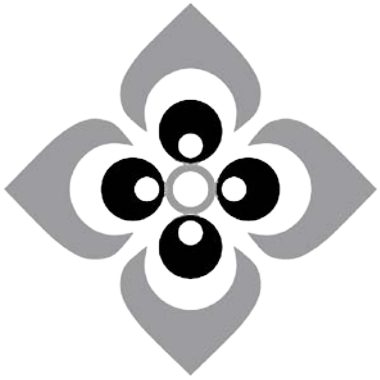

Consortium for Educational Communication

Module
on
Traditional Fermented Foods Of India (Cereal And Legume Based)

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TEXT

Brief introduction about fermentation

Fermented foods are those nutrient rich food stuff that is obtained by microbial metabolic reactions; simply called as "fermentation" reaction. Dahi (curd), vinegar, soy sauce, pickles, yoghurt, buns, beer and probiotic such as Yakult, are the frequently used and familiar fermented foods. According to Sandor Katz, author of *The Art of Fermentation*: Accordingly FAO, 1998 , defined fermentation as a slow decomposition reaction of organic substances accelerated by microorganisms or enzymes that essentially convert complex substances into simpler ones as carbohydrates to alcohols or organic acids.

Together with drying and salting, fermentation is one of the oldest methods of food preservation, and embedded in traditional cultures and village life. Fermentation processes are believed to have been developed over the years by women, in order to preserve food for times of scarcity, to impart desirable flavour to foods, and to reduce toxicity .Today, fermentation is still widely practised as a household or village-level technology in many countries, but comparatively very few operations are carried out at an industrial level. As a technology, food fermentation dates back at least 6000 years and probably originated from microbial interactions of an acceptable nature. Fermentation has enabled our ancestors in temperate and cooler regions to survive winter season and those in the tropics to survive drought periods, by improving the shelf-life and safety of foods and beverages.

Fermented products are prepared by controlled fermentation to produce acidity and flavour to a desirable level. Fermentation enhances digestibility, flavor and aroma of food and exerts health promoting benefits through biological enrichment of food substrates with protein, essential amino acids, essential fatty acids, and vitamins. It may also assist in the destruction or detoxification of certain undesirable compounds which may be present in raw foods.

The importance of fermentation in modern-day life is underlined by the wide spectrum of foods marketed both in developing and industrialized countries, not only for the benefit of preservation and safety, but also for their highly appreciated sensory attributes. Fermented foods are treasured as major dietary constituents in numerous developing countries because of their keeping quality under ambient conditions

- thereby contributing to food security - and because they add value, enhance nutritional quality and digestibility, improve food safety, and are traditionally acceptable and accessible. Fermentation is a low-input enterprise and provides individuals with limited purchasing power, access to safe, inexpensive and nutritious foods.

Fermentation in India

India being a large country displays climatic, ethnic and religious diversities vis-a-vis variation in food production and consumption. A lot of diversity prevails in the food habits of the people living in different parts of the country especially in the hilly regions where people have evolved indigenous method of preparing fermented foods and beverages based on easily available local raw materials. The skills of food preservation existed in the native people and the know-how of these fermentation was propagated orally. Diversity of fermented foods in Asia is directly related to food culture of each and every community, and also the availability of raw materials.

India, being a huge country has been the home of innumerable religious order of human population and diversity in climatic conditions has resulted in a large number of fermented foods. Most of these remain majorly secretive in their preparation being passed on from generation to generation and tend to be regionalized with many of them being made only on the home scale by using back slopping. Fermented foods have heterogeneousness of traditions and cultural preferences found in the different geographical areas, where they are produced. They have been consumed since ancient times due to their prolonged shelf life, reduced volume, shorter cooking times and superior nutritive value as compared to the non-fermented ingredients. Fermented products are prepared by controlled fermentation to produce acidity and flavour to a desirable level. Fermentation enhances digestibility, flavor and aroma of food and exerts health promoting benefits through biological enrichment of food substrates with protein, essential amino acids, essential fatty acids, and vitamins. It may also assist in the destruction or detoxification of certain undesirable compounds which may be present in raw foods. In many cases, production methods of different traditional fermented foods were unknown and passed down to subsequent generations as family traditions as in fermented milk product.

