Traditional Fermented Foods

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1. Introduction

Traditional fermented foods are popularly consumed and form an integral part of our diet since early history. It can be prepared in the household or in cottage industry using relatively simple techniques and equipments. Fermentation is one of the oldest and most economical methods of producing and preserving food. In addition, fermentation provides a natural way to reduce the volume of the material to be transported, to destroy undesirable components, to enhance the nutritive value and appearance of the food, to reduce the energy required for cooking and to make a safer product.

Since the age of civilisation, methods for the fermentation of milks, meats, vegetables and cereals have been described. The earliest records appear in the Fertile Crescent (Middle East) and date back to 6000 BC. Of course, the preparation of these fermented foods and beverages was in an artisan way and without any knowledge of the role of the microorganisms involved. However, by the middle of the nineteenth century, two events changed the way in which food fermentations were performed and the understanding of the process. Firstly, the industrial revolution resulted in the concentration of large masses of populations in towns and cities. As a consequence, food had to be made in large quantities, requiring the industrialisation of the manufacturing process. In the second place, the blossoming of Microbiology as a science in the 1850s formed the biological basis of fermentation, and the process was understood for the first time. Ever since, the technologies for the industrial production of fermented products from milk, meat, fruits, vegetables and cereals are well developed and scientific work is actively carried out all over the world.

India is traditionally rich in fermented foods. In the Indian sub-continent, fermented food using local food crops and other biological resources are very common. But the nature of the products and base material varies from region to region. Fermented foods such as idli and dahi were described as early as 700 BC. At present, there are hundreds of fermented foods with different base materials and preparation methodology. Each fermented food is associated with a unique group of microbiota, which increases the level of proteins, vitamins, essential amino acids and fatty acids. However, fermented foods are still produced traditionally by spontaneous fermentation and only limited knowledge has been obtained regarding the microbiota of these products.

The preparation of many indigenous or traditional fermented foods and beverages remains today as a house art. They are produced in homes, villages and small-scale industries. On the contrary, the preparation of others, such as soy sauce, has evolved to a biotechnological state and is carried out on a large commercial scale. In the distant past, there was no verified data on the economic, nutritional, technical and quality control implications of the indigenous fermented food. However, in the last 20 years, the number of books and articles dealing with indigenous fermented beverages and foods found around the whole world have rapidly

increased. In this context, this topic aims to summarize the types and production processes of some of the most common traditional fermented foods used in India.

2. Cereal based fermented foods of India

Cereal grains constitute a major source of dietary nutrients all over the world. Although cereals are deficient in some basic components (e.g. essential aminoacids), fermentation may be the most simple and economical way of improving their nutritional value, sensory properties, and functional qualities. In view of this, cereals have been chosen as raw materials for the production of fermented foods. Some of the commonly used traditional fermented foods are as follows.

- **Idli**

  A fermented, thick suspension made of a blend of rice (*Oryza sativum*) and dehulled black gram (*Phaseolus mungo*) is used in several traditional foods in Southeast Asian countries. Among them, idli and dosa are very popular in India and Sri Lanka. Traditionally, for idli preparation the rice and black gram are soaked separately. After draining the water, rice and black gram are grinded independently, with occasional addition of water during the process. The rice is coarsely ground and the black gram is finely ground. Then the rice and the black gram batters are mixed together (2:1 ratio) with addition of a little salt and allowing to ferment overnight at room temperature (about 30 ºC). Finally, the fermented batter is placed in special idli pans and steamed for 5–8 min.

  The lactic acid bacteria *Leuconostoc mesenteroides*, *Streptococcus faecalis*, *Lactobacillus delbrueckii, Lactobacillus fermenti*, *Lactobacillus lactis* and *Pediococcus cerevisiae* have been found to be responsible for the fermentation process, although *L. mesenteroides* and *S. faecalis* are considered to be the microorganism essential for leavening of the batter and for acid production in idli. The yeasts *Geotrichum candidum*, *Torulopsis holmii*, *Torulopsis candida* and *Trichosporon pullulans* have also been identified in idli fermentation. Fermentation of idli batter appears to have a significant effect on the increase of all essential amino acids and in the reduction of antinutrients (such as phytic acid), enzyme inhibitors and flatus sugars.

