

## Rare and unexplored traditional waste food processing and fermentation methods of the meitei-pangal community of Manipur: A northeastern state of India



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### ABSTRACT

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This research examines rare and unexplored traditional waste food processing and fermentation methods. Processed waste foods as well as fermented foods represent an important segment of the most commonly consumed foodstuffs and the nutrient suppliers of the living populations across the world. *Soibum*, *hawaijar*, *ngari*, *hentak*, and *yongchak* are some of the most commonly consumed processed waste foods and fermented foods among the natives of Manipur. To our knowledge, no proper compilation of traditional methods of waste food processing and the fermentation processes of the meitei-pangal community of Manipur has been carried out yet. In this study, the traditional methods of processing waste foods and fermentation steps of foodstuffs commonly consumed by the Meitei pangal community of Manipur are surveyed and recorded for the first time. The results of the study reveal that six unique and diverse categories and ways of processing waste foods and the fermentation of food products locally known as *Yongchak*, *chakring*, *ngari*, *hentak*, *soibum*, and *hawaijar* were practiced by every family of the meitei-pangal community of Manipur using local stinky beans (*Parkia sp.*), cooked rice-based products, local fish (*Puntius sp.*), bamboo shoots (*Bambusa sp.*), and soybean products. The study will offer a new understanding of the waste food processing and fermentation processes of some of the most commonly consumed foodstuffs by the natives of the northeastern states of India, with numerous health advantages for prospective future drug discoveries and nutraceutical applications.

**Contribution/ Originality:** This study represents the first report of the traditional way of processing and fermenting waste foods employed by the Meitei-Pangal community of Manipur, India, a native population that resides in the valley districts of Manipur. This study stands out because it not only fills an important research gap in the limited available literature but also provides a valuable database of the unique processing of waste foods for reuse and consumption, with numerous health benefits that may also enhance the prospects of food security in the future.

## 1. INTRODUCTION

One of the oldest and most successful processes for producing and conserving traditional foods is fermentation. Various folklore culture in the northeastern states of India produce and consume over 300 distinct traditional inherited fermented foods and beverages [1]. The study of edible plants and animals, along with the processing and preservation of foodstuffs for consumption and therapeutic purposes, has mostly been facilitated by gradual and incremental learning among members of society living in close connection with Mother Nature [2]. Food is an important factor in distinguishing one ethnic family from another, and it is notable that there is a significant demand for such foods as part of their traditional eating practices and lifestyle [3, 4]. Few people are aware that northeast India is the epicenter of a distinct cuisine that includes fermented and non-fermented food products as well as drinks containing alcohol [5], and the community inhabiting this region has always depended on their own preparation processes for the fermentation of food specimens for the dual purposes of preservation and quality enhancement. Indigenous fermented foods are an essential component of the diets of the clan tribes in the Indian mountain belt. They are the most traditional and widespread methods for creating a wide range of foods with distinct flavors, aromas, and textures, as well as for preserving food and adding biotic embellishment to food items by modifying the populations of different bacteria [6, 7]. According to estimates, the indigenous people of northeastern India have been consuming fermented foods, drinks, and alcohol for over 2500 years [8-10].

The people who originally inhabited the state of Manipur possess extensive knowledge about the processing of food waste and the fermentation of various foods. However, the majorities of these traditional processes is peculiar to the area and are generally only known to members of that group. The variety of rice-based foods and beverages available here may increase the availability of the ingredients needed for a balanced, healthy diet [11, 12]. Rice-based foods and beverages can explore therapeutic probiotics, healthy compounds, and enzymes, allowing these foods to be used as functional and healthy foods for the global community [13-15]. The improvement in the processing methods and the addition of innovative knowledge for the fermentation of foods by mixing with other food particles are also essential to expanding specific dietary grades as well as health [7, 16]. In Manipur, the traditional fermented diet is divided into fermented soybean and non-soybean legume foods, fermented vegetable foods, fermented fruit foods such as stink beans or broad beans and bamboo shoot foods, fermented cereal and pulse foods, fermented and smoked fish products, preserved meat products, milk beverages such as sangom aphantaba and chak athumba, non-food mixed amyolytic starters, and alcoholic beverages such as yu atingba, etc. [9, 17, 18]. Such processed foodstuffs contribute to dietary stability and boost their availability and market value [19, 20]. Nevertheless, some of these foods have been explored for their nutritional and therapeutic properties, which can provide valuable data that indicates their potential usage on a massive scale [1, 21-24].

Fermentation is a traditional practice passed down from generation to generation in Manipur and carries out its own methods of fermenting foodstuffs for the purpose of preservation and the enhancement of tastes [25-27]. Each fermented food item possesses distinct preparation techniques and substrates specific to its community. Some typical processed and fermented foods, like bamboo shoots, fermented soybeans, fermented fish, and fermented fish paste of Manipur's meitei-pangal, are shown to taste good despite using simple, locally grown veggies in their processing [28, 29].

However, processing waste food products serves as a source of nutrients that keep us healthy and protect us from a variety of diseases, in addition to assisting in the preservation of food for human consumption without wasting the food [24]. In addition, as the fermentation process has been associated with many health benefits, the microorganisms like lactic acid bacteria (LAB) present in the fermented foods have become an additional focus of attention [30]. These bacteria synthesize vitamins, minerals, and nutrients, generate peptides and enzymes such as proteinase and peptidase that have various biological activities, and help in the separation of some non-nutrients during fermentation [31]. Fermentation also helps in producing various bioactive amino acids with antioxidative and antimicrobial characteristics, as well as microbial functions that add to health advantages [32-35]. In order to

create superior products, advanced cutting-edge sciences and scientific-technological knowledge must be combined with old traditional knowledge and technology, and newer fermented foods and waste foods should be processed to meet food security as well as boost the market economy of the natives of the northeastern state of India. Thus, the goal of this paper is to document rare and unexplored waste food processing methods and fermentation processes of the natives of the northeastern states of India to provide a database about the fermentation methods and processing of waste foods that may be suitable for industrial-scale manufacturing systems for mass marketplaces as well as for the preparation of indigenous products having health benefits and nutraceutical value.

