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Knowledge of Traditional Fermented Food Products Harbored by the Tribal Folks of the Indian Himalayan Belt

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Abstract

The tribal or indigenous people inhabiting the Indian subcontinent with a population of 53.8 million in 5,000 forest dominated villages have plethora of traditional knowledge of their environment that correlates to the immediate nature and the resources that reside therein. Indigenous fermented foods are an intrinsic part of diet of the ethnic tribes in the Himalayan belt of India, being the oldest and most economic methods for development of a diversity of aroma, flavor, texture; food preservation and biological enrichment of food products by the manipulation of different microbial population. Human health-benefits include its antagonistic role against lactose-intolerance, high cholesterol level, cancer and diabetes. Vegetable based fermented foods like gundruk; sinki; anishi are prepared by tribes of Arunachal Pradesh; Sikkim and Nagaland respectively. Kinema; bhatootu, marchu and chilra; tungrymbai are cereal and pulse based fermented food indigenous to people in Darjeeling hills and Sikkim; Himachal Pradesh and Meghalaya respectively. Fermented bamboo shoot products like soibum and mesu form a major part of the diet among the tribes of Manipur; Darjeeling and Sikkim respectively. Fermented fish foods such as ngari and hentak are relished by the tribal population of Manipur. Fermented milk beverages such as kadi, churpa and nudu; and alcohol such as ghanti, jann and daru are consumed locally in Himachal Pradesh and Uttaranchal respectively. The review briefly discusses the traditional way of carrying out spontaneous natural fermentation of these foods using starter microbial culture at the household-scale followed by using relatively simple processing

facilities. At present, these products are prepared for local consumption at house-hold level without much consideration to GMP and HACCP guidelines. Modern science (for quality control, packaging, etc.) and collaborative research should join hands for the commercialization of novel value added products derived from indigenous food items, converting this local market to a global industry thus providing means of employment and economy to the tribal communities.

Keywords: Himalayan belt, tribes, fermented food, beverages, microbial culture, health-benefits, commercialization.

1. Introduction

The Himalayan region in India is host to the world's highest ecosystems stretching 3,500 km from Jammu and Kashmir to Arunachal Pradesh in the north east part of India. Traditional people residing in this biodiversity rich region have an understanding ofthe properties of plants and animals, the functioning of ecosystems and techniques of using and managing them, thus using the myriad resources such as timber, fibers, medicinal plants and edible plants and have also been engaged in bringing forth the subtle and innovative uses of the same so that maximum benefit is accrued (Emery, 1997; Negi and Palyal, 2007; Dutta and Dutta, 2005).

Fermentation is one of the oldest forms of food technology in the Indian Subcontinent (Deka, 2012) and is reported to enhance the nutritional quality of any product by enhancing the amount of vitamins and protein solubility (Sohliya et al, 2009). The requirement of fermentation is fuelled attributing to the production of organic acids, nutritional enrichment, reduction of endogenous toxins and reduction in the duration of cooking (Sekar and Kandavel, 2002). Indigenous fermented foods have been prepared and consumed for thousands of years, and are strongly linked to culture, traditions and reveal the intellectual richness of indigenous people of the country in terms of their ability to prepare microbial products for varied purposes in addition to food and beverages (Sekar and Mariappan, 2007). However, the preparation of indigenous or "traditional" fermented foods and beverages remain as a household art today (Larry and Beuchat, 2008). The indigenous fermented food is prepared utilizing different substratesand non-pathogenic micro-organisms as starter and processing culture to be sold at the local markets for local consumption.

2. Vegetable Based Fermented Food

2.1 Gundruk

The Adi tribe of Arunachal Pradesh converts some leafy vegetables into fermented acidic product for long-term use and preservation mostly using Lai saag (Deka, 2012). During its production, leaves of rayo-sag, mustard and cauliflower are wilted, shredded, crushed mildly and pressed into an earthen jar or container, made air tight

and fermented naturally for about 7-10 days. Freshly fermented gundruk is removed from the jar and sun dried for 3-4 days, and is stored for 2 years or more. It is sold in all local markets and eaten as soup or pickle (Tamang et al, 2012). Traditional process of gundruk fermentation results in loss of 90% of the carotenoids. Improved methods of drying might reduce the vitamin loss. (Battock and Azam-Ali, 1998) Gundruk has high concentrations of calcium and magnesium, thus acting as source of minerals to people in off season (Moser et al, 1998). Gundruk soup has appetizer qualities in a bland and starchy diet (Tamang and Tamang, 2009b).

Figure 1: Gundruk.