There are different fermented products in India such as Idli, Dosa,

Dhokla, Bhatura, Misti dahi, Kadhi, Grundruk, Sinki, etc. For preparation of fermented products starter culture is required. Starter culture is selected desirable microorganisms that are intentionally added to the base material to initiate and accomplish the desired fermentation in fermented products under controlled conditions. Lactic acid (LA) fermentation of foods as milk, vegetables and fruits is a common practice to preserve and improve the nutritional and sensory features of food. Most of lactic acid bacteria (LAB) were isolated from various traditional naturally fermented foods and observed as lactic acid bacteria are the predominant microflora of fermented products. Indian traditional fermented foods are generally fermented by LAB such as *Lactococcus spp*. *Lactobacillu splantarum, L. pentosus, L. brevis, W. koreenis, W. cibaria*, etc. and they are considered as the probiotic source from these foods. Availability of certain specific nutrients such as vitamins, minerals and carbon source and also acidic nature of fruits and vegetables provides a growth medium for fermentation by LAB. Probiotics are the live microorganism which is administered in adequate amount it will give health benefits to the consumer (FAO, 2002), such as *Lactobacillus plantarum*, *L. casei*, *L. acidophilus*, and *Streptococcuslactis,* which are supplemented by food that beneficially affect the host by improving its intestinal balance. Several studies have shown that supplementation of probiotics to food provides several health benefits such as reduction of serum cholesterol, improved gastrointestinal function, enhanced immune system, and lower risk of colon cancer. LAB are important for the dairy industry, especially in fermented milk processing because they increase food safety through the release of lactic acid and bacteriocins, produce aromas and flavor and accelerate the maturation process of cheese via their proteolytic and lipolytic activities, bring about desirable food textures via release of polysaccharides that increase the viscosity and firmness, and reduce susceptibility to syneresis. They may also be used to deliver polyunsaturated fatty acids and vitamins, leading to dairy products with increased nutritional value.

CLASSIFICATION

Fermented foods are classified on basis of substrate used:

Fermented milk products

Fermented cereal-legume/legume products

Fermented cereal products

Fermented vegetable and fruits products

Fermented meat and fish products

Miscellaneous foods

Following are the different fermented products available traditionally in India

Fermented food	Ingredients	Place of origin	Related Microorganisms
Rabdi(rabadi)	Flour of barley, pearl millet, corn or soybean and country buttermilk	Rajasthan	*Bacillus* and *Micrococcus* sp.
Kulu	Wheat flour, buttermilk	Himachal Pradesh	*Lactobacillus* sp.
Idli	Rice, black gram dhal, table salt, fenugreek seeds	South India	*L. mesenteroides, E. faecalis, P. cerevisiae*
Dosa	Rice, black gram dhal (either raw or parboiled rice), table salt	South India	*L. mesenteroides, E. faecalis*
Dhokla	Bengal gram dhal, rice and leafy vegetables	Gujrat	*L. fermentum, L. mesenteroides, E. faecalis*
Chilra or lwar	Wheat/barley, buckwheat flour and starter material Treh	North India	Not reported
Sinki	Radish root	North-east India	*L. casei, L. brevis, L. plantarum, L. fallax, L. fermentum*
Kinema	Soybeans	Darjeeling, Sikkim	*E. faecium*
Kanji	Carrot or beet root, rice, mustard	North India	*L. pentosus, L. paraplantarum, L. plantarum*

Curd (Dahi)	Milk	India	*S. cremoris, S. lactis, S.thermophilus, L. bulgaricus, L. acidophilus, L. helveticus, L. cremoris, , Lactobacillus delbrueckii subsp. Indicus*
Gundruk	Leaves of mustard/ radish/cauliflower	Arunachal Pradesh	*P. pentasaceous, L. fermentum, L. casei*

Cereal and legume based fermented foods

Fermentation of cereal based foods is a common practice all over the world. There are different types of cereal based fermented beverages produced all around the world, which are classified on the basis of the raw material or the type of fermentation involved in the manufacturing process. Alcoholic fermented beverages can be classified into wines and beers, while the great majority of non-alcoholic fermentations are souring, mainly lactic acid fermentation. Fermentation is a simple; home based technology and has fed large population. At present a variety of cereals based fermented foods and beverages are produced at house hold and semi industrial level and these foods are used as weaning food for infants and children and also for adults.

