CHAPTER 5

Traditional preserved and fermented foods and their nutritional aspects

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Contents

5.1 Introduction

India is rich in natural resources and has been known for its diverse culture and traditions since historical times. India is also known for its amazingly diverse food culture and culinary practices. Ethnic foods can be of three major types. Foods that are cooked using variety of cooking practices and consumed fresh, traditionally preserved foods for better flavors, aroma and long shelf life, ethnic fermented foods that give diversity as well as nutritional superiority to the product. Indian traditional foods, both fermented and unfermented, constitute the main component of daily diet giving diversity as well as ensuring the nutritional requirements of the individual. Food preservation has been in practice for many centuries spanning to early civilization (Tamang and Samuel, 2010). Preservation gives an opportunity to extend the shelf life of perishable as well as seasonal raw materials and also gives an opportunity to make a regional product to be transported to far-flung areas. Ancient food preservation methods are still practiced in India at the household as well as at the local level. These are practiced by using the traditional knowledge passed through generations. Traditionally, drying, pickling, dry salting, smoking, and fermentation are carried out to preserve all types of plant and animal resources such as fruits, vegetables, cereals, pulses, milk, fish, and meat. Fermentation is one of the oldest food-processing methods used since ancient time initiated either by the spontaneous and back-slop process. Asia in general and India, in particular, is home to a wide variety of traditional

Nutritional and Health Aspects of Food in South Asian Countries
DOI: https://doi.org/10.1016/B978-0-12-820011-7.00006-X

fermented foods. Fermented foods are known to give diversity, improve nutritional value, reduce antinutritional substances, and, more importantly, are known to be the sources of crucial probiotics (Tamang, 2010). Food preservation practices vary from region to region with the same substrate or with smaller variations in the raw materials used. This chapter focuses on traditional food preservation methods with respect to historical background, culture and traditions, and diversity as well as nutritional and health benefits.

5.2 Historical overview

Indian agriculture has been traditionally nonintensive and organic. Indian traditional and religious texts gave the highest importance to culinary aspects of food and also have linked the food and health, evidenced by documents such as *Nala's Pakashastra* and Indian system of medicines such as *Siddha*, where food is used as a principle for treating diseases (Sarkar et al., 2015).

Different preservation methods are employed during the ancient time to preserve perishable and seasonal foods by using simple methods. Postharvest processing and preservation have been minimal, limiting to drying, storage and manual milling of cereals and millets, manual processing of pulses, cold processing of oilseeds, and drying and pickling of vegetables and fruits. Indigenous structures such as *Bakhara* (made of wood), *Kanaja* (made of bamboo), *Kothi* (made of clay, wheat straw, and cow dung), *Sanduka* (wooden box storage structure), earthen pots, and *Gummi* (bamboo and mud-based structure) are used traditionally for storing and preserving the food grains since ancient period. These structures are made using locally available materials such as mud, bricks, cow dung, paddy and wheat straw, reeds, wooden logs, and bamboo sticks. Storage structures are constructed in various sizes and shape according to their region, climatic conditions, and function (Mann et al., 2016). Hand pounding is used for cereals and millets, which are known to preserve most of the essential nutrients. Since ancient times, parboiling of rice has been carried out in Southern India by steeping the paddy in hot water, steaming, drying until suitable moisture and milled. Traditionally, *Ghanis* (crude oil extracting equipment) is used for extracting the oil from oilseeds, and the *Kachighani* oils (crude oil extracted using *Ghani*) are considered to be rich in functional elements such as fatty acids and vitamins (Achaya, 1994). Interestingly, most of the traditional methods are coming back owing to their retention of nutrients and flavors.