2.2 Sinki

Sinki is a non-salted fermented radish tap root of the Gorkha (Tamang, 2005) and Gurung tribe of Sikkim (Singh, 2007) prepared by fermentation in 1m deep pit (Tamang, 2005) which is plastered with mud and warmed by burning (Tamang and Tamang, 2009b). Radish are washed, cut into small pieces and dried under sunlight in naaglo (local utensil made of bamboo for winnowing the grains) for 3-4 days. The dried pieces are packed in polythene and placed inside a pit. The pit is covered with cow dung and soil paste and left for over 15 days for fermentation (Singh, 2007). Sinki has an acidic flavor, mostly used soup and pickle (Tamang and Tamang, 2009b). It contains 14.5% of protein, 2.5% of fat and 11.3% of ash of dry weight. It is an effective appetizer (Tamang and Tamang,2009b), cures diarrhea, stomach pain and consumed mostly during the lean period (Singh, 2007).

Figure 2: Sinki.

2.3 Anishi

The Ao Naga tribe prepares Anishi from edible Colocasia species leaf (Deka, 2012). The fresh mature green leaves are washed, staked one above the other and wrapped finally with banana leaf. It is then kept aside for about a week till the leaves turn yellow and then ground into paste and cakes are made out of it. The cakes are dried over the fireplace in the kitchen. During grinding, chilly, salt and ginger are added to it. It is cooked with dry meat especially with pork, which is the favourite dish of the Ao tribe (Mao and Odyuo, 2007). It is liquid in nature, sour in taste and used as a condiment (Tamang and Tamang, 2009b).

Figure 3: Anishi.

3. Cereal and Pulse Based Fermented Food

3.1 Bhatooru, Marchu and Chilra

These are leavened breads or roties constituting the staple diet of rural people in Himachal Pradesh (Savitri and Bhalla, 2007). Bhatooru (also called as 'Sumkeshi roti'), marchu and chilra are prepared using wheat/ barley/buckwheat flour as substrate and inoculum 'Malera' and 'Treh' respectively (rich in lactic acid bacteria) after fermentation of time period required to leaven the dough/ slurry. The fermented dough of bhatooru and chilra and baked on hot plates while marchu is deep fried in mustard oil. Bhatooru is a staple diet of rural people and is taken in both meals with vegetables and curries. Marchu is prepared during festivals, religious and marriage ceremonies and is seved with tea. Chilra is a favourite snack of the tribe served with coriander chutney, potato and mutton soup (Thakur et al, 2004).

Figure 4: Chilra.

3.2 Kinema

It is soybean based fermented food (Deka, 2012) and usually consumed by indigenous people of eastern Himalayan regions of Darjeeling hills and Sikkim as a good and cheap source of protein (Tamang and Nikkuni, 1998). It is a fermented, ammonia flavored, alkaline food prepared from soybeans. The soybean seeds are soaked overnight and then cracked slightly in mortar and pestle. Grits are placed in abamboo basket lined with locally grown fresh fern fronds covered with a jute bag and left to fermentnaturally at ambient temperatures (25°-40°C) for 2-3 days above an earthen-kitchen oven (Tamang, 2001). The product of fermented soybean is salted, deep fat fried and consumed as soup along with rice and vegetables (Sarkar et al, 1993).Kinema contains (per 100 gm of dry matter) protein 48 gm, fat 17 gm, carbohydrates 28 gmand 478 kilocalories (Tamang, 2001). Hence, it is a low cost source of protein.

Figure 5: Kinema.

3.3 Tungrymbai

Tungrymbai is a traditional fermented food product prepared from soybean seeds used in Meghalaya by the indigenous Khasi tribe. For preparing tungrymbai the soybean seeds are cleaned, washed and soaked in double the quantity of water for about 4-6 hours, outer skin is removed and then cooked in the same water for about 1 hour till all the water is absorbed. The cooked beans which can now be pressed easily in a bamboo basket, lined on its inner surface with leaves of *Clinogyne dichotoma* (locally known as lamet) and allowed to cool. They are then left to ferment either in the ambient temperature (25–400 ºC) or near the fire place in order to provide the necessary temperature for fermentation to take place. The incubation time is usually 3-4 days after which the fermented product is obtained as a brown mass with a characteristic odor (Sohliya et al, 2009; Jeyaram et al, 2009; Agrahar-Murungkar and Subbulakshmi, 2006). Tungrymbai is a popular fermented soybean based sticky food which serves as a cheap source of high protein food in local diet (Sohliya et al, 2009).

Figure 6: Tungrymbai.

