traditionally designed bamboo chambers and lining the chamber with leaves/polythene sheets.

Another fed-batch fermenting method (Andro type) involves partially packing finely sliced young bamboo shoots into backed clay pots. When the volume lowers as a result of fermentation, fresh bamboo slices are added. Every time new slices are added, a little push is performed. The process is continued until the pot is full, after which fermentation occurs or 6–12 months.

Unlike the Kwatha/Noney type, the Andro type fermentation extract is not emptied or discarded. Aging

is critical in both kinds, and prolonged incubation improves Soibum quality (Giri, 2000). Soibum that has been completely fermented can be kept for up to a year before selling (Das and Deka, 2012; Jeyaram et al., 2009).

5.4 Soidon

The Meitei people of Manipur produce Soidon, another fermented food, from the apical meristems of bamboo shoots. The species used for Soidon were *Melocana bambusoide* Trin, *Teinostachyum wightii*, *Dendrocalamus giganteus* Munro, and *Bambusa tulda* Roxb. It is a short-period fermented bamboo shoot product that is sour and unsalted (Kabui et al., 2024; Jeyaram, et al., 2010).

Preparation:

Unlike soibum and soijin, soidon is made from the young apical shoots of *Teinostachyum wightii* (Nath) (Figure 6). Traditionally, Soidon is made by filling backed clay jars with sliced and chopped apical shoots of bamboo with milky fermented soup from the previous batch (1:1 dilution), which serves as the starter for fermentation. The fermentation extract is not eliminated, allowing for submerged fermentation of up to a week or five to seven days. The Soidon is taken out of the container once the fermentation is finished, and the milky fermentation soup is drained away before being offered for sale. To enhance the color and flavor, chenghi, or rice-washed water and pieces of *Garcinia pedunculata* (Heibung) fruit are added as an acidifier, it may occasionally be added in a 1:10 dilution. For almost a year, it may be stored in an airtight container (Jeyaram et al., 2009).

Figure 5 *Flowchart illustrating the preparation process of Soibum with a representative photographs of 1) young bamboo shoot for making Soibum, 2) final product Soibum*

Figure 6 *Flowchart illustrating the preparation process of Soidon with a representative photographs of 1) young bamboo shoot for making Soidon, 2) final product Soidon*

Table 1 *Nutritional benefits of fermented food of Meitei community*

Fermented product	Microorganism identified	Health benefits	Risk factors	Reference
Hawaijar	*Bacillus subtilis*, *B. licheniformis*, *Staphylococcus aureus*, *S. sciuri*	Anticancer, antiosteoporosis, hypocholesterolemic, antioxidant, antidiabetic	Risk of pathogens contamination if hygiene is poor. The presence of *B. cereus* (10^8 cfu/g population) reported for food poisoning.	Jeyaram et al. (2008) Singh et al. (2014)
Hentak	*Bacillus cereus*, *B. subtilis*, *Staphylococcus aureus*, *Lactobacillus fructosus*, *Enterococcus faecium*, *L. amylophilus*, *Candida* spp.	Helps in gut health, controls cholesterol, and blood pressure, and antihypertensive, probiotic and antioxidant activity	Risk of pathogens contamination if hygiene is not maintained. The growth of *Staphylococcus* in Hentak presents a potential health hazard since many strains produce enterotoxins, which cause food poisoning if ingested.	Thapa et al. (2004)
Ngari	*Lactococcus plantarum*, *Bacillus subtilis*, *B. pumilus*, *Miocrococcus* sp., *Candida* sp.	Lower blood pressure and cholesterol, antithrombotic and antioxidative activities	Possibility of biogenic amine synthesis. Spoilage bacteria if not handled properly during processing. *Staphylococcus* count exceeding 10^6 cfu/g is considered hazardous leading to toxicity and illness.	Thapa et al. (2004) Sarojnalini and Suchitra (2009)
Soibum	*Lactobacillus brevis*, *L. plantarum*, *Leuconostoc mesenteroides*, *L. fallax*, *Saccharomyces* sp.	Reduces cholesterol, anti-cancer, lower blood pressure, weight loss, control piles, antiaging, anti- free radicals	Inadequate fermentation increases the risk of *Clostridium botulinum* contamination. Cyanide poisoning due to the presence of cyanogenic glycosides. Presence of a high load of *B. cereus* results in food poisoning.	Das and Deka (2012) Sonar and Halami (2014) Thakur et al. (2016)
Soidon	*Lactobacillus brevis*, *L. lactis*, *L. curvatus*, *Leuconostocfallax*, *Enterococcus* spp.	Prevent cardiovascular disease and arthritis, acts as an immune booster, promotes digestion, controls blood pressure, antioxidant, antidiabetic, anticancer	Possibility of spoilage if not fermented properly. Generation of biogenic amines; alarming population load (10^6 cfu/g) of *B. cereus* group can lead to food poisoning.	Jeyaram et al. (2010) Das and Deka (2012) Sonar and Halami (2014) Sonar et al. (2015)