Fermentation is one of the widely used traditional strategies for processing and preservation and also to bring diversity to the food products. Since ancient times, earthen pots are used for the fermentation process, as it imparts a unique flavor and texture to the fermented food (Samanta et al., 2011). During 6000−4000 BC period onwards, the usage of *Dahi* (homemade yogurt), fermented milk, which is recorded in Hindu's sacred books such as *Rig Veda* and *Upanishad* (Aiyar, 1953), is in practice. In 3000 BC, wide usage of buttermilk and butter are recorded in *Bhagavad-Gita* and

Vaishanavik literature. *Idli*, a popular fermented rice-black gram-based food of South India is cited by the poet Chavundaraya (during 1025 AD) (Iyengar, 1950). Another similar cereal–pulse-based food, *Dhokla*, the popular fermented breakfast food of Northern India prepared with rice and Bengal gram dhal is stated as early as 1066 AD (Prajapati and Nair, 2003). In Tamil Sangam literature from India during the sixth century, *Dosa*, a cofermented product of rice and dhal, is mentioned (Srinivasa, 1930). These citations take back the histological origin of some of the traditional fermented foods.

5.3 Culture and traditions

History of Indian civilization and religious texts such as the *Bhagavad-Gita, Ramayana*, and *Manusmriti* provide information that food culture forms an integral part of cultural heritage. India has one of the most divergent historic civilization rich in diversities of cultures and traditions. Variations are documented in customs, languages, cultural practices, ethnic wear, festive celebrations, food, and cuisine from region to region throughout the country. The beauty of India also lies in diversity in ethnicity and rich food culture (Asrani et al., 2019). It is well known for wide diversity for food culture including ethnic foods, traditionally preserved foods, ethnic fermented foods, and beverages (Rao et al., 2005; Sekar and Mariappan, 2007). Consumption of traditional foods is also in practice for many thousands of years even though the method of preparation varies from region to region. Religious ethnic foods play an important part in Indian food culture through a close link between traditional foods and religious festivals. Each ethnic group, as well as the religious subset, follows unique traditional food habits closely linked to the religious customs. Various environmental factors, availability of raw materials, geographical location, and preference to the food make the Indian ethnic food unique (Kwong and Tamang, 2015). There are specific traditional foods for different seasons, different health conditions, and age groups.

5.4 Traditional food preservation methods in India

In India, in spite of modernization, traditional practices are still being used in the villages. Drying, fermentation, pickling, dry salting, and smoking are some of the most common methods followed for preserving foods traditionally both in household and small- and medium-scale food industries, as these methods are easier, less expensive, and do not need modern infrastructure facilities (Fig. 5.1) (Tamang et al., 2016).

Drying is the processing of dehydrating foods by removing the moisture content to an extent that prevents microbial activity. Mostly, traditional drying is done under direct sunlight, and sometimes temperature control equipment is used. Fruits, vegetables, spices, legumes, nuts, meat, and seafood are traditionally preserved by sun drying (Sekar and Mariappan, 2007). Throughout India, dried fish products are famous and

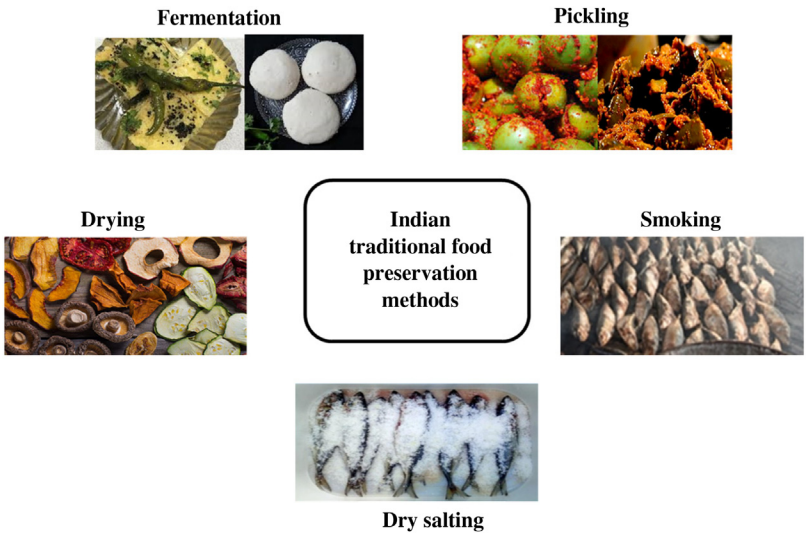

Figure 5.1 Traditional food preservation methods in India.