4. Bamboo Based Fermented Food

4.1 Mesu

The people of Himalayan regions of Darjeeling hills and Sikkim feed on a bamboo shoot derived fermented dish called mesu. Its chief producers are the Limboo women belonging to Nepali community (Sekar and Mariappan, 2007) (Tamang and Sarkar, 1996) (Tamang and Tamang, 2009a). The months of June to September are suitable for the preparation of mesu when Bamboo shoots sprout. Locally available species of bamboo are used such as choya bans (*Dendrocalamus hamiltonii Nees* and Arnott), bhalu bans (*D. sikkimensis Gamble*) and karati bans (*Bambusa tulda Roxb*) (Tamang and Sarkar, 1996) which are defoliated, chopped and pressed tightly into a green bamboo hollow stem, the tip of stem is covered tightly with leaves and left to ferment for 7-15 days. Mesu is mostly consumed as pickle (Tamang and Tamang, 2009b).

Figure 7: Mesu pickle.

4.2 Soibum

It is a fermented bamboo shoot product, an indigenous food of the state of Manipur used as an indispensible part of the diet. Soibum is produced exclusively from succulent bamboo shoots of the species *Dendrocalamus hamiltonii, D. sikkimensis, D. giganteus, Melocana bambusoide, Bambusa tulda and B. balcona* (Deka, 2012). Noney/ kwatha type and andro type are two types of fermentation procedures adopted. The outer inedible and hard casings of succulent bamboo sprouts are peeled off while

and the soft portions are chopped and pressed tightly into wooden or earthen pots and left to ferment for 6-12 months in both the methods. (Jeyaram et al, 2009).It is consumed as regular side dish consumed with steamed rice (Tamang and Tamang, 2009b). The bamboo shoots are rich in potassium, carbohydrates, dietary fibres, vitamins and various antioxidants.

Figure 8: Soibum.

5. Fish Based Fermented Food

5.1 Ngari

The fermented fish product ngari forms an intrinsic part of the diet of people in Manipur (Deka, 2012). Phoubu, a sun dried, non-salted dry form of a fish species *Puntius sophore* is used for the preparation of ngari dish (Jeyaram et al, 2009). Phoubu is sun dried and washed briefly with water and then water is drained for 24 hours. It is then spread, covered with gunny bags and pressed hard with legs followed by packing in an earthen pot of 45-50 kg capacity strengthened with metal lining (internally coated with mustard oil) and sealed tightly with mud. It is a 4 months to 12 months long process in which solid state fermentation takes place at room temperature (Thapa et al, 2004). It is eaten as a side dish with cooked rice. It is a rich source of proteins.

Figure 9: Ngari.

5.2 Hentak

Hentak is a ball-like thick paste (Jeyaram et al, 2009) prepared by fermentation of a mixture of sun-dried fish (*Eso musdanricus*) powder and petioles of aroid plants (*Alocasi macrorhiza*) in Manipur (Thapa, 2002). The mixture is kept in an earthen pot and is fermented for 7–9 days (Thapa et al, 2004). It becomes to be eaten only after 2 weeks of complete fermentation giving proper texture and aroma to the dish. However, on being stored for a few months the balls harden which can then be used as reserve food by it propounding it to a paste with a little water and stored as balls (Jeyaram et al, 2009). Hentak is consumed as curry as well as a condiment with boiled rice (Thapa, 2002). Sometimes it is given to women in the final stages of their pregnancy or patients recovering from sickness or injury (Sarojnalini and Singh, 1988).

Figure 10: Kadi.

6. Milk Based Fermented Food

6.1 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) (Savitri and Bhalla, 2007). Kadi is prepared by simmering a mixture of chaa/buttermilk, besan/gramflour and spices (Sharmaand Singh, 2012). Buttermilk is boiled, then water is discarded and solids are dried hard which later used to prepare soups called churpa or churpe (Tamang et al, 2005a). Nudu is a ceremonial food prepared by cooking wheat flour in milk with small amount of salt and is eaten with ghee (Savitri and Bhalla, 2007).

7. Alcoholic Beverage

7.1 Ghanti, Jann/Jaan and Daru

Ghanti which is made from fermented musk is consumed by the people in Kinnaur district of Himachal Pradesh consume and Bhotiyas of Uttaranchal drink jann and daru, which are prepared from cereals and fruits (Roy et al, 2004). Jann has a very low alcoholic content which is used as a traditional local beer. It is prepared from rice, koni, wheat, jau, oowa. Daru is a distilled liquor containing ethyl alcohol at a much

higher concentration. Rice, jaggery, koni, chuwa, oowa and wheat are used in the preparation of daru (Sekar and Mariappan, 2007). The starter culture (*Balam*), used in the preparation of jann and daru, is made using wheat as a substrate mixing with a number of herbs and spices (Das and Pandey, 2007) Jann is obtained by slow, anaerobic fermentation consuming a period of 6 to 10 months in porous earthenware at a temperature of 10 to 15ºC. But daru is obtained by a rapid fermentation within a period of 2 to 3 days. It is performed in a non-porous metallic ware at a temperature of 30 to 40ºC (Sekar and Mariappan, 2007).

