

FERMENTATION TECHNOLOGY PRACTICE IN NORTH EAST INDIA -FERMENTED FOODS AND ALCOHOLIC BEVERAGES

Abstract

Fermentation technology is an age-old widely applied biotechnological process used for the preservation of foods and beverages. Fermented foods are considered as the storehouse of microorganisms as microbes play a key role during the fermentation process, which leads to required biochemical changes and important changes in the food. Many people from different communities of the world practice the fermentation process in their unique traditional methods or with advanced methods. People living in the North-Eastern region of India strictly follow their traditional methods of preserving foods and beverages which are inherited from generation to generation. Locally available fish, vegetables, and soybeans are commonly fermented by most of the tribes of North-East India. Apart from the fish and vegetables, the fermented alcoholic beverages prepared in this region are unique and are highly related to yeast-mediated fermentation. This chapter discussed the detail traditional fermentation techniques practiced in North-East India, the microbes associated with their fermented products, the type of nutritional values associated and the communities associated with each of the food types.

Keywords: Fermented food, techniques, North east India, microorganisms

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I. INTRODUCTION

The North Eastern part of India, consisting seven sister states namely- Assam, Meghalaya, Manipur, Mizoram, Nagaland, Arunachal Pradesh and Tripura, is highly rich in cultural diversity. Different lineage of indigenous group resides in this particular region of India who highly abides by their ancestral rituals and traditions. Tribal communities used to solely depend on natural ingredients for nutrition and survival. There is a number of food cultures particularly and uniquely related to each of these groups. Usage of local fruits, vegetables, locally available herbs and fish etc. as nutrients has not only been proved as good energy source but has shown multiple health benefits. There are many communities which even depend solely on these local ingredients for medicinal purposes. Fermentation is a chemical process driven by microbes (bacteria, yeast) to break down complex food substances and produce flavored compounds along with CO₂, alcohol etc. This process is often found naturally without any pretreatment. Production of fermented food is an age old technique where the knowledge of natural fermentation (by keen observation for a considerable time span by ancestors) is utilized for large production by creating optimum environmental condition. Fermentation mediated by application of selected yeast strains is a very widely applicable method for both bakery and brewery industries. All of the small communities in north east have their very own type of alcoholic beverages and these are highly related to yeast mediated fermentation. The very first application of such fungal strain was first noted back in 6000 BC in Egypt (Saerens, 2010). In India the ancient most encrypted evidence of brewery is from Rig Veda period (1500-1200 BCE) when “Sura”- the alcohol used to be offered in holy rituals. Production of rice beer by different tribal communities has also been mentioned in many ancient encrypts. Apart from fermented alcoholic beverages, fermented food associated with yeast and lactic acid fermentation (driven by lactic acid bacteria) is also a key feature of nutritional constituents of North-East Indian communities. Each of the seven sister states have their very own traditional fermented food dishes. For example- Soibum, Soijin, Kalpi, Ngari, Goyang, Gondruk, Ziang-sang, Hawaijar etc. are very few of the hundreds of fermented vegetable, fruit and fish products. In this chapter, we will focus on the ancient fermented techniques based with the most famous of these fermented food items. This chapter will provide a detailed idea about the different techniques and their advantages, disadvantages, type of nutritional values associated to them and the communities associated to each of the food types.

II. FERMENTED VEGETABLE PRODUCTS OF NORTH-EAST INDIA

- 1. Gundruk:** Gundruk is a common fermented vegetable food product popular among tribes of Nepalis living in northeast Indian states, Nepal, and Bhutan (Tamang, 2006). This dry non-salted food is made from leafy vegetables and is usually prepared during the winter season due to the abundant availability of green vegetables. The ingredients used are leaves of cauliflower, cabbage, Rayo-sag, radish, mastered, and many other varieties of locally found leafy vegetables. This item is commonly consumed by people as a pickle or soup with boiled rice (Tamang & Tamang, 2010).

Traditional Method for Preparing Gundruk: To make the gundruk the vegetables are allowed to wilt for 1-2 days, shredded, or cut into small pieces, and then crushed. Then they are transported and pressed into an earthen pot or container. The container should be airtight and kept for 15-22 days to ferment naturally at normal room temperature.