## 2. MATERIALS AND METHODS

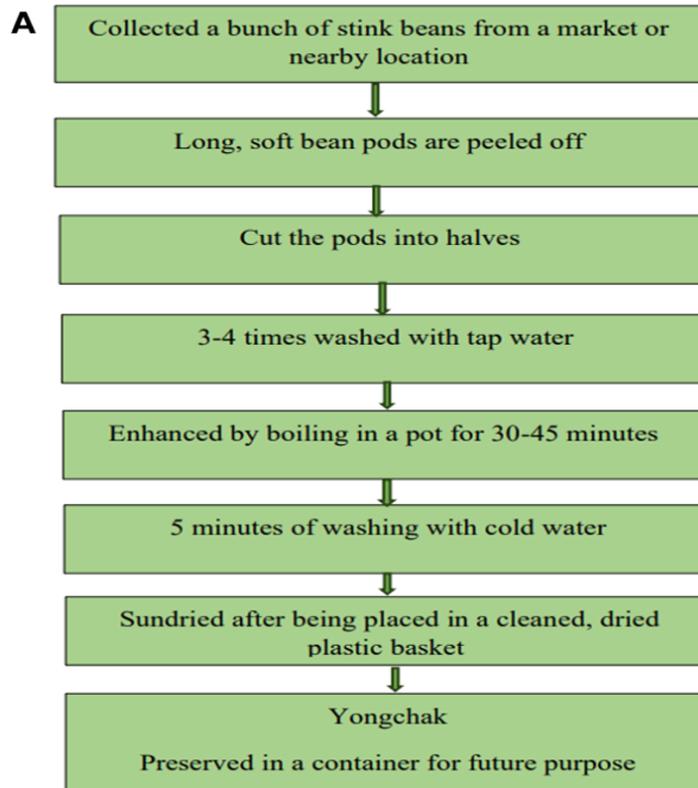
### 2.1. Study Design and Setting of the Study

The meitei-pangal community, residing in six different villages in the four valley districts of Manipur, conducted the study from March to November 2022. The main villages covered in this study were Kshetrigao and Khergao Yangbi of Imphal East District (24.7674° N, 93.9636° E), Lilong Mayai Leikai (24.6963° N, 93.9237° E), Moijing Leingoiijil of Thoubal District (24.6488° N, 93.9543° E), Keirak village of Kakching District (24.4969° N, 93.9831° E), and Kwakta village of Bishnupur District of Manipur (24.5245° N, 93.7842° E). To document the traditional knowledge related to native fermented food preparation methods and the processing of waste food products, a survey was carried out regularly during the study period by using standard questionnaires and personal interactions with villagers at the study sites. For each foodstuff, six distinct production sites were visited, and all the information related to unique native practices related to food waste processing and fermentation was documented. Recognized village practitioners were also interacted with and observed the processing methods using camera recording, photographs, personal interviews, etc. we thoroughly identified the traditional plant and animal items and recorded their local names. The food waste processing methods of the meitei-pangal community of Manipur recorded in this study are *yongchak* (fermented stink beans) and *chakring* (dried cooked rice), *ngari* (fermented fish), *hentak* (fermented fish paste), *soibum* (fermented bamboo shoots), and *hawaijar* (fermented soyabean). The waste food preservation methods of *Yongchak* (*Parkia sp.*) were carried out in Yangbi villages of the Imphal east district of Manipur, while cooked rice products (*chakring*) were studied in different meitei-pangal households of Thoubal district, Manipur. We have extensively documented the collection and preparation methods of fermented bamboo shoots in Keirak village, Kakching district of Manipur, where the majority of the rural women engage in these practices. *Ngari* and *hentak* collection sites and processing were documented from Lilong villages in the Thoubal district of Manipur. The fermentation process of *hawaijar* was documented from the 20–30 Meitei-pangal households in Kshetrigao villages of Imphal east district, Manipur, where the fermentation process of *hawaijar* is carried out in a crude traditional way.

## 3. RESULTS

### 3.1. Waste Stink Tree Bean (*Yongchak*) Processing Methods of the Meitei-Pangal Community of Manipur

Stink beans are known as *yongchak* in Manipur and are a species of *Parkia* (*Parkia speciosa*, *Parkia javanica*, *Parkia singularis*, and *Parkia timoriana*) [36, 37]. It produces flat, edible beans with bright green seeds that are plump in size and shape and have a rather strong and persistent odor. The main *yongchak* collection sites of the wasted *yongchak* are primarily the Yangbi villages of the Imphal East district of Manipur (24.7674° N, 93.9636° E). We defoliated the long, tender pods or beans, peeled off all the leftovers, cut them into half-square slices, cleaned them three to four times, and then boiled them in a boiling pot for 30–40 minutes to improve their taste and texture. After boiling, it was rinsed with cold water for 5–10 minutes and stored in a dry and clean plastic basket in the sun for 10–20 days. Before consumption, we also dry and season the seeds. In another traditional processing technique, the sensitive pods and seeds are separated and stored in a container that is exposed to sunlight until the seeds turn black after drying and the dried broad beans mature for long-term storage, as shown in Figures 1(A) and 1(B).