6 Nutritional benefits of fermented food of Meitei community

The indigenous traditional fermented foods of Meitei community are full of nutrition and flavor in it but also include a number of healthy microbes that have given important health benefits to humans. In addition to introducing probiotics and improving nutritional bioavailability, fermentation aids in the management and prevention of chronic illnesses. An overview of the health advantages of each major fermented food is provided in Table 1 with the references.

According to the study conducted by Thakur et al. (2016), Sonar et al. (2015), Singh et al. (2014), Das and Deka (2012), Sarojnalini and Suchitra (2009), Jeyaram et al. (2008) and Thapa et al. (2004), beneficial

Table 2 *Nutrient composition of fermented food of Meitei community*

Fermented Product	Substrate	Nutrient Composition	Reference
Hawaijar	Soybean	Protein 43.9%, Fat 19.3%, Carbohydrate 23.4%, Food value 521.2 kcal/100 g, Ca 357.8 mg, Na 88.7 mg, Fe 92.3 mg, K 835.1 mg, Zn 63.0 mg	Jeyaram et al. (2008) Premarani et al. (2011)
Hentak	Fish	Protein 32.7%, Fat 13.6%, Carbohydrate 38.7%, Food value 408.0 kcal/100 g, Ca 38.2 mg, Fe 1.0 mg, Mg 1.1 mg, Mn 1.4 mg, Zn 3.1 mg	Thapa et al. (2004) Thapa et al. (2007)
Ngari	Fish	Protein 34.1%, Fat 13.2%, Carbohydrate 31.6%, Food value 381.6 kcal/100 g, Ca 41.7 mg, Fe 0.9 mg, Mg 0.8 mg, Mn 0.6 mg, Zn 1.7 mg	Thapa et al. (2004) Thapa et al. (2007)
Soibum	Tender bamboo shoot	Protein 36.3%, Fat 3.2%, Carbohydrate 47.2%, Food value 362.8 kcal/100 g, Ca 16.0 mg, Na 2.9 mg, K 212.1 mg	Sarangthem and Singh (2003) Tamang et al. (2008) Jeyaram et al. (2010)
Soidon	Matured bamboo shoot	Protein 37.2%, Fat 3.1%, Carbohydrate 46.6%, Food value 363.1 kcal/100 g, Ca 18.5 mg, Na 3.7 mg, K 245.5 mg	Tamang et al. (2008)

microorganisms like *Bacillus subtilis*, *Lactobacillus* spp., *Leuconostoc* spp., *Enterococcus* spp. and *Candida* spp. are found in Manipur's traditional fermented foods, such as Hawaijar, Ngari, Hentak, Soibum, and Soidon as mentioned and these microorganisms provide a variety of health benefits to humans which includes cardiovascular support, anti-aging, probiotics, hypocholesterolemia, antioxidants, antidiabetics, anti-cancer, anti-osteoporosis, and digestive health-promoting qualities. These outcomes demonstrate their potential as functional foods for preserving and enhancing health.