After fermentation, the wet gundruk is sun-dried for 2-4 days to make it edible and can be stored for a year or more (Tamang & Tamang, 2010; Sharma and Yaiphathoi, 2020). Common microorganisms reported from gundruk are *Lactobacillus plantarum*, *L. lactobacillus*, *L. paracasei*, *Leuconostoc fallax*, *Pediococcus acidilactici* and *P. pentosaceus* (Tamang et al., 2005).

- 2. Khalpi:** Khalpi is also prepared by the Nepali peoples of Sikkim and Darjeeling. Khalpi is prepared from fermented cucumber that is consumed as a pickle, especially by the Chetti and Bahun castes of Nepali people.

Traditional Method of Preparing Khalpi: To prepare the khalpi mature and ripened cucumbers are collected and then sliced into desirable pieces followed by sun drying for 2 days (Sharma and Yaiphathoi, 2020). Then the dried cucumber pieces are placed into a handmade vessel, locally called “dhungroo” which is made of bamboo. Then airtight the vessel and allow it to ferment for a week at room temperature. After fermentation, khalpi can be stored as pickles in an airtight container. Chilli powder, salt, and mustard oil are usually added to the pickle for consumption. (Tamang and Tamang, 2010).

The microbes that have been reported from khalpi are *Lecunostoc fallax*, *Lactobacillus brevis*, and *L. plantarum* (Sharma and Yaiphathoi, 2020).

- 3. Sinki:** Sinki is the ethnic fermented vegetable food of Sikkim and Nepal. Sinki is made from radish tap root instead of leaves usually in the winter season due to its availability in that season ((Tamang & Sarkar, 1993; Sekar & Mariappan, 2007). It is a highly acidic flavored non-salted fermented pickle, also consumed as soup that has health benefits for gastrointestinal problems (Tamang and Sarkar 1993, Sharma and Yaiphathoi, 2020).

Traditional Method of Preparing Sinki: To prepare this item, radishes are cleanly washed and allowed to wither under sunlight for 1-2 days. It is very interesting that some people use pit fermentation to prepare Sinki and some people use earthen containers for fermentation. After softening from sundry, the radishes are cut into suitable pieces or crushed, dipped in lukewarm water, and squeezed to drain of the excess water. Then prepared radishes are transferred to earthen containers or a pit which is dug about 2-3 feet in a dry and clean location. The pit used is first properly cleaned and plastered with mud, and then a little burned. For better results, the pit is layered with paddy straw and bamboo sheaths to keep it dry and warm then squeezed radishes are transferred into the pit by applying a tight press. Then the top of the pit or container is covered by dry leaves and sometimes heavy stones are also used to weigh down the leaves. In the case of pit fermentation, the top portion of the pit is covered with mud and kept for about one month to occur natural fermentation. When using a container, it is also left for 30 days in a dry place to get a better fermentation product. After fermentation is completed, let the fresh sinki sundried for 3-5 days and then it could be stored for approximately two years. During the storage process, it is better to keep the sinki under sunlight periodically for a few hours to avoid food spoilage ((Tamang & Sarkar, 1993; Tamang & Tamang, 2009). In the fermentation process various microorganisms are involved such as *Lactobacillus brevis*, *L. fermentum*, and *L. plantarum*, and (Tamang & Sarkar, 1993).

- 4. Goyang:** Sherpa tribe of Sikkim and Darjeeling prepared this ethnic fermented vegetable food. Goyang is prepared from leaves of locally known 'magane-saag' (*Cardamine macrophylla* Willd.) that is found wild in Sikkim (Tamang and Tamang, 2009).