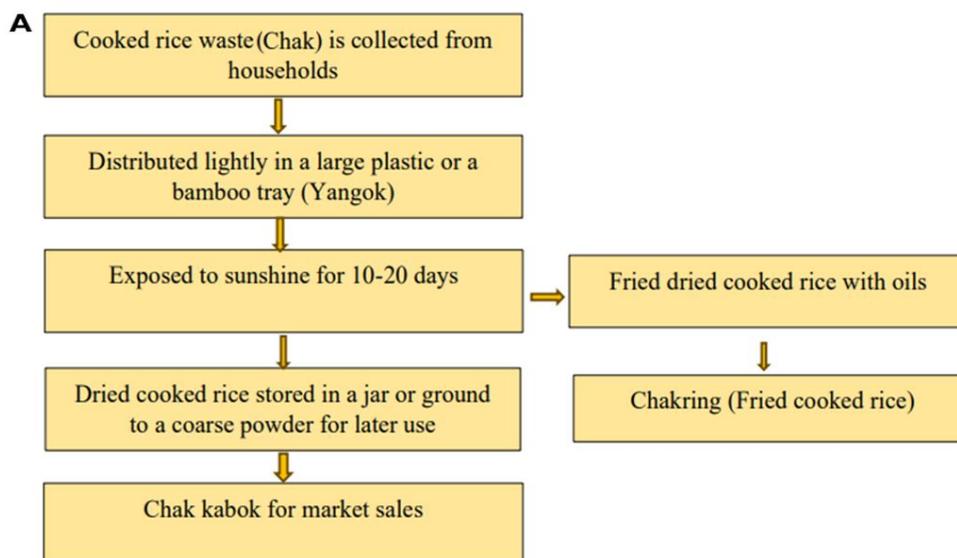
**Figure 1(A).** Flowchart showing the methods of obtaining dried stink beans (*Yongchak*) among Manipur's meitei-pangal community.



**Figure 1(B).** A photograph depicts the processing of dried stink beans (*yongchak*) among Manipur's meitei-pangal community.

### 3.2. Processing of Waste Cooked Rice Products of the Meitei-Pangal Community of Manipur

In Manipur, the art of preparing many types of dishes using fermented rice or cooked rice-based foods is well known. This processing method involves preparing batter, a semi-solid form of cooked rice waste. Simple techniques enable the preparation of these in homes or tiny cottages. The basic process begins with batter preparation, in which semi-solid cooked rice wastes are collected from household members, placed in a large plastic tray or thin bamboo tray known as a *yangok*, and dried in the sunlight for 10–20 days, [Figure 2\(A\)](#). You can store the dried form of cooked rice in a jar for later use or consume it as a ground powder. Cooked rice powder can be consumed as a spicy concoction (*kupsu*) with chili, fermented fish, and some salt. People mix rice powder with milk and water to form a round shape (*chak kabok*) or fry it with oil (*chakring ngauba*). Such traditional homemade preparations can boost the market economy and reduce food waste, as shown in [Figure 2\(B\)](#).



**Figure 2(A).** Flowchart showing the methods of waste rice products (chakring) among Manipur's meitei-pangal community.



**Figure 2(B).** A photograph depicts the preparation of wasted cooked rice for special recipes known as chakring among Manipur's meitei-pangal community.

### 3.3. Fermentation of Fish-Based Food Products by the Meitei-Pangal Community of Manipur

Different communities of Manipur, including meitei-pangal community, prepare *Ngari*, a type of traditional fermented fish prepared from the waste fish species known as *Esomus danricus* and *Puntius*. There was a slight difference in the fermentation process of *ngari* among different communities. If proper measures are not taken to stop or prevent further deterioration then, there are chances of small or medium fishes to spoil quickly or turn rotten. Small fresh or rotten fish are collected separately from local markets, surrounding farms, or the riverfront in two different containers or buckets for extended preservation. It is prepared by softly roasting fish species such as *Esomus danricus* (balloon nga or ngasang) and *Puntius species* (phoubu nga) in a fry pan (khang), setting them in trays, exposing them to the sun with the addition of seed oil and a pinch of salt, and drying them in the sun for 7–14 days until the fish is dried. The dried fish are then securely packed in a large clay pot, which is sealed and preserved for a few months. The product is ready for serving and storage after 6–12 months of fermentation at room temperature. Looking right at hardened fish and preserving it for a few months prior to presenting it to commercial markets and conserving foods for many years. Phoubu nga (fermented fish) is aggregated in various sizes or grades during the autumn-winter season and stored in wrapped bags or containers in a dried form. Alternative methods involve placing decaying fish in a thin bamboo tray, arranging them fairly, and sun-drying them for 20 days before storing them in a glass jar for future use.

(Figures 3(A) and 3(B). *Ngari* is widely popular in Manipur, especially among the meitei-pangal population. These fermented fish products are best when combined with flavor-mixed foods such as onion and chilli powder. Eromba is a famous local delicacy in the meitei-pangal community prepared by mixing boiled potatoes and vegetables and dried fish (nga akangba) after mixing with vegetables such as onion leaves, ginger, and garlic leaves with a pinch of salt, as shown in Figure 3(C).