Cereals are a major component of human food in all over the world. Nutritional experts have paid attention to cereal based foods from maize, wheat, rice, barley, oat, sorghum and millet sources. During storage grains are metabolically inactive with very low water activity and moisture content of about 9 - 12%. This low water activity and low moisture content prevents the growth of microorganisms and the enzymes are also inactive at this state. This is the resting stage of the grain. Addition of water to the grains makes them absorb water which ultimately stimulates the enzyme into action and growth of microorganisms. This process enables fermentation to start. This is followed by size reduction through milling and sometimes the use of specific microorganisms and enzyme actions. Cereals have high content of soluble non-starch polysaccharides such as β-glucan which has a health promoting role. Clinical and epidemiological studies reported that β-glucan from oat and barley based products control cardio vascular disease in human beings. Cereals also contain relatively high levels of minerals, vitamins, sterols and other growth factors that support microbial growth. Physiological compounds used in functional food

systems are available in cereals. cereals are good fermentable substrates for the growth of probiotic microorganisms. Some important factors of substrates that affect growth of probiotics include; Composition of cereal substrate, processing method, fermentation of substrates, productivity of starter culture, growth of organisms, sensory and nutritional properties of products. Cereals have many health benefits e.g. prevent cardiovascular diseases and cancer, reduces tumour, lowers blood pressure, controls cholesterol level and lowers the incidents of heart diseases, reduce the rate of fat absorption, delays gastric emptying and improve gastrointestinal health.

Some of the commons fermented are as under:

Idli

It is a traditional fermented food, prepared and consumed in South India and in many parts of Sri Lanka. It is normally consumed with chutney and sambar. Idli is made up of a blend of rice and dehulled black gram. For Idli preparation rice and black gram are soaked in water and then the rice is coarsely ground and the black gram is finely ground. Then the rice and the black gram batters are mixed together in 2:1 ratio with addition of a little amount of salt and leave it for fermentation overnight at about 30°C. Finally, the fermented batter is steamed for 5-8 min in Idli. Lactic acid bacteria *Leuconostoc mesenteroides*, *Lactobacillus fermenti, Streptococcus faecalis, Lactobacillus delbrueckii, Lactobacillus lactis* and *Pediococcus cerevisiae* are the significant microorganisms responsible for Idli fermentation. Some yeast like *Torulopsis holmii, Geotrichum candidum*, and *Trichosporon pullulans* are also helps in idli fermentation. Idli is a low caloric food used as breakfast and snacks. Fermentation increase essential amino acid in Idli and decrease antinutritients. In Idli preparation, instead of rice, kodri, millet and soybean or green gram instead of black gram are also used.

Dosa

In Dosa preparation, wheat, bajra, maize or kodri instead of rice and sprouted peas, cowpea, field beans, soybeans or groundnut, oilcake instead of black gram are also used. Dosa batter is similar to Idli batter but the dosa batter is thinner. A dosa better is prepared by grinding wet rice and wet black gram individually with water and the two suspensions are then mixed and allowed to undergo fermentation, usually for 8–20

h. After fermentation, the fermented Dosa batter is heated with little oil on hot pan as thin, semi soft to crisp pancake and eaten with chutney and Sambar. The microbiological and nutritive value of Dosa are similar to Idli. Lactic acid bacteria *Leuconostoc mesenteroides, Lactobacillus fermenti, Streptococcus faecalis, Lactobacillus delbrueckii, Lactobacillus lactis* and yeast *Torulopsis holmii, Geotrichum candidum* are responsible for Dosa fermentation.

Dhokla

Dhokla is cereals based fermented product. It is also similar to Idli except that Bengal gram dhal is used instead of black gram dhal in its preparation. It is famous in south India and Srilanka. A mixture of rice and chickpea flour is also used as the substrate for the fermentation. The fermented batter is poured into a greased pie tin and steamed in an open steamer as in Idli preparation. 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. *Leuconostoc mesenteroides, Streptococcus faecalis, Torulopsis candida, T. pullulans* are the major microorganisms involved in Dhokla fermentation. It is used as steamed cake for breakfast or as snack food.

Pachwai

Pachwai is a Indian rice beer mainly drink in North India. It is rice based with a starter culture Bakhar. Powdered starter 'Bakhar' is added to steamed rice and allowed to ferment for 24 hours. The whole mass is then transferred to earthenware jars, water is added and fermentation continues. The beer develops a characteristic alcoholic flavour and is ready to drink in 1 or 2 days. Nature of fermentation is Alcoholic fermentation and microorganisms involved in this fermention are *Rhizopus spp*., *Mucor spp*. and yeast.