Traditional method of preparing Goyang: To prepare Goyang, fresh leaves of magane-saag are collected and washed to get rid of dust particles, cut into small pieces, and squeezed to get rid of the amount of excess water. The squeezed leaves are then placed into a bamboo basket which is pre-prepared with a few lines of fig leaves. The leaves are allowed to naturally ferment in the bamboo basket by covering the top of the basket with fig leaves. The completion of the fermentation process takes around one month at room temperature. For storage, the fermented leaves i.e the fresh goyang is transferred to airtight containers to preserve for two to three months (Tamang and Tamang, 2009; Sharma and Yaiphathoi, 2020). The microorganisms reported from fermentation are *Lactococcus lactis*, *Lactobacillus brevis*, *L. plantarum*, *Pediococcus pentosaceus* and *Enterococcus faecium* (Tamang & Tamang, 2007).

- 5. Ziang-dui/ Ziang-sang:** Ziang-sang/ ziang-dui, an ethnic food of the Naga people belongs to Nagaland and Manipur. It is a fermented food prepared from Mustard leaves especially in the cold season when the leaves are abundant (Tamang et al., 2012). This item is commonly consumed with boiled rice.

Traditional Method of Preparing Ziang-dui/Ziang-sang: To prepare the fermented item, fresh Brassica leaves are collected and allowed to wither under sunlight for 2-3 days. After withering, leaves are crushed, dipped in warm water, and squeezed to drain the excess water. Then the leaves are placed into an airtight container, then pressed and allowed for natural fermentation for 7-10 days at 20 °C-30 °C temperature. After fermentation is completed, the liquid is squeezed off from the paste and let the paste sun dry for 3-5 days. The paste is called Ziang-sang which can be stored in an airtight container for more than one year and the extracted liquid is called Ziang-dui is boiled after extraction and made into a concentrated liquid for consumption. This Ziang-dui can be kept for more than one year in traditional bamboo containers ((Tamang & Tamang, 2009; Jeyaram et al., 2009). Microbes associated to Ziang-dui/ Ziang-sang are *Lactobacillus brevis*, *L. plantarum* and *Pediococcus acidilactici* (Tamang et al., 2005).

- 6. Kahudi:** Kahudi also known as 'panitenga' is a common and very popular fermented food product of Assam. It is made from either black or white mustard seed mixed with the extract of *Garcinia pedunculata* which is locally known as 'thekera' in Assam. Sometimes tamarin is also used instead of garcinia fruit. Kahudi is usually consumed with steamed rice by Assamese people (Goswami et al., 2017)

Traditional Method of Preparing Kahudi: To prepare kahudi, good quality mustard seeds (either black or white) are collected and washed it to clean properly, then dried. After drying, seeds are roasted in a pan applying a very gentle flame, care has been taken not to burn the seeds. The roasted seeds are then ground to an irregular granular shape followed by mixing with salt, mustard oil, and the juice of ripe *Garcinia* fruit. Then the small balls are made from this raw product, wrapped in banana leaves, and kept for natural fermentation for one to two weeks. After fermentation it could be stored in airtight container for future consumption (Goswami et al., 2017)

Some lactic acid bacteria are reported from kahudi namely, *Lactobacillus fermentum*, *L. plantarum*, *L. casei* and *Enterococcus durans* (Goswami et al., 2017).

III. FERMENTED FISH PRODUCTS OF NORTH-EAST INDIA

1. **Ngari:** Ngari is an ethnic fermented fish product of Manipur prepared and consumed mainly by Meitei community of Manipur. It is used as an important ingredient for making different Manipuri cuisines like singju, eronba etc. Ngari is made from the fish *Puntius sophore Hamilton* locally known as phoubunga.

Traditional Technique / Process of Making Ngari: For the preparation of ngari fresh *Puntius sophore Hamilton* fish is first rub with salt and sun-dried for at least 3 to 4 days, then thoroughly washed the sun-dried fishes (whole) and spread on bamboo mats. The sun-dried fishes are filled in an earthen pot which were coated with mustard oil or any vegetable oil in the inner surface and then traditionally pressed tightly by foot covered with gunny bags then the pot is stored at room temperature for 4 to 6 months or more at room temperature Associated Microorganisms: The microbial composition of ngari includes bacteria *B. subtilis*, *B. pumilus*, *L. plantarum*, *L. fructosus*, *L. lactis subsp. cremoris*, *L. amylophilus*, *L. coryniformis subsp. Torquens*, *L. plantarum*, *E. faecium* and *Micrococcus* and yeasts species of *Saccharomyces* and *Candida* (Thapa, 2016).