Table 1: Microbial diversity found in traditional fermented food products of Indian Himalayan belt.

Fermented food	Microorganisms responsible for fermentation	References
GUNDRUK	Lactobacillus fermentum, L. plantarum, L. casei, Pseudoplantarum and Pediococcus pentosaceus	Tamang et al, 2005b
SINKI	Lactobacillus fermentum, L. brevis and L. Plantarum	Tamang, 1993
ANISHI	Not reported yet	-
KINEMA	Bacillus subtilis, Enterococcus faecium;Candida parapsilosis and Geotrichum candidum	Sarkar et al, 1994
BHATOORU, MARCHU and CHILRA	Lactobacillus plantarum, L. acidophilus Leuconostoc, Bacillus sp., Lactococcus lactis; Sacchromyces cerevisiae, DebaromyceshanseniiBacillus sp., Lactococcus lactis	Kanwar et al, 2007
TUNGRYMBAI	Bacillus subtilis and Enterococcus faecium; Candida parapsilosis, Saccharomyces bayanus, Saccharomycopsis fibuligera and Geotrichum candidum	Sohliya et al, 2009; Sarkar et al, 1993
SOIBUM	Enterococcusdurans, Streptococcus lactis, B. subtilis, B. licheniformis, B. coagulans, Candida sp., Saccharomyces sp., Torulopsis sp.	Tamang and Tamang, 2009b; Tamang et al, 2008
MESU	Lactobacillus plantarum, L. brevis and L. pentosaceus	Tamang and Sarkar, 1996
NGARI	Lactococcus plantarum and Lactobacillus plantarum, Bacillus subtilis, B.pumilus and Miocrococcus sp., Enterococcus faecium	Thapa et al, 2004
HENTAK	Bacillus cereus, B. subtilis, Staphylococcus aureus, Enterococcus faecium, Candida sp.	Thapa et al, 2004

CHURPA	Lactobacillus plantarum, Lb. curvatus, Lb. fermentum, Lb. paracasei subsp.pseudoplantarum and Leuconostocmesenteroides	Tamang et al, 2009
DARU and JANN	Saccharomyces cerevisiae, Candida famata, C. valida, Kluveromycesmaxianus, Saccharomycopsis fibuligera,	Thakur et al, 2004; Das and Pandey, 2007

Figure 11: A view of indigenous folks of Himalayas selling fermented food products at local markets.

8. Conclusion

The knowledge of traditional foods harbored by the tribal communities is rich in terms of its capacity cure diseases. Fermented foods are encountered worldwide and their origin is due to their prolonged shelf life (through lactic acid, alcohol, acetic acid and alkaline fermentations), reduced volume, shorter cooking times and superior nutritive value as compared to the non-fermented ingredients, biological enrichment of food substrates with protein, essential amino acids, essential fatty acids, and vitamins and elimination of anti-nutrients. Fermented foods have and enhance the flavor and aroma of food. The process also increases digestibility and exert health promoting benefits. Fermentation may assist in the destruction or detoxification of certain undesirable compounds which may be present in raw foods. Other health benefits include cholesterol control, anti-cancer effects, immunity, longevity, anti-hypertensive effect, and anti-diabetic effect. Therefore, the review throws light on these technologies and gives way to further scientific analysis and authentication of this knowledge, currently limited to only the tribal communities. This information behooves us to turn back to the traditional ways in preparing our daily food menu; to consume more fermented foods and not rely as heavily on refrigeration and freezing of our food supply as a means of preserving food. Mankind has been eating fermented food for millennia; it’s time to get back to practicing the same healthy ways of preparing family foods.

In order to commercialize these food products extensive studies are required right from starter culture to dealing with toxicological problems. With increasing urbanization, traditional fermented food should move from small-scale house-hold level to large-scale operations. Modern science like genetic engineering could be used to enhance mass production and maintain safety levels, thus, introducing value-added products in the market. Certainly, a transition from local consumption to global industry is the need of the hour in order to create employment and means of income for sustainable livelihood to the tribal communities.

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