7 Nutrient composition of fermented food of Meitei community

Depending on their plant or animal-based substrates, Manipur's traditional fermented meals vary in their protein, energy, and vital mineral content. Their nutritional composition is shown in Table 2.

The five major fermented foods — Hawaijar, Hentak, Ngari, Soibum and Soidon are rich in essential nutrients. Hawaijar, made from soybeans, is particularly high in protein (43.9%), fat 19.3 ± 0.7%, and minerals like iron (92.3 mg) and potassium (835.1 mg), offering a high energy value of 521.2 kcal/100 g (Jeyaram et al., 2008). Hentak and Ngari, both fish-based, are good sources of protein (~33%), moderate in fat and carbohydrates and provide significant micronutrients (Thapa et al., 2004, 2007). Soibum and Soidon, prepared from tender and matured bamboo shoots respectively, are rich in carbohydrates (~47%), moderate in protein, and offer a range of minerals like potassium, though lower in fat (~3%) and overall calories (~363 kcal/100 g) (Jeyaram et al., 2010; Tamang et al., 2008; Sarangthem and Singh, 2003).

8 Conclusion

Until date, there is no determining the precise annual production volume and daily dietary intake percentage of traditional fermented foods, which remains a persistent challenge, even though these foods are integral dietary staples. Determining the proportionate contribution of the items to the overall diet is challenging due to the lack of quantitative data and the difficulty of accurately administering dietary recall for daily consumed items.

Traditional fermented foods of Manipur such as Hawaijar, Soibum, Soidoi, Hentak and Ngari, are significant from a socioeconomic, cultural, and nutritional perspective. The growing interest in native and functional foods around the world presents opportunities for both scientific study and commercial development. Characterizing microbial diversity, probiotic qualities, and nutritional advantages should be the main goals of future research.

The microbial content of these foods makes it essential to fully comprehend their potential health benefits and risks, emphasizing the need for careful and contamination-free preparation methods. Standardizing packaging, quality assurance, and preparation techniques can improve marketability and safety with the help of local communities particularly women and maintain cultural

traditions. Culturally rich food systems and sustainable practices can result from fusing new technology with traditional knowledge.

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10 References

Albert G., Moat J.W., Foster M.P.S. (2002). Microbial Physiology, 4th ed. Wiley-Liss Inc., New York, USA, p. 412–431.

Ananou S., Maqueda M., Martinez-Bueno M., Valdivia E. (2007). Biopreservation, an ecological approach to improve the safety and shelf-life of foods. In: Mendez-Vilas A. (Ed.) Communicating current research and education topics and trends in applied mikrobiology. Formatex, Madrid, p. 475–486.

Asati B.S., Yadav D.S. (2003). Diversity of horticultural crops in North Eastern Region. ENVIS Bulletin: Himalayan Ecology, 12(1), 1–10.

Available online: https://sourcebooks.fordham.edu/mod/1879pasteur-ferment.asp [accessed on 21 January 2020].

Ayam V.S., Ayam S.C., Soibam H. (2012). Ancient art of alcoholic fermentation, its importance at present and future prospects – a review. Journal of Phytological Research, 25(1), 15–22.

Bhattacharya, B.J., Deka D.C. (2023). Biochemical Indices and Consumption Pattern of Traditional Alcoholic Beverages by Tribal Communities of North-East India: A Review. Current Research in Nutrition and Food Science, 11(2), 470–487. http://dx.doi.org/10.12944/CRNFSJ.11.2.02

Das A.J., Deka C. (2012). MiniReview Fermented foods and beverages of Northeast India. International Food Research Journal, 19, 377–392.