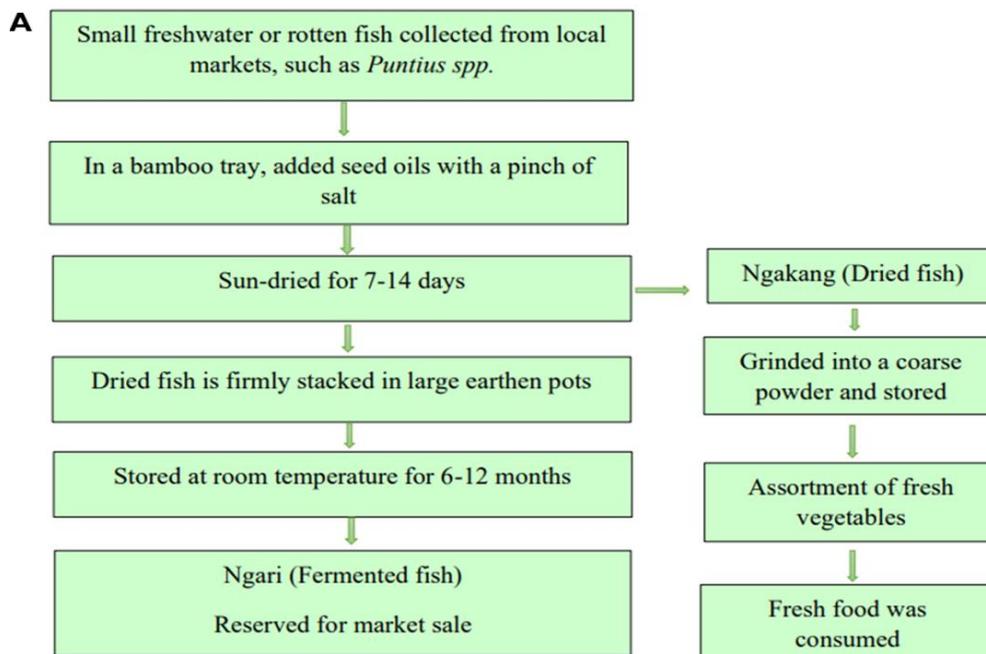


Figure 3(A). Flowchart showing fermentation and processing of fish-based products (Ngari and nga akangba) by the meitei-pangal community.



Figure 3(B). A photograph depicting the preparation of fermented fish (ngari) in a commercial setting in Manipur's meitei-pangal village.

### 3.4. Preparation of Hentak by Meitei-Pangal Community of Manipur

*Hentak* is a thick fermented food paste made with sundried fish powder and vegetable components. People commonly use aroid petioles to enhance flavor and aid in the fermentation process. The meitei-pangal community of Manipur uses the little flying barb fish known as balloon nga or ngasang (*Esomus danricus*) and phoubu nga (*Puntius*

*species*) in preparation for hentak. It can also be made from dead or rotten fish (fish waste). We gathered the fish from local markets or from rural ponds and riverbanks, placed them in a thin bamboo tray, and left them in the sun for 10 days before grinding them to powder. The aroid petioles known as hongu (*Colocasia species*) were cut into small pieces, washed thoroughly with water and drained out, exposed to sunlight for 1 day, and mixed in equal proportions. Then, the dried fish powder was sealed in earthen pots (leibak chafu) and fermented for approximately 1-2 weeks or incubated at room temperature. Finally, as shown in Figures 4(A) and 4(B), hands mold the product into a spherical shape for sale in commercial marketplaces.



Figure 3(C). A photograph depicting the preparation of dried fish (*Ngakang*) in a commercial setting in Manipur's meitei-pangal village.

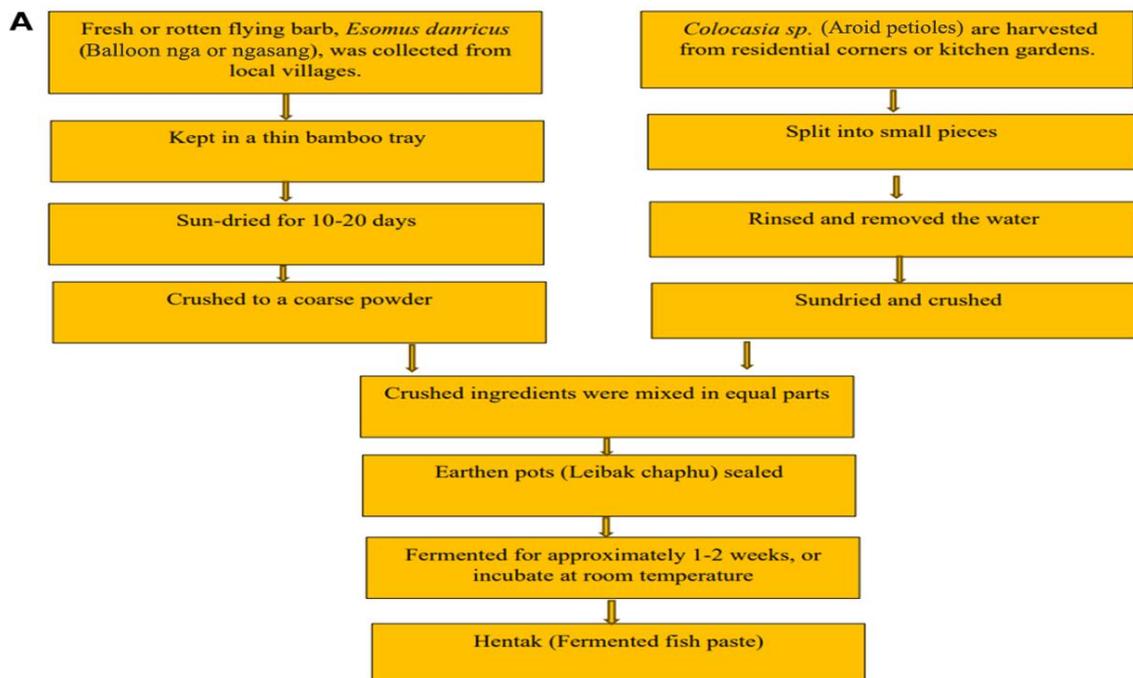


Figure 4(A). Flowchart showing the process of preparing fermented fish-based products (*hentak*) by the meitei-pangal community.