practiced since the ancient period by drying fishes under direct sun and wind for several days. The shelf life of this product varies from several months to a year, and it depends on the species used and is mostly done by fisherman families since the ancient period. The dried fish name varies from region to region, for example, *Sukho Bangdo* in Konkan region, *Karuvadu* in Tamil, *Suka masa* in Marathi. *Sidra* and *Sukuti* are sun-dried fish products in the North-Eastern part of India (Thapa, 2016). *Vadam*, the dried ground rice, and *Vathal*, the dried vegetable products, are common in South India. *Mormilagai*, a sun-dried chili, is prepared by soaking in buttermilk overnight and drying in sun for few days. This can be stored for many months in air-tight containers, and this type of preservation is also used for a few other vegetables such as bitter gourd and turkey berries. *Aampapad*, a dried mango pulp preserve, is prepared by spreading pulp on the sheet as thin film and rolled into shapes after drying.

The fermentation process is one of the most commonly used preservation technologies traditionally from ancient times. This process is carried out to improve the shelf life of the product, which also augments the digestibility, nutritive value, texture, taste, and aroma of the food (Tamang, 2015). Fermentation is done by either spontaneous or backslopping method, and mainly lactic acid bacteria, yeast, and some fungi are involved. In the backslopping method, traditionally people are using starters to prepare ethnic fermented foods in the Northeastern region of India, especially Sikkim and Meghalaya. *Marcha* and *Thiat* are some of the amylolytic starters that are used to prepare various ethnic fermented beverages and often sold in the market as starters. The technique of preparing these starters is a traditional practice that is still existing in these states and is a vital part of their sociocultural heritage; otherwise, it would disappear

with time (Sha et al., 2017). Due to this cultural practice, now we are able to explore the microbial diversity scientifically of these starters that existed ethnically from many hundred years ago. Fermented foods are categorized widely based on the substrates used, viz. cereal- and/or pulse-based, fruits and vegetables, dairy, fish- and meat-based products. However, regionwise products differ in the preparation process and usage of substrates. Common traditional foods preserved by fermentation are discussed in subsequent "Typical food and food products" section. *Idli*, *Dosa*, *Dhokla*, *Bhatura*, *Misti*, *Dahi*, *Kadhi*, *Papad*, *Jalebis*, *Kinema*, *Khaman*, *Lassi*, *Vada*, *Grundruk*, and *Sinki* are widely consumed fermented foods in India (Rao et al., 2005; Savitri and Bhalla, 2007). *Ngari, Hentak, Tungtap*, and *Shidal* are fermented fish products of North Eastern India (Thapa, 2016).

Pickling is a process of preservation by anaerobic fermentation in brine, oil, or vinegar. Mostly vegetables and few fruits are preserved by this method. Mango, citrus fruits, and cucumbers are extensively preserved by pickling. Pickles also occupy a very important part in Indian meal as spicy condiments and appetizers. Different type of jars and clays are used for preparing pickles (Joshi and Bhat, 2000).

Dry salting, fermentation, or pickling techniques are used traditionally in India, as these do not involve any complicated process or expensive instruments. The lower salt concentration of 2%–5% encourages the fermentation process, while the higher salt concentration of around 20%–30% prevents the microbial activity, thereby preserving the food with its original freshness. Predominately, fishes are preserved by the dry salting method traditionally. Smoking is a process of preservation by exposing the food to wood smoke, thereby increasing the flavor, appearance, and shelf-life extension. Smoked fish and meat are ethnic foods of the north-eastern states of India done at the household level. *Karati*, *Bordia*, and *Lashim* are sun-dried and salted fish products, whereas *Suka ko maacha* and *Gnuchi* are ethnic smoked and dried fish products of the north-eastern states of India (Thapa, 2016).

5.5 Typical foods and food products

India is the center of diverse food culture showing variations within the same product in different locations and regions. Ethnic foods gain a significant role in diverse food culture involving both fermented and nonfermented foods and beverages. Ethnic fermented foods are unique foods of a particular ethnic group prepared by using the native knowledge transferred from generation to generation through their ancestors. Locally available materials are used for the fermentation by either natural or by the usage of starters containing functional microbiota (Tamang, 2010). Exhilarating feature of the Indian fermented food is known to possess functional traits leading to many health benefits apart from providing basic nutrition. Biological functions include the preservation of delicate nutrients, enhancement of nutritional values, bioavailability of minerals, and production of bioactive components such as antioxidants, enzymes,

Table 5.1 Traditional fermented foods of India.