The nutritional value of ngari includes food value: 381.6kcal/100g, fat:13.2%, moisture, protein: 34.1%, carbohydrate: 31.6%, 33.5%, pH: 6.2, ash: 21.1%, Fe: 0.9 mg/100 g Ca: 41.7 mg/100 g, Mg: 0.8 mg/100 g, and Zn: 1.7 mg/100g Mn: 0.6 mg/100 g, (Thapa, 2016)



Figure 1: Ngari in Earthen Pot(Monica, 2014)



Figure 2: Ngari (Monica, 2014)

2. **Hentak:** Hentak is an indigenous fermented fish paste of Manipur. It is prepared and consumed by Meitei community as side dish or used as condiment in preparation of many Manipuri cuisines for its flavor and aroma. Sometimes it is given to patients recovering from sickness or injury or pregnant women. Hentak is made from the mixture of *Alocasiamacrorrhiza* petioles and sun-dried fish powder

- **Traditional Process of Making Hentak:** *Esomus danricus* is first washed, sun-dried and crushed into powder, (ii) washed and cut pieces of petioles of *Alocasia macrorrhiza* exposed to sunlight for one day. (iii) Sun-dried *Esomus danricus Hamilton* is mixed and made paste with the cut pieces of the petioles of *A. macrorrhiza*

in an equal amount and then the paste is kept in a tightly seal earthen pot and left undisturbed for fermentation for 7 to 9 days.

Associated Microorganisms: It is reported that bacteria *Bacillus subtilis*, *Bacillus pumilus*, *Enterococcus faecium*, *Lactococcus lactis* subsp. *cremoris*, *Lactococcus plantarum*, *Lactobacillus fructosus*, *Lactobacillus amylophilus*, *Lactobacillus coryniformis* subsp. *Torquens*, *Lactobacillus plantarum*, , *Micrococcus* and yeasts *Candida* sp. and *Saccharomyces* were associated with Hentak.

It is also reported that hentak has a nutritional value of food value: 408.0 kcal/100 g, moisture: 40.0%, carbohydrate: 38.7%, fat: 13.6%, protein: 32.7%, pH: 6.5, ash: 15.0%, and Fe: 1.0 mg/100g, Ca: 38.2 mg/100 g, Zn: 3.1 mg/100 g, Mn: 1.4 mg/100 g, Mg: 1.1 mg/ 100 g (Thapa, 2016)



Figure 3: Hentak (Wahengbam *et al.*, 2020)

3. Shidal: Shidal is semi-fermented and non-salted ethnic fish product of Tripura and it is a delicacy for most tribal communities, Bengali, and other residents of Tripura for its characteristic taste and flavor. *Shidal* is made or prepared either from *Puntius* sp. (*Puntius sophore*) which is popularly called *Puntishidal* or from estuarine fish *Setipinna phasa*, known as *Phasa Shidal* (Majumdar *et al.*, 2010). Shidal has several local names such as seedal in Assam, seepa in Tripura, hidal in Arunachal Pradesh and shidol in Nagaland. Shidal is a delicacy for most of the Bengalis, tribals and other people of Tripura for its characteristic taste, flavor and aroma.

- **Traditional technique / Process of Making Shidal:** Minor carp (*Puntius spp.*) have to be sun-dried (semi-dried about 50% of the total moisture is retained in the fish) and filled in a specially designed earthen pots/vats called mutka. The mouth portion of the pot is filled with cover paste prepared from crushed dried fish and covered with cover- leaf which can be yam or banana leaves for a week, then the cover- leaf is removed and sealed almost airtight with clay and made it fermented naturally for 4 to 6 months under anaerobic condition until the product develop a characteristic appearance, texture and odour.