**Figure 4(B).** A photograph showing fermented fish paste (*hentak*) in Manipur's meitei-pangal commercial setting.

### 3.5. Fermentation Process of the Bamboo Shoot Products (*Soibum*) of the Meitei-Pangal Community of Manipur

*Soibum* and *soidon* are indigenous fermented bamboo shoot products popular among Manipur's Meitei-Pangal population. These fermented items are exclusively prepared in Manipur between June and October of every year from bamboo shoot sprouts known as ushoi. *Soibum* and *soidon* are primarily consumed in the form of mixed vegetable curry with fermented fish and spicy chilli (*eromba*), fish curry (*ngapai soibum thongba*), fried *soibum* with potatoes and vegetables (*soibum kanghou*), and mixed vegetables with a pinch of salt and light chilli (mixed salad) as a special food.

The main *soibum*-producing Pangal village sites in Manipur are primarily located in Keirak, Kakching district (24.4969° N, 93.9831° E), and Kwakta, Bishnupur district of Manipur (24.5245° N, 93.7842° E), based on the abundance of raw food material in this district. The type of fermented bamboo shoots used by the meitei-pangal community for the preparation of indigenous fermented food are succulent bamboo shoots from *Melocanna baccifera*, locally known as moubi wa. The shoots are plucked and peeled off, chopped into thin slices, washed with cold water, soaked for 30 minutes, pressed tightly into earthen pots or containers covered with large, thick polythene bags, and pressed hard and tightly with hands. This chamber is entirely packed with thin, small bamboo stalk fragments. For effective pressing, the upper surface is securely wrapped with polythene sheets after stuffing. Traditionally, the meitei-pangal community of Manipur believed that good-grade *soibum* could be processed by pressing it firmly enough.

For solid-state fermentation, the fermentation processing materials are preserved entirely for 6–12 months. *Soibum* can be preserved for up to 1–2 years before being marketed, as shown in [Figures 5\(A\)](#) and [5\(B\)](#).

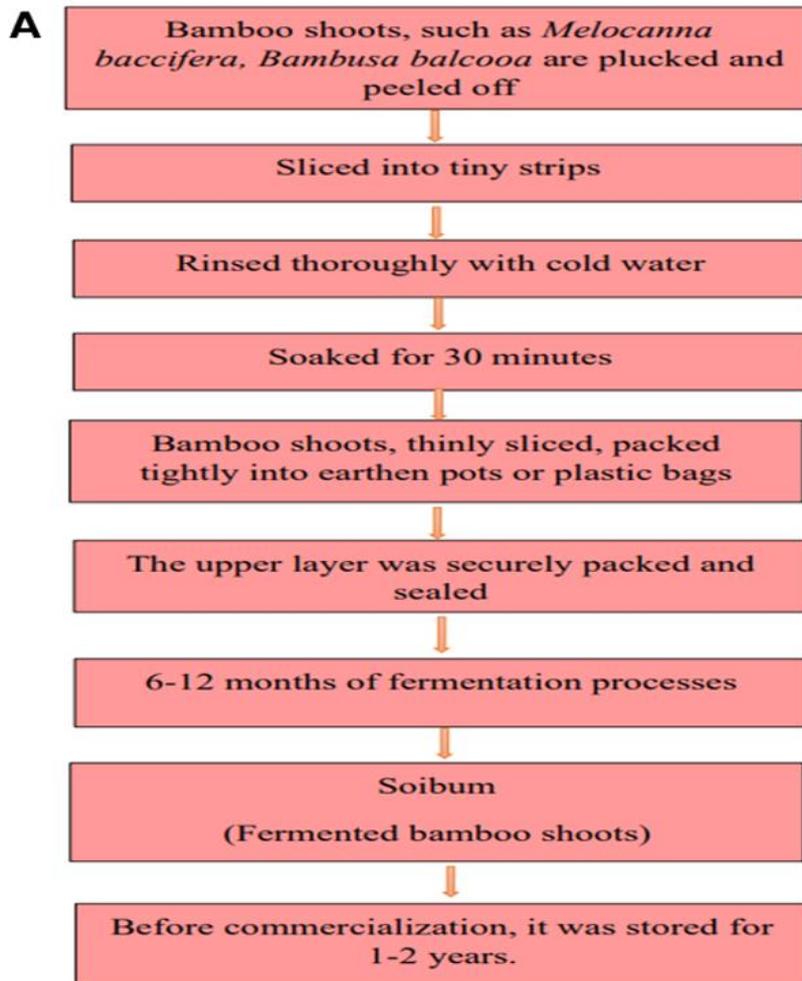


Figure 5(A) Flowchart showing fermentation methods of bamboo shoots (*Soibum*) among the Meitei-Pangal community.



Figure 5(B). A photograph showing fermented bamboo shoot products (*soibum*) of the Meitei-Pangal community.