Fermented foods	Substrate	Ethnic region	Nutritional/bioactive component/health benefits	Health benefits	References
Idli	Rice, black gram dal	Southern India	Rich in all essential amino acids Good source of soluble vitamins such as folate, vitamin A, B_1, B_2, and B_{12}, acetoin and volatile fatty acids	Acts as an antiobesity component and consumed for losing weight Dietary supplement for children with malnutrition and kwashiorkor Reduction toward the risk of high blood pressure, cardiovascular diseases, and stroke Micronutrients such as calcium, folate, iron, and zinc help in the prevention of anemia and enable the oxygenation of the blood thereby nourishing the bone and muscle. Dietary fiber along with carbohydrates supports good digestion and formation of bulky stools Substantial increase in the bioavailability of zinc (50%–71%) and iron (127%–277%) and protein content, and production of bioactive compounds such as thiamine, methionine, choline, and riboflavin	Blandino et al. (2003), Ghosh and Chattopadhyay (2011), Hemalatha et al. (2007), Joshi et al. (1989), Purushothaman et al. (1993), and Ray et al. (2016)
Kinema	Soybean	North Eastern India	48% protein per 100 g dry matter; 8 mg thiamine, 12 mg riboflavin, and 45 mg niacin per kg dry matter; rich in phenolic acids, linoleic acid, essential fatty acid and phytosterol, rich in polyglutamic acid.	Cholesterol reducing property	Sarkar et al. (1996, 1998), and Tamang (1992, 2015)

Tungrymbai	Soybean	North Eastern India	45.9% protein per 100 g dry matter; carotene (212.7 μg/100 g) and folic acid (200 μg/100 g)	–	Agrahar-Murugkar and Subbulakshmi (2006) and Tamang (1992)
Hawaijar	Soybean	North Eastern India	26%–27% soluble proteins	Possess medicinal properties such as antiosteoporosis, anticancer, and hypocholesterolemic effects	Somishon and Thahira Banu (2013), and Thingom and Chhetry (2011)
Gundruk	Mustard leaf	North Eastern India	Rich in free amino acids such as glutamic acid, alanine, leucine, lysine, and threonine; rich in organic acids such as lactic, acetic, citric, and malic acids. It also possesses a fine quantity of ascorbic acid, carotene and palmitic, oleic, linoleic, and linolenic acids	Good appetizer, Higher levels of carotene with anticancer properties Induces milk production in mothers	Tamang et al. (2005), Tamang and Tamang, (2010)
Soibum	Bamboo shoot	North Eastern India	Abundant essential amino acids, vitamins, minerals, and fatty acids	Higher phenolic compounds and tannins, and possess antioxidants, anticancer, and antiaging properties	Giri and Janmejay (2000), Jeyaram et al. (2010), Tamang and Tamang, (2009), and Thakur et al. (2016)
Dahi	Milk	All over India	Potential source of vitamin B complex, folic acid, riboflavin, and bioactive compounds such as diacetyl, hydrogen peroxide, and reuterin, bioactive peptide (ACE-I peptide)	Substantially hinders the fall of glucose intolerance, thereby signifying the reduction in risk of diabetes; suppress the growth of undesirable flora such as *E. coli, Bacillus subtilis*, and *Staphylococcus aureus*	Ashar and Chand (2004), Sarkar and Misra (2001), Sharma and Lal (1997), and Yadav et al. (2007)

(*Continued*)

Table 5.1 (Continued)