Devi A.N., Devi N.B, Devi C.U., Chanu E.K. (2024). Traditional Fish Fermentation of Meiteis of Manipur: An Overview. Journal of Nutrition Food Science and Technology, 5(1), 1–4. https://doi.org/10.47485/2834-7854.1037

Devi P., Suresh Kumar, P. (2012). Traditional, ethnic and fermented foods of different tribes of manipur. Indian Journal of Traditional Knowledge, 11(1), 70–77.

Giri S.S., Janmejay L.S. (2000). Effect of bamboo shoot fermentation and aging on nutritional and sensory qualities of soibum. Journal of Food Science and Technology, 37(4), 423–426.

Gurumayum I.D. (1994). Physiological and biochemical studies of fermented Glycine max – Hawaijar [Doctoral dissertation, Manipur University].

Irabanta S.N., Umabati Devi A. (1995). Fermentation process of two phylloplane bacteria in traditional Hawaijar made from boiled soybean (Glycine max L.). Journal of Food Science and Technology, 32(3), 219–220.

Jain A., Sundriyal M., Roshnibala S., Kotoky R., Kanjilal P.B., Singh H.B., et al. (2011). Dietary use and conservation concern of edible wetland plants at indo-burma hotspot: A case study from northeast India. Journal of Ethnobiology and Ethnomedicine, 7, 29. https://doi.org/10.1186/1746-4269-7-29

Jamir B., Deb C.R. (2014). Studies on some fermented foods and beverages of Nagaland, India. International Journal of Fermented Foods, 3(2), 127–138. https://doi.org/10.5958/2321-712X.2014.01314.3

Jeyaram K., Anand Singh T., Romi W., Ranjita Devi W., Mohendro Singh W., Dayanidhi H., Rajmuhon Singh N., Tamang J.P. (2009). Traditional fermented foods of Manipur. Indian Journal of Traditional Knowledge, 8(1), 115–121.

Jeyaram K., Romi W., Singh T.A., Devi A.R., Devi S.S. (2010). Bacterial species associated with traditional starter cultures used for fermented bamboo shoot production in Manipur state of India. International Journal of Food Microbiology, 143(1–2), 1–8. https://doi.org/10.1016/j.ijfoodmicro.2010.07.008

Jeyaram K., Romi W., Singh T.A., Devi A.R., Devi, S.S. (2010). Bacterial species associated with traditional starter cultures used for fermented bamboo shoot production in Manipur state of India. International Journal of Food Microbiology, 143(1–2), 1–8. https://doi.org/10.1016/j.ijfoodmicro.2010.07.008

Jeyaram K., Singh T.A., Romi W., Devi A.R., Singh W.M. (2009). Traditional fermented foods of Manipur. International Journal of Food Microbiology, 8(1), 115–121. Retrieved from: http://14.139.206.50:8080/jspui/bitstream/1/1356/1/IJTK-Manipur-2009.pdf

Jeyaram K., Singh W.M., Premarani T., Ranjita Devi A., Chanu K.S., Talukdar N.C., Singh M.R. (2008). Molecular identification of dominant microflora associated with 'Hawaijar' – a traditional fermented soybean (*Glycine max* (L.)) food of Manipur, India. nternational Journal of Food Microbiology, 122(3), 259–268. https://doi.org/10.1016/j.ijfoodmicro.2007.12.026

Kabui K.K, Rawson A., Athmaselvi K.A. (2025). Selected fermented foods of Manipur, India: Traditional preparation methods, nutritional profile, and health benefits. Food Chemistry Advances, 6, 100864. https://doi.org/10.1016/j.focha.2024.100864.

Keishing S., Banu T. (2015). Fermented fish (Ngari) of Manipur –preparation technique and its potential as a functional food ingredient. Elixir Food Science, 85(November), 34502–34507.