- **Dosa**

  It is very similar to idli batter except that the rice and black gram are finely ground and that the fermented suspension instead of being steamed is heated with a little oil, on a flat plate. A dosa suspension is prepared by grinding wet rice and black gram separately with water. The two suspensions are then mixed and allowed to undergo natural fermentation, usually for 8–20 h. To make a dosa, the fermented suspension is spread in a thin layer (of 1–5 mm thickness) on a flat heated plate, which is smeared with a little oil or fat. A sol to gel transformation occurs during the heating and within a few minutes, a circular, semi-soft to crisp product resembling a pancake, ready for consumption is obtained. The microbiological, physical and biochemical changes of dosa during fermentation and its nutritive value are quite similar to idli.

- **Dhokla**

Dhokla is also similar to idli except that Bengal gram dhal is used instead of black gram dhal in its preparation. A mixture of rice and chickpea flour is also used as the substrate for the fermentation. As in idli preparation, the fermented batter is poured into a greased pie tin and steamed in an open steamer. As in other indigenous fermented foods, a significant improvement in the biological value and net protein utilisation of dhokla due to fermentation has been reported.

- **Koozhu**

  Koozhu is the Tamil name for porridge made from millet. Finger millet, a traditional South Indian weaning food, is also consumed in the fermented form, as koozhu in rural and urban households. Koozhu is made from Kezhvaragu or Cumbu flour and broken rice in a mud pot. Koozhu is consumed as a breakfast and during festival time by the rural population. Koozhu is easily digested and it cools the body; therefore, during summer street vendors sell it as a cool drink in South India.

- **Appam**

  Appam is a type of pancake made with fermented rice batter and coconut milk. It is a common food in the South Indian state of Kerala. It is also popular in Tamil Nadu and Sri Lanka. It is eaten most frequently for breakfast or dinner.

- **Fermented rice or Pazhaiya soru**

  Fermented rice or Pazhaiya soru is prepared by adding water to cooked rice and by incubating the mixture overnight, and finally adding buttermilk and salt and directly consumed. It is an early morning diet for farmers prior to going to the field. Predominant microbiota isolated from these foods include: *Lactobacillus fermentum, L. plantarum, Enterococcus faecalis, Pediococcus acidilactici, P. cerevisiae, L. mesenteroides*.

- **Cereal-based fermented sweets and snacks**

  These foods are consumed mostly during festival times and other special occasions. Wheat, rice and barley flours are predominantly used cereals. Sugar or salt is added compulsorily in the fermented foods mentioned in this category, in jilebi and selroti, sugar as high as 25% is added. These foods select only those microbes which can survive low water activity. Fermented sweets and snacks are popularly consumed throughout India.

3. Vegetable based fermented products

Many different forms of vegetables are fermented and preserved by the tribal people of India.

- ***Gundruk***

  Gundruk is a fermented vegetable product indigenous to the *Nepali* people of the Himalayan region. It is commonly prepared during winter i.e, October to December, when perishable leafy vegetables are plenty. These vegetables are mainly leaves of mustard (*Brasicca juncea*), *rayo-sag* (*Brasicca rapa*), cauliflowers (*Brasicca*

oleracea), radish (*Raphanus sativus*) and some other locally grown vegetables. The microorganism predominantly occurring in *gundruk* have been identified as *Lactobacillus brevis, L. plantarum, L. paracasei, Pediococcus pentosaceus, P. acidilactici* and *Leuconostoc fallax*.

For its fermentation, fresh leaves of the selected vegetables are first wilted and shredded using a sickle or knife. These are then crushed mildly and pressed into an earthen pot. The container is then made air tight and left to ferment naturally at room temperature for about 7 to 10 days. After the incubation period the leaves takes a mild acidic taste which indicates the completion of fermentation. The *gundruk* is then removed and sun dried for 3 to 4 days, which helps in storage. *Gundruk* is sold in all the local markets of Darjeeling hills and Sikkim by the *Nepali* women. It is eaten as a soup or pickle. The soup which is prepared after mixing *gundruk* with certain ingredients serves as a good appetizer

- ***Sinki***

  This is a form of fermented radish (*Raphanus sativus* L.) tap root and is consumed by the *Nepalis* in Darjeeling, Sikkim and Nepal. It is prepared during the months of winter when weather is least humid and there is ample supply of this vegetable.The microbes associated with its fermentation have been identified as *Lactobacillus plantarum, L. brevis* and *L. fermentum*.

