Article ID 240202073

Fermented Foods and Their Healthful Legacy: Exploring the Richness of North-Eastern India

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Abstract

Fermentation is a conventional technique for preserving food and is extensively employed to enhance food safety, extend shelf-life, and improve the sensory and nutritional qualities of food. The region of NE India is characterized by its rich cultural diversity and the traditional customs practiced by the indigenous tribal communities residing in the area. These tribal tribes have a long-standing tradition of practicing the technique of fermenting foods, which is an integral aspect of their culture and heritage. Research conducted in recent decades has revealed the possible health advantages and medicinal qualities associated with certain fermented foods. These fermented foods provide economic sustenance to those who prepare and sell them locally in rural markets.

Introduction

The North-Eastern (NE) area consists of eight states: Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. Around 225 tribes out of the 450 tribes of India reside in this region. NE India comprises approximately 8% of the total land area of India and is home to nearly 40 million people, or 3.1% of the total population of India. Fermentation is a time-honored and cost-effective method utilized to maintain the safety and quality of foods while also contributing essential minerals, bio-nutrients, and flavor and aroma enhancement. The native communities of the NE states ferment locally sourced foods such as soybeans, bamboo shoots, fish, meat, and cereals (Das *etal.*, 2012). In the NE states of India, over 250 distinct varieties of familiar and unfamiliar ethnic fermented foods and alcoholic beverages are prepared and consumed (Fig. 1). Ethnic fermented foods of NE India are categorized and named based on the basic materials such as fermented soybean and non-soybean legume, fermented vegetable (anishi, goyang, khalpi, gundruk, sinki, ziang-sang/ziang-dui), fermented bamboo shoot (soibum, mesu, ekung, eup, hirring), fermented soybean foods (kinema, hawaijar), fermented smoked fish (shidal, tungtap, ngari, hentak, gnuchi) and fermented beverages (Sekhmai Yu, kodo ko jaanr, zawlaidi, zutho, chuwak).

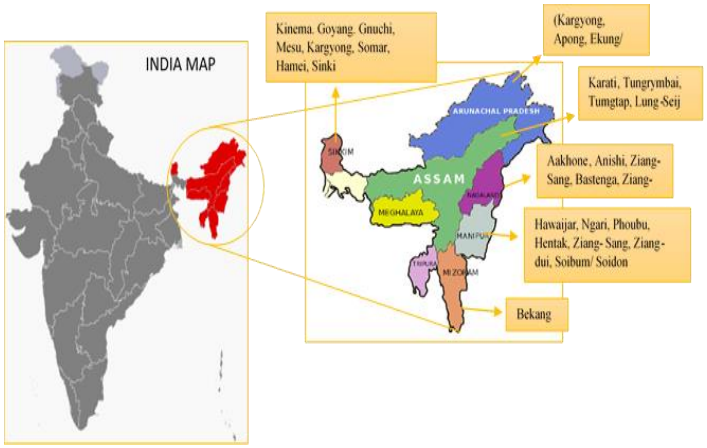

Fig. 1. The fermented foods of the North-Eastern states of India are depicted on this map

Ethnic fermented food products of North-Eastern India

Fermented vegetables-based products

Gundruk is an indigenous fermented vegetable product that originates from the Himalayan region of Nepal. Typically, it is prepared from October to December, when there is a plentiful supply of perishable verdant vegetables. The fermented vegetable products in question consist primarily of mustard leaves (*Brasicca juncea*), radish (*Raphanus sativus*), rayo-sag (*Brassica juncea*), and cauliflowers (*Brasicca oleracea*) that are grown locally. Gundruk preparation has been found to harbor an assortment of microorganisms, including *L. plantarum, L. paracasei,*

Leuconostoc fallax, Lactobacillus brevis, Pediococcus pentosaceus, and *P. acidilactici* [2].

Sinki vegetable by-product is a fermented product derived from radish (*Raphanus sativus* L.). It is a product indigenous to Sikkim, Darjeeling, and Nepal. Primarily, it is prepared during the winter months, when vegetable supplies are abundant and the climate is least humid. The fermentation process is accompanied by the presence of *Lactobacillus plantarum, L. Fermentum,* and *L. brevis* microorganisms [3].