Keishing S., Banu T., Umadevi M. (2015). Effect of fermentation on the nutrient content, antioxidant and antidiabetic activities of Hawaijar, an indigenous fermented soya of Manipur, India. Journal of Human Nutrition and Food Science, 3(3), 1066. https://doi.org/10.47739/2333-6706/1066

Majumdar R.K., Roy D., Bejjanki S., Bhaskar N. (2016). Chemical and microbial properties of shidal, a traditional fermented fish of Northeast India. Journal of Food Science and Technology, 53, 401–410. https://doi.org/10.1007/s13197-015-1944-7

Medhi P., Kar A., Borthakur S.K. (2013). Medicinal uses of wild edible plants among the *Ao Nagas* of Mokokchung and its vicinity of Nagaland, India. Asian Resonance, 2(4), 64–67.

Modern History Sourcebook: Louis Pasteur (1822–1895): From the Physiological Theory of Fermentation by Louis Pasteur. 1879.

Mokoena M.P., Mutanda T., Olaniran A.O. (2016). Perspectives on the probiotic potential of lactic acid bacteria from African traditional fermented foods and beverages. Food & Nutrition Research, 60, 29630. https://doi.org/10.3402/fnr.v60.29630

Myers N., Mittermeier R.A., Mittermeier C.G., Da Fonseca G.A., Kent J. (2000). Biodiversity hotspots for conservation priorities. ature, 403(6772), 853–858. https://doi.org/10.1038/35002501

Nirmala C., Bisht M.S., Laishram M. (2014). Bioactive compounds in bamboo shoots: Health benefits and prospects for developing functional foods. International Journal of Food Science and Technology, 49(6), 1425–1431. https://doi.org/10.3402/fnr.v60.29630

Okoro C.K., Elhalis H., Abdel-Aziz S.M., Shah, N.P. (2022). Plant-based alkaline fermented foods as sustainable sources of probiotics, prebiotics and bioactive compounds. Frontiers in Sustainable Food Systems, 6, 885328. https://doi.org/10.3389/fsufs.2022.885328

O'sullivan L., Murphy B., Mcloughlin P., Duggan P., Lawlor P.G., Hughes H., Gardiner G.E. (2010). Prebiotics from marine macroalgae for human

and animal health applications. Marine Drugs, 8(7), 2038–2064. https://doi.org/10.3390/md8072038

Premarani T., Chhetry G.K.N. (2008). Microbiota Associated with Natural Fermentation of Hawaijar (An Indegeneous Fermented Soyabean Product) of Manipur and their Enzymatic Activity. Journal of Food Science and Technology, 45(6), 516–519.

Premarani T., Chhetry G.K.N. (2010). Evaluation of Traditional Fermentation Technology for the Preparation of Hawaijar in Manipur. Assam University Journal of Science and Technology, 6(I), 82–88.

Premarani T., Chhetry G.K.N. (2011). Nutritional analysis of fermented soyabean (Hawaijar). Assam University Journal of Science and Technology, 7, 96–100.

Rajapakse N., Mendis E., Jung W.K., Je J.Y., Kim S.K. (2005). Purification of a radical scavenging peptide from fermented mussel sauce and its antioxidant properties. Food Research International, 38(2), 175–182. https://doi.org/10.1016/j.foodres.2004.10.002

Rawat K., Kumari A., Kumar S., Kumar R., Gehlot R. (2018). Traditional fermented products of India. International Journal of Current Microbiology and Applied Sciences, 7(4), 1873–1883. https://doi.org/10.20546/ijcmas.2018.704.214

Roy B., Kala C.P., Farooquee N.A., Majila B.S. (2004). Indigenous fermented food and beverages: a potential for economic development of the high altitude societies in Uttaranchal. Journal of Human Ecology, 15(1), 45–49.

Sarangthem K., Singh T.N. (2003). Microbial bioconversion of metabolites from fermented succulent bamboo shoots during fermentation. Current Science, 84(12), 1544–1547. https://www.jstor.org/stable/24108259

Sarkar P.K., Nout M.J.R (2014). Handbook of Indigenous Foods Involving Alkaline Fermentation. CRC Press, Taylor & Francis group, New York, Vol. 1, p. 365–370.

Sarojnalini C., Singh W.V. (1988). Composition and digestibility of fermented fish foods of Manipur. Journal of Food Science & Technology, 25(6), 349–351.