- ***Ziang-sang/ Ziang-dui***

  This is a fermented leafy vegetable product which is common to both the states of Manipur and Nagaland. It is produced dominantly by the *Naga* women and sold in the local markets. The microbes associated have been identified as *Lactobacillus plantarum, L. brevis* and *Pediococcus acidilactici*.

- ***Goyang***

  The *Sherpa* tribe belonging to the state of Sikkim and hills of Darjeeling prepare this fermented product from leaves of the wild plant *maganesaag* (*Cardamine macrophylla* Willd.). Samples have been found to contain the species *Lactobacillus plantarum, L. brevis, Lactococcus lactis*, *Enterococcus faecium* and *Pediococcus pentosaceus.*

- **Fermented Bamboo shoot**

  This is another fermented product which is extensively used in the states of North-East India and bears resemblance to *jiang-sun* and *kardi* in Orissa. It is mainly used as a taste enhancer and flavour provider. Many varieties of bamboo are used separately by the different tribes using their own traditional techniques.

  Soibum/ Soidon are fermented bamboo shoot products and are indigenous foods of the state of Manipur. They are consumed as an indispensible part of the *Manipuri* diet and are familiar with the social customs of the people. *Soibum* is produced exclusively from succulent bamboo shoots. The organisms found to be associated with the fermentation of *soibum* have been identified as *Lactobacillus plantarum, L. brevis, L.*

coryniformis, L. delbrueckii, , L. lactis, Leuconostoc falllax, L. mesentroides, Enterococcus durans, Streptococcus lactis, Bacillus subtilis, B. licheniformis, B. coagulans, and the yeasts.

- **Khalpi**

Khalpi is a cucumber product of the state of Sikkim and Darjeeling hills. It is generally prepared for home consumption by the *Nepali* Brahmins belonging to the *Bahun* and *Chettri* castes. Microbes associated with its fermentation have been identified as *Lactobacillus plantarum, L. brevis* and *Lecuonostoc fallax.* For preparation of *khalpi,* mature and ripened cucumbers are cut into definite sizes and sundried for 2 days. They are then put into bamboo vessels called *dhungroo* and sealed. Fermentation is allowed to take place for 4 to 7 days at room temperature. The product can be stored for about a week in an air tight container. It is taken as a pickle after mixing with mustard oil, chillies and salt.

- **Fermented beans**

Fermented foods made from legumes constitute an important part of the human diet in many developing countries, including India. Fermented soybean products have been reported to be used extensively in almost all the states of North-East India.

Kinema is a soybean based fermented food. The soybean (*Glycine max*) is locally known as *bhatmas* and the varieties used are "yellow cultivar" and "dark brown cultivar". It is produced individually or on household level and sold in the local markets. It is extensively prepared by the *Nepalis* belonging to the *Limboo* and *Rai* castes of Sikkim.

Hawaijar Produced in the state of Manipur, *Hawaijar* is a sticky fermented soybean product.

Aakhone/ Bekang / Peruyyan: These are all fermented soybean products and known by different names among different tribes. They are prepared from soybean. Lactic acid bacteria, *Bacillus subtilis* and other *Bacillus* species have been found in these samples.

4. Milk-based fermented foods

Milk and milk-based products are consumed most popularly due to their nutritive value. Most of the foods in this category are prepared by simply adding lactic acid bacteria to milk of either cow, buffalo or yak and allowed to ferment. One such fermented food is dahi, its description is found in texts as old as 700 BC. Dahi or curd is most popular and commonly used traditional Indian fermented product. Dahi differs from yogurt in its use of mixed starters of mesophilic lactococci. A principal flavour-inducing metabolite is diacetyl, which is appreciated more by people of South Asian origin compared to the acetaldehyde flavour in yogurt.