Ziang-sang, often referred to as *ziang-dui*, is a leafy vegetable product. It is primarily located in Nagaland and Manipur. Primarily, the Naga women undertake the processing of the product, which is thereafter sold in local marketplaces. The microorganisms responsible for the fermentation of the substrate are *Pediococcus acidilactici, Lactobacillus plantarum*, and *L. Brevis* [2].

Goyang is a fermented product derived from the leaves of the natural plant *Cardamine macrophylla* Willd., commonly referred to as *Magane saag*. This substance is particularly well-known among the Sherpa tribe living in the Darjeeling and Sikkim districts of West Bengal. *Lactobacillus plantarum, Enterococcus faecium, L.brevis, Lactococcus lactis,* and *Pediococcus pentosaceus* are the fermenting bacteria that participate in the process [4].

Fermented fish-based products

One of the most important components of the Manipuri people's diet is *ngari*, which is a fermented fish product. *Puntius sophore*, often referred to as *Phoubunga* in the local language, is the species of fish that is utilized in the creation of this dish. *Bacillus subtilis*, *B. pumilus*, *Lactococcus plantarum*, *L. plantarum*, *Miocrococcus* sp., and *Candida* sp. have been identified as the microorganisms that are considered to be related with this condition [5].

Tungtap is the fermented fish product which is very popular in Meghalaya *khasi* tribe people. It is mainly procured at household of villages and sold to the markets of Meghalaya. The microorganisms associated in this fermented fish product are *Lactobacillus coriniformis, L. fructosus, L. lactis, Bacillus cereus, B. subtilis, Saccharomycopsis* sp., and *Candida* sp. [6]. For its preparation, the *Puntius sophore* fishes are used.

Gnuchi is a smoked and dried fish product which is generally consumed by the *Lepcha* tribe peoples of Sikkim. In *Lepcha* language, *Gnuchi* is also called as smoked fish. It is mainly prepared by the rural tribe people which also serve as a valuable source of protein in the local diet. The microorganisms associated in this type of smoked fish product have been identified as *Pediococcus pentosaceus, Enterococcus faecium, Micrococcus* sp., and *Bacillus subtilis* [7].

Hentak is the traditional fermented fish product procuring in Manipur and sold generally in the form of paste. The microbes used to make *hentak* have been identified as *Lactobacillus fructosus, L. amylophilus, Enterococcus faecium, Bacillus cereus, B. subtilis, Enterococcus faecium, Staphylococcus aureus,* and *Candida* sp.[5].

Fermented bamboo shoot-based products

The Darjeeling hills and Sikkim tribal limbo women who are members of the Nepali community are the ones that produce *mesu*, which is a traditional product that is prepared from fermented bamboo shoots. *Mesu* is crafted from bamboo species that are readily available in the area, including choya bans (*Dendrocalamus hamiltonii*), bhalu bans (*Dendrocalamus sikkimensis*), and karati bans (*Bambusa tulda*). The microorganisms that have been discovered as being related with this condition are *Lactobacillus plantarum, L. brevis,* and *L. pentosaccus* [8].

Eup is a fermented foodstuff that is derived from bamboo shoots and hails from the state of Arunachal Pradesh. After being sliced into pieces, the bamboo shoots are fermented using a technique that is quite similar to that of *ekung*. The *eup* is then chopped into pieces and sun-dried for a further five to ten days, which causes the color to shift from a whitish to a chocolate brown. This process takes place after the fermentation period of one to three months. Both *L. plantarum* and *L. fermentum* are considered to be the most important bacteria involved with the *eup* [9].

Ekung is a fermented product that is made from bamboo shoots. The people of Arunachal Pradesh are the ones that produce and drink it the most consistently. After the bamboo shoots have been

chopped, they are placed into the bamboo basket, which is then covered with the leaves and secured for a secure closure. A hole measuring three to four feet in height is created for the stored basket, which is then lined with leaves. In order to remove any extra water from the basket, the heavy load is placed within, and then a period of time ranging from one to three months is allowed to pass before the fermentation process begins. *L. plantarum, L. casei, L. brevis,* and *Tetragenococcus halophilus* are the most prominent microorganisms that may be found in the *ekung* [9].

Fermented soybean-based products

Hawaijar is the fermented soybean product and it is the local product of Manipur. It has the good flavour and sticky in nature. It is considered as protein source food at low-cost to common people. *Hawaijar* is also considered as potential source of anti-osteoporosis, anti-cancer, and hypocholesterolemic agent. A special Manipuri dish called *chagempomba* is also made from *hawaijar* along with rice and other vegetables [10].