Jalebi

It is a sweetened fermented product prepared by use of maida (refined wheat flour), dahi and water. The fermented batter is deep fat fried in oil in spiral shapes and immersed in sugar syrup for a few minutes. This traditional food is prepared during marriage ceremonies and festivals. *Lactobacillus fermentum, L.buchneri, Streptococcus lactis, S. faecalis* and *Saccharomyces cerevisiae* are found in the fermented batter. The pH decreases from 4.4 to 3.3 and there is a 9% volume increase in the batter. During fermentation both amino nitrogen and free sugar

decreases.

Kulcha nan and Bhatura

Various types of traditional fermented snack foods like Bhatura (white wheat flour product), Kulcha (white wheat flour product), Nan (wheat flour product), are prepared indigenously in India. For the fermentation of these products, mainly by *Saccharomycesn cerevisiae* and LAB are used.

Kinema

It is a soybean based fermented food and consumed in eastern Himalayan regions of Darjeeling hills and Sikkim. It is a good and cheap source of protein. It is alkaline fermented, ammonia flavoured food prepared from soybeans. For preparation soybean seeds are soaked overnight and then cracked slightly in a mortar and pestle. Grits are placed in a bamboo basket lined with locally grown fresh fern fronds covered with a jute bag and left to ferment naturally at ambient temperatures (25°-40°C) for 2-3 days above an earthen kitchen oven. The microflora of Kinema is *Bacillus subtilis*, *Enterococcus faecium, Candida parapsilosis and Geotrichum candidum.* The product of fermented soybean is salted, deep fat fried and consumed as soup along with rice and vegetables.

Adai and vada

These both are cereal legume based breakfast or snack food in India. Microorganisms required for the fermentation of both the products predominantly are *Pediococcus*, *Streptococcus*, *Leuconostoc*.

Sez

It is traditional semi-fermented food of Uttaranchal. It is made from rice, and mostly used as snacks. Earlier, it was prepared only during certain festivals. In most cases, sez is extracted while preparation of rice jann (local beer).

Health benefits of fermented foods

1. **As a probiotics**: Lactobacillus plantarum has been linked to reduced inflammatory bowel, small bowel bacterial overgrowth in children, reduced problems for sufferers of irritable bowel syndrome, and had a positive effect on the immune systems of those suffering from HIV. Bifidobacteria has been linked to decrease cases of neonatal necrotizing

enterocolitis. Many strains of probiotics have been directly linked to reduced bouts of digestive complaints including diarrhea. *Lactobacillus acidophilus* also shows a preventative effect for polyps, adenomas, and colon cancer.

2. **Source of nutrition**: Fermentation increases the digestibility and nutritional value of cereals based foods. Cereals based fermented foods protect the body against age-related diseases such as diabetes and cardiovascular diseases. Cereals also contain micronutrients such as vitamin E, folates, phenolic acids, zinc, iron, selenium, copper, manganese, carotenoids, betaine, choline, sulphur amino acids, phytic acid, lignins, lignans, and alkylresorcinols which provide various types of health benefits.

3. **Flatulence reducing effect**: During fermentation of the beans for preparation of tempe, the trypsin inhibitor is inactivated, and the amount of several oligosacharides which usually cause flatulence are significantly reduced.

4. **Anticholesterolemic effect**: Some studies have reported hypercholesteremic effect of yoghurt in human subjects receiving a oneweek dietary supplement. Studies on supplementation of infant formula with Lb. acidophilus showed that the serum cholesterol in infants was reduced from 147 mg/ml to 119 mg/100 ml.

5. **Anticancerogenic effect**: Anticarcinogenic effect of fermented foods showing potential role of lactobacilli in reducing or eliminating procarcinogens and carcinogens in the alimentary canal.

6. **Provide functional components**: Fermented cereals can also contain a high mineral content and generally have a lower fat percentage than their dairy-based counterparts, but grains are generally lacking in essential amino acids. These forms of beverages can also naturally provide plant-based functional components, such as fibre, vitamins, minerals, flavonoids and phenolic compounds, which can effect oxidative stress, inflammation, hyperglycemia and carcinogenesis.