Sarojnalini C., Suchitra T. (2009). Microbial profile of starter culture fermented fish product – Ngari of Manipur. Indian Journal of Fisheries, *56*(2), 123–127. Retrieved from: https://epubs.icar.org.in/index.php/IJF/article/view/6834

Sathe G.B., Mandal S. (2016). Fermented products of India and its implication: A review. Asian Journal of Dairy and Food Research, 35(1), 1–9. https://doi.org/10.18805/ajdfr.v35i1.9244

Sathivel S., Bechtel P., Babbitt J., Smiley S., Crapo C., Reppon K. (2003). Biochemical and functional properties of herring (*Clupea harengus*) byproducts hydrolysates. Journal of Food Science, 68, 2196–2200. https://doi.org/10.1111/j.1365-2621.2003.tb05746.x

Sekar S., Kandavel D. (2002). Patenting microorganisms: towards creating a policy framework. Journal of Intellectual Property Rights, 7, 211–221.

Singh A., Singh R.K. (2007). Cultural significance and diversities of ethnic foods of Northeast India. Indian Journal of Traditional Knowledge, 6(1), 79–94.

Singh H.B. (2011). Plants associated in forecasting and beliefs within the Meitei community of Manipur, Northeast India. Indian Journal of Traditional Knowledge, 10(1), 190– 193.

Singh K.J., Huidrom D. (2013). Ethnobotanical uses of medicinal plant, *Justicia adhatoda* L. by Meitei community of Manipur, India. Journal of Coastal Life Medicine, 1(4), 322–325.

Singh N.I., Devi A.U. (1995). Fermentation Prospects of two Phylloplane Bacteria in Traditional Hawaijar made from Boiled Soyabean (Glycine max L.). Journal of Food Science and Technology (Mysore), 32(3), 219–220.

Singh N.R. (2003). Dietary pattern: edible wild plants of Manipur. ADAM Publications, pp 7–9.

Singh P.K., Singh H.K. (1996). Superstition in botanical folklore with reference to Meitei culture. Journal of Economic and Taxonomic Botany,12, 367–372.

Singh T.A., Devi K.R., Ahmed G., Jeyaram K. (2014). Microbial and endogenous origin of fibrinolytic activity in traditional fermented foods of Northeast India. Food Research International, 55, 356–362. https://doi.org/10.1016/j.foodres.2013.11.028

Sohliya I., Joshi S.R., Bhagobaty R.K., Kumar R. (2009). Tungrymbai- A traditional fermented soybean food of the ethnic tribes of Meghalaya, Indian Journal of Traditional Knowledge, 8(4), 559–561.

Soibam H., Ayam V.S., Chakraborty I. (2017). Preparation and evaluation of wine from sugarcane and beet juice. Advances in. Bioresearch, 8(4), 216–219.

Soibam H., Ayam, V.S. (2018). The Traditional Fermented Foods of Meiteis of Manipur, India: A Case Study. Journal of Pharmacognosy and Phytochemistry, 7(4), 535–539.

Somishon K., Thahira Banu A. (2013). Hawaijar – a fermented Soya of Manipur, India: review. IOSR Journal Of Environmental Science, Toxicology And Food Technology, 4(2), 29–33.

Sonar N.R., Halami P.M. (2014). Phenotypic identification and technological attributes of native lactic acid bacteria present in fermented bamboo shoot products from North-East India. Journal of Food Science and Technology, 51(12), 4143–4148. https://doi.org/10.1007/s13197-014-1456-x

Sonar N.R., Vijayendra S.V.N., Prakash M., Saikia M., Tamang J.P., Halami P.M. (2015). Nutritional and functional profile of traditional fermented bamboo shoot based products from Arunachal Pradesh and Manipur states of India. *International Food Research Journal, 22*(2), 788–797.