Kinema is an ethnic fermented dish that is mostly manufactured and consumed in the states of Sikkim, Darjeeling, and Nepal, which are located in the northeastern area of India on the Indian subcontinent. This substance has a sticky consistency, a gray color, and high flavonoid content. *Kinema* is a source of income for those living in the Eastern Himalayas and it is consumed as a curry served alongside steamed rice as a supplementary dish. *Bacillus sphaericus, B. licheniformis, B. circulans, B. cereus, B. subtilis,* and *B. thuringiensis* are the microbes that are most frequently discovered [11].

Fermented beverage-based products

Sekhmai Yu is a popular cereal-based fermented beverage in the Indian state of Manipur. They prepare it using locally sourced Manipuri rice varieties such as *Moirang Phou, Kumbi Phou,* and *KD Phou*. A quantity of 5-6 kilograms of Manipuri rice is gathered and prepared by cooking it in pots made of aluminum. Afterward, the rice is allowed to cool down to be combined with *Hamei*, with a recommended ratio of 40-50 grams per kilogram of rice. This mixture is then left to ferment. *Hamei* is produced by immersing 3-4kg of white rice in water for 1.5 hours and thereafter drying it to eliminate its moisture content. The dried rice is ground into a powder, which is commonly referred to as Yam in the local language. The Yam is combined with the powdered extract of the *Yanglee* plant (*Albizia Myriophylla* Benth). Following the mixing process, a paste-like substance known as *Hamei* is produced. The *Hamei* and cooked rice mixture is transferred to a dry pot, with the pot's opening covered by a clean cloth. It is then left in the sunshine for a period of 3-4 days. During the winter season, the mixture is placed in a bamboo basket and wrapped with leaves from the *Fiscus hispide* L, *Tectona grandis* L, and *Musa paradisica* L plants [12]. This wrapping facilitates the fermentation process. At the final stage of production, this product exhibits a range of tastes, including alkaline, bitter, and sweet.

Zawlaidi is a renowned beverage made from fermented fruits in Mizoram. Primarily composed of black grapes. The collected grapes are sundried, washed, and cleansed to remove any excess moisture. Dried Quercus serrate Murray bark is gathered and utilized as the fermenting agent in the preparation of *Zawlaidi* [13]. The fermentation period for the preparation of *Zawlaidi* is four to five days. Once the fermentation is complete, the mixture is filtered and disposed of. Alcoholic contents ranging from 11% to 14% were detected in *Zawlaidi* wine.

Health benefits of fermented foods

As a biological process, fermentation helps keep food fresh for longer. When these foods are enhanced with antimicrobial by-products such as ethanol, bacteriocins, and organic acids, they pose less of a threat of contamination. When foods are fermented, they take on flavors and textures that are different from what was originally there. This is one of the many benefits of fermented foods. Additional qualities beyond basic nourishment can be provided by the outcomes of fermentation, especially by the involvement of bacteria. Although there has been no recorded clinical data, fermented foods have been suggested to provide health benefits in inflammatory bowel disorders and other immune-related pathologies such as sclerosis and arthritis.

Fermented foods safety

Fermented foods typically exhibit a commendable safety track record, especially in regions with limited resources where individuals lacking expertise in microbiology or chemistry produce these meals in unsanitary and polluted conditions. These products are used daily by a vast number of individuals worldwide, including both developed and developing countries and they have a very commendable safety track record. Fermented foods are generally safe, but it is important to recognize that they do not address the issues of contaminated drinking water, environments with high levels of human waste, inadequate personal hygiene among food handlers, disease-carrying flies, unfermented foods that may cause food poisoning or contain human pathogens, and unfermented foods that, even when cooked, can become unsafe if mishandled or stored improperly [14].

Conclusions

NE Indians are familiar with fermented food production and consumption. Traditionally, fish, bamboo shoots, soybeans, and indigenous vegetables were used to ferment food. The NE weather is ideal for fermented foods. The researchers want to standardize ethnic food production. This requires selecting highly productive microbe strains, optimizing processes, selecting raw ingredients, and conducting probiotic investigations. Commercial fermentation food processing, packaging, and marketing units will be needed in the future. This will extend product shelf-life and boost rural economies. Future research should examine ethnic food bioactive compounds' health advantages.

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