Fermented foods	Substrate	Ethnic region	Nutritional/bioactive component/health benefits	Health benefits	References
Yogurt	Milk	Northern India	Minerals such as calcium, phosphorus, magnesium, potassium, and proteins function together to build up strong healthy bones	–	Chandan and Kilara (2013)
Lassi	Milk	North India	Possess 8 antioxidant peptides and 14 bioactive peptides	–	Padghan et al. (2017)
Sour rice	Rice	South India	Rich source of vitamin B complex, vitamin K, and minerals such as sodium, potassium, and calcium	Energy rehydrating food; prevents constipation by controlling the bowel movement; maintains the beneficial intestinal microflora Prevents gastrointestinal ailments such as celiac disease, duodenal ulcers, Crohn's disease, candida infection, irritable bowel syndrome, infectious ulcerative colitis	Choi et al. (2014) and Ray et al. (2016)
Dhokla	Rice and Bengal gram dhal	Western and Northern India	50% increase in thiamine and riboflavin content; a rich source of acetoin and volatile fatty acids	Lower glycemic index suitable for diabetic individuals; help in managing age-related diseases and oxidative stress-induced degenerative diseases	Joshi et al. (1989), Ray et al. (2016), and Roy et al. (2009)
Porridge	Pearl millet	South India	Enrichment of ferulic acid		Palaniswamy and Govindaswamy (2016)

Dosa	Rice and dehusked black gram	South India	Substantial increase in the levels of total acids, free amino acids, enzymes, vitamins, folic acid, antimicrobial and antioxidant ingredients	Improves the bioavailability of zinc and iron Helps in managing pre- and postdiabetic conditions due to its lower glycemic load and glycemic index levels Believed to help in increasing fertility, fetus weight, and breast milk. Provides sufficient energy for extended physical stamina and helps in the treatment of rheumatism and neural disorders Cofermentation of finger millet and horse gram and/or pearl millet in *dosa* batter significantly enriches the dietary fiber, calcium, and iron content and also enhances flavor, aroma, and appealing qualities	Blandino et al. (2003), Chelliah et al. (2017), Gupta and Tiwari (2014), and Palanisamy et al. (2012)
Ambali	Finger millet	South India	–	Highly suitable for infants due to its easy digestibility, rich protein, low resistant starch, and high calcium content Increased levels of vitamins and tryptophan, reduced leucine to lysine conversion, and bioavailability of minerals	Mangala et al. (1999), Mbithi-Mwikya et al. (2000), and Kumar et al. (2013)
Hentakis	Fermented fish	Manipur	–	Good for women during the late pregnancy stages or persons retrieving from illness or wounds	Sarojnalini and Vishwanath (1988)
Chyang	Finger millet	Himalayan region	–	Recommended for postpartum to boost their internal strength	Thapa and Tamang (2004)
Ngari	Fermented fish	Manipur	Protein (34.1%), fat (13.2%), carbohydrate (31.6%), Ca (41.7 mg/100 g), Fe (0.9 mg/100 g), Mg (0.8 mg/100 g), Mn (0.6 mg/100 g), and Zn (1.7 mg/100 g)	–	Thapa et al. (2007)

bioactive peptides, and nutraceuticals. Long-term consumption of these foods is reported to impart health benefits such as lowered cholesterol levels, antiatherosclerotic, anticarcinogenic, antidiabetic, antidiarrheal, antiallergic, and immunomodulatory properties (Hotz and Gibson, 2007; Tamang et al., 2012; Sarkar et al., 2015). Fermentation microflora in ethnic foods is also known to have probiotic and prebiotic properties. Another interesting feature of fermented foods is that it aids in the management of beneficial microorganisms in the gut leading to better defense against pathogens and positively modulating the gut–brain axis of the host (Tamang, 2015; Ray et al., 2016). A list of important fermented foods and their nutritional composition and health benefits are detailed in Table 5.1.

5.6 Future outlook

Traditional foods have a strong place in the Indian food plate. Many of these traditionally processed and fermented food products have been consumed for centuries in spite of influences of modern lifestyle and onslaught of westernization. With the passing time, more and more health benefits of traditional foods are being documented and their benefits with respect to the management of metabolic disorders are becoming apparent. Traditional foods are now getting more relevant in the modern food plate and rapidly being identified as health foods. India with diverse traditional foods and recipes can be harvested commercially as health foods for satisfying the rapidly developing market of health and functional foods in the world. There is an urgent need for the documentation of traditional foods that are consumed regionally by small ethnic groups and in-depth studies into the nutritional and health beneficial properties of these products.

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