Associated Microorganisms: *Bacillus spp.*, *Staphylococcus aureus*, *Micrococcus spp.* and *Escherichia coli* were reported as the microbial associated with Shidal (Thapa, 2016)

4. **Tungtap:** Tungtap is a popular ethnic fermented fish product which is commonly consumed and prepared by Khasi and Jaintia tribes of Meghalaya. Tungtap is made from *Puntius spp./Daniospp* fish species and it is consumed as pickle, and taste enhancer.

Traditional technique / Process of Making Tungtap: Briefly washed Sun-dried fish (*Danio spp.*) are mixed with salt and filled in air-tight earthen pots. The earthen pots are then kept at room temperature (18– 28 °C) for 3–6 months for fermentation. (Rapsang and Joshi, 2012)

Microbial association of Tungtap Bacteria (*L. lactis subsp. cremoris*, *L. plantarum*, *E. faecium*, *L. fructosus*, *L. amylophilus*, *L. plantarum*, *B. pumilus*, *L. coryniformis subsp. Torquens*, *L. puhozhii*, *B. subtilis*, and *Micrococcus*) and yeasts (*Candida* and *Saccharomycopsis*) are present in tungtap (Thapa, 2016)

Nutritional value of Tungtap includes moisture: protein: 32.0%, fat: 12.0%, carbohydrate: 37.1%, Food value: 384.4 kcal/100 g, 35.4%, pH: 6.2, ash: 18.9%, Fe: 0.9 mg/100 g, Mg: 1.6 mg/100 g, Ca: 25.8 mg/100 g, Mn: 0.8 mg/100 g, and Zn: 2.4 mg/100 g (Thapa, 2016)

5. **Lonailis:** Lonailis is an ethnic salted fermented fish product of Tripura. Lonailis eventually made or prepared from *Hilsa*, *Tenualosailisha*. It is widely devoured in Bangladesh and Northeast parts of India.

- **Traditional Method of Processing Lonailish:** Lonailish is conventionally prepared by dry salting, the *Hilsa* is cut into chunks followed by fermentation process in saturated brine solution in a metal container until the appearance of the characteristic flavor and texture. The product is kept immersed in the fermenting medium before it is consumed. The fermentation period is around 4-6 months. (Majumdar and Basu, 2010)

Fresh *Hilsa* fish/18-24hrs ice preserved *Hilsa* is washed with clean water and the fish is descaled and beheaded without removing the guts and cut diagonally into small chunks, mixed with salt and layered in bamboo basket with light proof cover (to drain the fluid from the fish) and left for 48 hours in dark. The fish pieces are then tightly packed in tin containers filled with priorly boiled, cooled saturated brine and stored in the dark room for 4-6 months for fermentation.

Associated Microorganism: The microorganisms involved during the fermentation of lonailish are *Bacillus spp.* and *Micrococcus spp.* (Majumdar and Basu 2010).

6. **Numsing:** It is an ethnic fermented fish product of Assam which is prepared and consumed by missing tribes of Upper Assam region. Numsing is prepared from small economic fishes like *Puntius*, *Mola*, *Channa*, *Tengra* etc. Preparation of Namsing includes drying, smoking and fermentation.

Traditional Technique / Process of Preparing Numsing: Flame dried and smoked fishes with spices is grinded in a traditional huller and filled in the bamboo container which is stuff with fern leaves, rice straws and clay in the final layer. The product is then

kept fermented with intermittent heating and keeping it near a fire place for about a month.

- 7. Dang-pui-thu:** Dang-pui-thu is an indigenous fermented fish product of Mizoram. It is prepared and consumed by the indigenous tribe of south Mizoram. Dang-pui-thu is prepared from small prawn, crab and fish species from local rivers, lakes and streams.

Traditional Technique / Process of Making Dang-pui-thu: It is prepared by traditional method Sundried small fish and prawns for 4-5 hours and ground to paste. The paste has to be kept fermented in an earthen pot for 2-4 months.