- **Kadi, Churpa/Churpi and Nudu**

In Himachal Pradesh, traditional milk based products are prepared from the milk of several species of indigenous cattle, buffalo, sheep, goats, and churu (hybrid of cow and

yak). Kadi is prepared by simmering a mixture of chaa/buttermilk, besan/gramflour and spices. Buttermilk is boiled, then water is discarded and solids are dried hard which later used to prepare soups called churpa or churpe. Nudu is a ceremonial food prepared by cooking wheat flour in milk with small amount of salt and is eaten with ghee.

- Shyow is a thick gel curd like product, prepared from yak milk.
- Mohi is buttermilk, prepared by churning dahi. It is consumed as a refreshing beverage.
- Somar is a soft paste, strong flavoured with bitter taste and is consumed as soup along with cooked rice or finger-millets by the Sherpas of Sikkim.
- Philu is a typical indigenous cream-like milk product obtained from cow milk or yak milk and is mostly eaten as a cooked paste delicacy with boiled rice by the Sikkimese.

4.b Meat-based fermented foods.

In India, people of the North-eastern region ferment meat of yak, goat, pig, fish and crab for preservation for longer period. Kargyong is an ethnic sausage-like fermented product prepared from yak, beef and pork.

Fermented fish products are important dietary components in the protein deficient South-East Asia. Preservation of fish by salt is an age-old technology. Hentak is a ball-like paste prepared by fermentation of a mixture of sun-dried fish (Esomus dandricus) powder and petioles of aroid plants (Alocasia macrorhiza) in Manipur. Tungtap is a fermented fish paste, commonly consumed by the Khasias tribes of Meghalaya in the North-eastern state of India. Dry fish (Danio spp.) is mixed with salt, kept in an earthen pot and fermented for 4–7 days. It is consumed as pickle.

Lactobacillus lactis subsp. cremoris, Lactococcus plantarum, Enterococcus faecium, Lactobacillus fructosus, L. amylophilus and L. corneformis are predominant LAB species reported in fermented meat based products.

5. Traditional health benefits of fermented foods

Indian fermented foods are consumed by the local population not just as a diet but as traditional medicine too. Many of the foods were observed to have beneficial effect during ailment by the local people and they are used as a special diet or medicine for ages. Fermented food idli is easily digested and often used as food for infant and invalids. It is a prescribed diet in the hospitals for patients undergoing treatment. Koozhu is included in the daily diet of rural and agricultural workers and is claimed to be a nourishing health food. There is an increase in thiamine, riboflavin and niacin contents during its fermentation. Koozhu is given to children at weaning age. Fermented milk dahi can be used to cure intestinal disease such as diarrhea.

Certain fermented vegetable products (gundruk, sinki, Kanjika and Iromba) are said to be good appetizers, and the ethnic people use these foods for remedies from indigestion. Bhutia women use gundruk soup and give it to breast-feeding mothers to improve milk efficiency. It is considered as a tonic for old age people. Fermented radish root pieces are called sinki. It is very effective in curing diarrhea and stomach pain, and is consumed mostly during lean period. Iromba is prepared from tree bean (*Perkia roxburgii*) and is considered an appetizer. Fermented rai helps in curing stomach pain and gas trouble, and significantly improves digestion. Kanjika or kanji is a lactic fermented rice product. It has been prescribed for a number of chronic diseases

by Indian ayurvedic practitioners. Carrot Kanji is considered to have high nutritional value and cooling and soothing properties. Beetroot kanji is considered to have potential to prevent infection and malignant disease. Most of the health benefit claims for these traditional fermented foods based on traditional belief, hence there is a scope to conduct scientific survey and experiment-based research to prove these claims.

Conclusion:

Indian fermented foods are diverse due to diversity in India's culture and food habit. Consumption of some of the fermented foods has medicinal properties such as appetizing, relief from diarrhoea, constipation, stomach pain and gas trouble; it also prevents plaque, infection and malignant diseases. Besides, they have cooling and soothing effect when consumed during summer.