Steinkraus K. (1995). Handbook of Indigenous Fermented Foods, Revised and Expanded. CRC Press, Boca Raton, p. 792. ISBN 0-8247-9352-8, https://doi.org/10.1201/9780203752821

Steinkraus K.H. (2002). Fermentations in world food processing. Comprehensive Reviews in Food Science and Food Safety, 1, 23–32. https://doi.org/10.1111/j.1541-4337.2002.tb00004.x

Steinkraus K.H. (2004). Origin and history of food fermentation. In: Hui Y.H., Meunier-Goddik L., Josephsen J., Nip W.-K., Stanfield P.S. (Eds.). Handbook of Food and Beverage Fermentation Technology. CRC Press, Boca Raton, p. 1–8. ISBN 9780429223952, https://doi.org/10.1201/9780203913550

Tamang B., Tamang J.P., Schillinger U., Franz C.M.A.P., Gores M., Holzapfel W.H. (2008). Phenotypic and genotypic identification of lactic acid bacteria isolated from ethnic fermented bamboo tender shoots of North East India. I International Journal of Food Microbiology, 121(1), 35–40. https://doi.org/10.1016/j.ijfoodmicro.2007.10.009

Tamang J. P. (1998). Role of microorganism in traditional fermented foods. Indian Food Industry, 17(3), 162–166.

Tamang, J. P. (2015). Naturally Fermented Ethnic Soybean Foods of India. Journal of Ethnic Foods 2, no. 1 (2015): 8–17. https://doi.org/10.1016/j.jef.2015.02.003

Tanasupawat S., Visessanguan W. (2014). Fish Fermentation. In: Boziaris. I.S. (Ed.) Seafood Processing: Technology, Quality and Safety. Wiley Blackwell, Oxford, p. 177–207. ISBN 978-1-118-34620-4, https://doi.org/10.1002/9781118346174.ch8

Thakur K., Rai R.C.S., Tomar S.K., Panmei A. (2016). Fermented bamboo shoots: A rich niche for beneficial microbes. Journal of Bacteriology & Mycology: Open Access, 2(4), 8. https://doi.org/10.15406/jbmoa.2016.02.00030

Thapa N., Pal J., Tamang J.P. (2007). Microbiological profile of dried fish products of Assam. Indian Journal of Fisheries, 54, 121–125.

Thapa N., Pal J., Tamang, J. P. (2004). Microbial diversity in ngari, hentak and tungtap, fermented fish products of North-East India. World Journal of Microbiology and Biotechnology, 20(6), 599–607. https://doi.org/10.1023/B:WIBI.0000043171.91027.7e

Thingom P., Chhetry G.K. (2011). Nutritional analysis of fermented soybean (Hawaijar). Assam University Journal of Science and Technology, 7(1), 96–100.

Thiyam G., Koijam K., Appaiah A.K.A. (2011). Process improvement as influenced by inoculum and product preservation in the production of Hawaijar — A traditional fermented soybean. African Journal of Food Science, 5(2), 63–68.

Thomas J., Montville, K.R.M. (2008). Food Microbiology – An Introduction, 2nd ed. ASM Press, Washington, DC, USA, p. 244–245.

Toussaint-Samat M. (2009). A History of Food. Wiley-Blackwell, Oxford, UK, p. 103, 201, 223.

Voidarou, C., Antoniadou, M., Rozos, G., Tzora, A., Skoufos, I., Varzakas, T., Lagiou, A., Bezirtzoglou, E. (2021). Fermentative foods: Microbiology, biochemistry, potential human health benefits and public health issues. Foods, 10(1), 69. https://doi.org/10.3390/foods10010069

Wahengbam R., Thangjam A.S., Keisam S., Asem I.D., Ningthoujam D.S., Jeyaram K. (2020). Ethnic Fermented Foods and Alcoholic Beverages of Manipur. In: Tamang J. (Ed.) Ethnic Fermented Foods and Beverages of India: Science History and Culture. Springer, Singapore. https://doi.org/10.1007/978-981-15-1486-9_14