IV. FERMENTED SOYBEAN PRODUCTS OF NORTH-EAST

Fermented Soybean Product: soybean is used as a very common and popular food item for the Preparation of varieties of both non-fermented and fermented food products in the states belonging to Eastern Himalayas (Tamang, 2015). In North East states of India, the fermentation products of soybean are used as an essential deity that includes various products as follows:

- 1. Hawaijar:** Hawaijar is a fermented soybean product of Manipur. For Manipuri people Hawaijar is an important and healthy dietary food item that is locally prepared. It can be consumed as a curry or sometimes as side dish or ametpa with king chilli that increases the flavor and taste. It can be cooked as a curry locally called Chagempomba and can also be added to other vegetables and meats during preparation.

- **Traditional Technique / Process of Making Hawaijar:** To prepare hawaijar, the good quality soybeans are collected and soaked overnight and clean properly by washing. Then steamed or pressure-cooked till they become squeezy. After steaming, the cooked beans are dipped in hot water, dried and wrapped with healthy fig or banana leaves and then tightly packed in a bamboo basket having a lid which is locally known as lubak. The basket is prepared by putting a layer and lining it with the leaves of the banana or fig tree to maintain the warm temperature and then the basket is covered with a jute cloth followed by keeping it in a warm area (>400 C) for fermentation for 4–5 days. The final product forms the brown color with a sticky slimy texture that have an odour like ammonia. For longer storage, the product is sundried and stored in a container.

Associated Microorganisms: Various microbial strains have been reported in the fermentation process including *Bacillus licheniformis*, *B. cereus*, *B. subtilis*, *Staphylococcus sciuri*, *S. aureus*, *Providencia rettger* and *Alkaligenes* sp. (Jeyaram et al., 2008a).

- 2. Peru-Yaan, Agya, ChhukChhoro, Lip Chhuro:** Peru-Yaan, Agya, ChhukChhoro, Lip Chhuro are fermented soybean products prepared and consumed by Apatani, Galo, Sherdukpen, Monpa and Nyishi tribes of Arunachal Pradesh. The method of preparation is similar for all the products only the names are different according to the different tribes. The fermented product is consumed as chutney or it is used as an ingredient in the preparation of curries.

Traditional Technology/ Process of Making: Fresh boiled soybean seeds (boiled for 1-2 hrs) are packed in bamboo basket after removing the excess water. The basket is lined with ginger leaves or Nijji leaves in an airtight condition and kept over the wooden rack in Chang-ghar (specially designed fireroom) for 3-5 days for fermentation.

V. FERMENTED ALCOHOLIC BEVERAGES OF NORTH EAST INDIA

1. **Apong:** Apong is one of the most favoured rice based fermented alcoholic beverage of Arunachal Pradesh. It is mostly prepared and consumed by almost all the tribal communities of Arunachal Pradesh.

- **Traditional Technology for the Preparation of Apong:** Materials required – Rice, ipoh (Starter culture), Bamboo mat, pot or vessel (either earthen pot, wooden containers or metallic containers), Muslin cloth etc.

Associated Microorganisms: *Saccharomyces cerevisiae*, *Pischia sp.*, *Hanseniasporasp*, *Kloeckerasp*, and *Candida sp* (Sharma & Yaiphathoi, 2020).

- **Preparation of ipoh (Starter Culture):** Washes and dried rice is grinded to give it a powdery texture. In it mixed of *Veronia cinerea* and *Clerodendron viscosum* Vent plant seeds and bark powders are added. The mixture is made into a paste and mould into small cakes. The product is then kept in a fire place for 3-4 days for drying.