### 3.6. Methods of Fermentation of the Soybean Products (*Hawaijar*) of Meitei-Pangal Community of Manipur

Fermented soyabean, popularly known as *Hawaijar*, is a customary fermented food consumed by the meitei-pangal community of Manipur. Large, medium, or small-sized soybean seeds were purchased from the local market, steeped for one day to improve flavor and texture, boiled in a pot (dhaba), and then washed with cold and hot water. After cleaning, carefully stuff into a conventionally made bamboo basket, covered with a layer of *Ficus* sp. (parelhei mana), and keep the temperature stable by covering tightly with heavy clothing or dry, clean woolen clothing. Lastly, either sun-dry the bamboo basket or place it next to the fire stove (phunga mei). A ready to eat properly fermented soybean can be obtained within 3–7 days. A pleasant smell or odor with a sticky fiber appearance is an indicator of high-quality fermented products. *Hawaijar* can be more savory when blended with salt and chili powder, sundried, and then stored in a plastic or glass container for 6–12 months. Figure 6(A) and Figure 6(B).

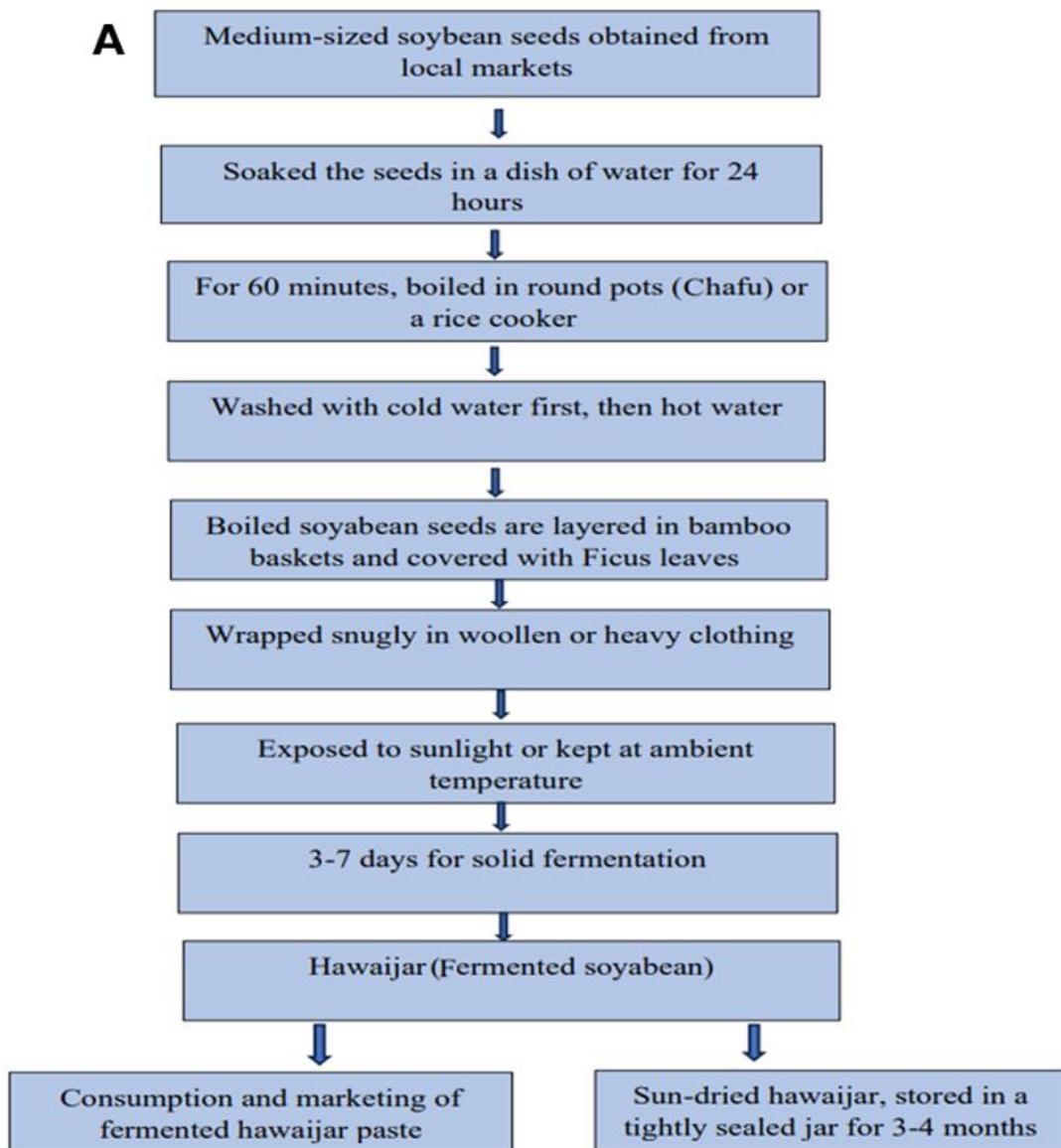


Figure 6(A). Flowchart showing the methods for the preparation of fermented soyabean-based foods (*hawaijar*) among Manipur's meitei-pangal community.



**Figure 6(B).** A photograph showing fermented soyabean products (*hawaijar*) of the meitei-pangal community.

#### 4. DISCUSSION

Methods of waste food processing and fermentation of foods by the meitei-pangal community of Manipur are mostly performed conventionally at various households and are distinct cases of food preparation through traditional knowledge passed over from generation to generation. In this study, seven diverse categories and methods of processing waste foods as well as fermentation of food products locally known as *Yongchak*, *chakring*, *ngari*, *hentak*, *soibum*, and *hawaijar*, which are traditionally practices of every family and frequently used on several occasions by the meitei-pangal community of Manipur, were studied. In this study, while surveying the varieties of traditional foods, an effort was made to document and explore the processing of waste food products and fermentation of foods from local stinky beans (*Parkia sp.*), cooked rice-based products, local fish (*Puntius sp.*), bamboo shoots (*Bambusa sp.*), and soyabean products by the meitei-pangal community of Manipur, India. The study revealed that for the processing of excess and wasted *yongchak* for reconsumption and long-term preservation, tender pods after peeling off and boiling for approximately half an hour were stored in clean plastic baskets and dried in the sun for 20 days (Figures 1A & 1B). Alternatively, the pods and seeds are separated, dried in sunlight until the seeds turn black color and then stored in a container. Finally, the dried beans are used for long-term storage. *Yongchak* is a popular food item in Manipur, particularly among the meitei-pangal community. The *yongchak* goes best with other strongly flavored foods, such as fermented fish (*ngari*) or vegetable salad.

For the processing of wasted cooked rice for the purpose of reconsumption and long-term preservation, semisolid cooked rice trash was prepared, placed in a large plastic tray or thin bamboo tray, and dried in sunlight for 10–20 days (Figures 2A and 2B). you can store the dried form of cooked rice in a jar for future use or consume it as a ground powder. Cooked rice powder can be consumed as a spicy concoction (*kupsu*) with chilli, fermented fish, and some salt. People mix rice powder with milk and water to form a round shape known as (*chak kabok*). Such traditional homemade preparations can boost the market economy and reduce food waste. In other traditional methods commonly employed by the meitei-pangal community for the reconsumption of wasted cooked rice, products, a unique recipe known as fried cooked rice (*chakring ngauba*) was prepared. In order to make dried cooked rice it is mixed with vegetable oils for 30 minutes in a fry pan and kept in a plastic-tight container (Figure 2A & 2B). The oldest practices for preserving fish, such as salting, curing, and smoking, are still used by other communities in the state. Previously, communities in the state fermented and stored some of them for a year as preserved food [38]. Homemade preparations can boost the market economy and reduce food waste. Variability in the wasted food materials, namely *yongchak* (*Parkia sp.*), *chakring ngauba* (dried rice-based products), and cereals is chiefly rummage-sale for the preparation of ethnic fermented or dried foods. However, the quantity and devising procedure for all these products differ across areas [39-41].

The fermentation methods of dried fish products “*Ngari*” by meitei-pangal Community are more and less similar to the fermentation processes of other communities in Manipur [39], except the sundried form of fish known as *ngakang* is extensively used as a preservation method and is stored in a jar combined with salts and

sesame oils as a pickled form (Figure 3A, 3B, and Figure 3C). Beef or meat also commonly uses this preparation method. *Ngari* is used after simmering and frying because of its traditional health benefits, specifically for gastritis, notably in adult women. Some of the ethnic fermented dried fish commonly practiced by the natives of the northeastern region of India are *Karoti*, *Tungtap*, *Sukuti* of Assam, Meghalaya, and Sikkim [42-44]. *Ngari* is widely popular in Manipur, especially among the Meitei-Pangal population. These fermented fish products are best when combined with flavor-mixed foods such as onion and chili powder; eromba as a whole consumed by mixing with boiled potatoes and vegetables is a local delicacy; dried fish (*nga akangba*) is crushed and mixed with vegetables such as onion leaves, ginger, and garlic leaves with a pinch of salt that is used in Manipur's meitei-pangal community as a common cuisine; seasoning and recently, a dried version of *phoubu nga* was successfully marketed in Manipur. In fish fermentation, the methods of preservation are traditionally used with cultural identity. In the meitei-pangal community, these arts of fermentation are handed down from generation to generation. Species such as *Lactococcus plantarum*, *Lactobacillus plantarum*, *Bacillus subtilis*, *B. pumilus*, and *Micrococcus sp.* and the fungal species *Candida sp.* have also been detected in *ngari* [19, 44].

*Hentak* is an indigenous fermented paste made from sun-dried *Esomus danricus* after crushing it in the form of a powder, mixing it with pieces of petioles, and fermenting for 14 days. The *hentak* prepared by the meitei-pangal community of Manipur is similar to *hentak* prepared by other communities of Manipur, as reported by Jeyaram, et al. [38], except the resulting paste is kept in a well-sealed pot made of clay for almost 2 weeks, and it is believed that if the resulting mixture is kept for thirty days, the *Hentak* ought to be a nutritious diet (Figure 4A & Figure 4B). Generally, two types of fish were used: *Ngasang* (balloon nga) and *Ngapemma* (fifteen nga), and it is thought that the *hentak* produced from these two types of fish by the meitei-pangal population of Manipur is the most delicious among them. The fermentation of bamboo shoot by the meitei-pangal community is similar in most of the steps, followed by other communities of Manipur, except that the highest quality *soibum* is produced in Keirak of the Kakching district and Kwakta of the Bishnupur district for the meitei-pangal community. The fermentation of bamboo shoots (*soibum*) involves several procedures, including plucking and trimming sensitive sprouts from their recessed areas, peeling the outermost epidermis while it is being washed, sawing and splitting, metabolizing inside pottery pots, and finally preparing. When the bamboo shoots reach approximately 60 cm in length, branches are sliced away from their primary stem. Bamboo shoots are then washed well before being diced or peeled into pieces and soaked for thirty minutes. Following stuffing, containers holding chopped or diced bamboo shoots are securely covered with polythene sheets for effective pressing. The meitei-pangal population of Manipur traditionally believed that they could dry and store good-quality *soibum* in a jar for one year for future use. *Soibum* can be stored for up to two years before being offered for sale (Figure 5A & Figure 5B). In Manipur, the Noney/kwatha type of fermented bamboo shoot fermentation is very popular, where the fermentation process is carried out in a chamber made and specially designed from bamboo along with a sheet of polythene. In another method of fermentation of bamboo shoots commonly practiced in the village of Andro in Manipur, fermentation is carried out in earthen pots using slices of bamboo shoots and incubation. In all types of fermentation, the duration of incubation is very important, as the longer the period of incubation, the higher the quality of fermented products [39]. *Ekung* or *Hirring* is a traditional fermented bamboo shoot in the state of Arunachal Pradesh. *Dendrocalamus hamiltonii*, *D. giganteus* Munro, *Bambusa balcooa*, *Bambusa tulda*, and *Phyllostachys assamica* are commonly used bamboo shoot species for this purpose. *Lactobacillus* species such as *Lactobacillus plantarum*, *L. lactis*, *L. brevis*, *L. casei* and *Tetragenococcus halophilus* are microbe species involved in this fermentation [42, 45].