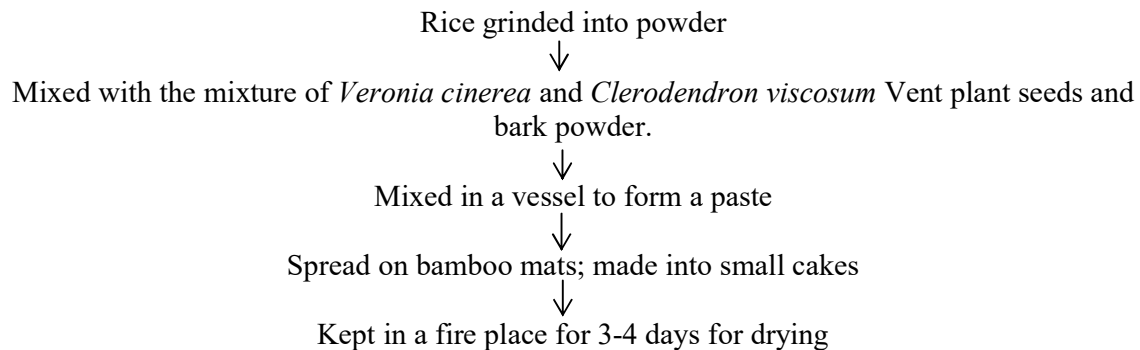


Figure 4: Flow Chart for Preparing ipoh (Tiwari, Shrestha, & Agrawal, 2007).

- **Preparation of Apong**

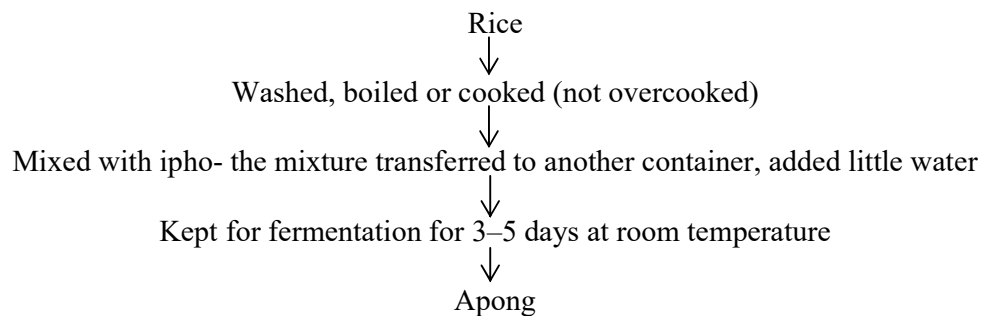


Figure 5: Flow chart for preparation of Apong (Tiwari et al., 2007).

Properly cooked rice is mixed with the previously prepared starter culture ipho and in a new container with little water then the mixture is kept for fermentation in a room temperature for 3-5 days.

2. **Atingba:** Atingba is traditional rice based mild alcoholic beverage locally prepared and consumed by the Meitei and Kabui communities of Manipur. For the preparation of this beverage traditionally prepared starter culture Hamei is used. Hamei is dry rounded or flattened fermented rice dough prepared from the mixture of unpolished raw rice and the bark of *Albiziamyriophylla* with the previous batch hamei powder. (Wahengbam et al., 2020)
 - **Traditional Technology/Process of Making Atingba:** For the preparation of Atingba over night soaked local varieties of rice like Moirangphou, Khumbiphou, KD phou etc., are steamed or cooked and washed with clean water and made it air dried by spreading on yangkok or phoura, bamboo made winnowing trays. The clean dried rice is mixed with the crushed hamei powder and the mixture is transferred into specially designed earthen pots and covered by *Alocasia* leaves or clean cloth and left undisturbed for a span of 3-4 days in summer and a duration of 6-8 days in winter for fermentation. (Wahengbam et al., 2020)

Associated Microorganisms: The identified bacteria imparting active part in the fermentation processes are *Lactobacillus plantarum* and *Pediococcus pentosaceus* (Tamang&Nikkuni, 1998) and the fungus involved are *Saccharomyces cerevisiae*, *P. guilliermondi*, *Pichia anomala*, *P. fabianii*, *Candida tropicalis* etc. (Jeyaram et al., 2008b).

VI. CONCLUSION

This chapter has solely focused on the various fermented food associated with different tribal communities of North-East Indian states. A discussion on various technologies related for production of these food items have been illustrated briefly in details. The microbes associated with each type of food have specific probiotic and organoleptic properties and hence are beneficial for human health. Apart from health benefits and nutritional fulfilment and supplementation, these food items have medicinal values as well. Many of these food items have anti-cancer, anti-inflammatory, anti- allergic, analgesic etc. properties. It is to conclude that the fermentation techniques associated with these items, if upgraded with modern techniques, both yield and quality can be developed.

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