Manipur prepares *Hawaijar*, a unique indigenous fermented food, from soybean. In *hawaijar* preparation, boiled soyabean seeds are tightly packed in a container with the leaves of banana plants [46]. Gunny bags pile up in the basket to maintain a high temperature for two to three days. Mucilage fibers along with ammonia flavor are indicators of the quality of fermented products of soyabean. The *hawaijar* preparation methods of meitei-pangal Community are similar to those reported by other communities of Manipur [38], except for fermentation

operations. Two distinct approaches are used by the Meitei-Pangal community of Manipur. An alternative method involves sun-drying the soybean throughout the season. The *hawaijar* is prepared for intake after around three to four days in the refrigerator. *Hawaijar* is well known for its unique characteristics. It has a distinct flavor and aroma and has long been a favourite dish of Manipur's meitei-pangal population. It can be consumed directly with vegetables or mixed vegetables such as eromba, a special delicacy, or it is prepared with fermented fish paste, mixed chilli powder, and some spicy leaves with a pinch of salt to taste (meitei-pangal cuisine), mixed salad (*hawaijar singju*), deep fried *hawaijar*, or *hawaijar* is fried along with eggs. People sometimes consume it in pickle form. It improves both the appearance and the flavor (Figure 6A & Figure 6B). The *Khasi* tribe of Meghalaya, India, also prepares *tungrymbai* from soybean (*Glycine max* (L.) Merrill)-based fermented food, which is quite popular in the region [43, 46, 47]. This fermented food is sticky and has a good flavor and acts as an inexpensive source of protein for the masses. In the *tungrymba*, *Bacillus subtilis* and *Enterococcus faecium* are the bacterial species recorded, while *Candida parapsilosis*, *Saccharomyces bayanus*, *Saccharomycopsis fibuligera* and *Geotrichum candidum* are the fungal species detected [43, 44, 48-50].

## 5. CONCLUSION

The present study shows that the Pangals community of Manipur favors fermented food products in their regular regime; however, scientific data and studies on the conservation and preservation of fermented food products are very necessary. Hence, a research investigation was completed on the preservation and processing permanency of certain fermented food products and found that they can be preserved for months to years without influencing taste, flavor or texture. Wide-ranging research is essential to putting effort into exploring and documenting new scientific knowledge of the health benefits of fermented food products in local villages, and additional nutraceutical potential and metabolome studies will be more advantageous. Innocuous food delivers basic social requirements. It supports the state's low-cost economy, trade, and leisure industry, subsidizes diet safety, and supports sustainable development. Worldwide development has led to growing economic demand for a wide-ranging diversity of diets, followed by gradually intricate and longer universal food links. As the social population increases, the rise and economic growth of agronomy and animal production to satisfy rising food demand presents both opportunities and difficulties for food safety. The role of fermented foods in diet and nutrition is crucial, and their value is indisputable. There are many benefits associated with traditional fermented foods, such as increased storage life, deliciousness, and nutrient value, suggesting the importance of these food products. Many substances in fermented foods may have health-promoting nutrients and various related microbes. These substances may exert positive and negative impacts on the well-being of distinctive individuals and populations, and their success and security require item-by-item practices. Indigenous practices of traditional fermented foods or food waste processing methods of the meitei-pangal community of Manipur namely *Yongchak*, *chakring*, *ngari*, *hentak*, *soibum*, and *hawaijar*, are vital food processing, fermentation and preservation methods that can be carried out on industrial scales. Fermented foods play an important role in economics in developing countries. These foods have fascinated people all over the world as food that might promote longevity, both traditional and cultural. It is also possible to obtain a large variety of different food products, and there is a need for intensive multi-institutional collaborative research. Food production technique that decreases processing or fermentation duration, health risks, and uniform quality in packed form. Value-added product development through microorganism selection and genetic improvement, process improvement, food waste, natural resource enhancement, and other factors will lead to the industrialization of these food products. A rising number of recent scientific studies have described the good effects of fermented foods on numerous aspects of human health and disease via diverse pathways. The development of innovative fermented foods, which could be marketed at a reduced price. Such an endeavour is predicted to have a good impact on the health and welfare of the meitei-pangal community, particularly the low-income group in India's Manipur states and needs to undergo more research in order to preserve such healthy foods.

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**Transparency:** The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

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