Traditional Fermented Products of India

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ABSTRACT

Traditional fermented products are those products which are indigenous to people and people of the local area prepare them with the help of their ethnic knowledge from the ancestors. There are uncountable varieties of traditional food present in the world. One such country is India, where numerous varieties of traditional food products are present due to the variation in culture, geographical indication and variability in the raw material present in that particular locality (grains, milk, plant sources). In past, to enhance the shelf life of the food product many food processing and preservation techniques were introduced in household level such as smoking, drying, fermentation and germination. Out of these technique the best techniques for the preservation of food was fermentation. Fermentation is bioprocess technology which is practiced since time immemorial. Fermentation technology lead to the formation of two products: fermented food and fermented beverage. Fermentation is mainly done with the help of microorganism, specifically lactic acid bacteria (LAB). The microorganism involved in fermentation are generally probiotic in nature means they are good for the human health and when these microorganism are grown in the food product they enhance the nutritional property, with increasing the therapeutic property of the food. Fermented food must be eaten daily in human diet and some standardization technique should be developed so as these fermented product can be sale in the market which will be source of income generation to the villagers.

Keywords
Fermentation, Lactic acid bacteria, traditional, Food, Beverage

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Introduction

Traditional Indian foods have been prepared for many years and preparation varies across the country. In India fermented foods and beverages are the fundamental part of ethnic heritage. One of the traditional oldest and most cost-effective methods for producing and preserving food is fermentation (Jeyaram, 2009). It has been practiced since ancient time by the antique man as the cost-effective method for providing longevity to fermented products (foods and beverages). Traditional fermented food preparation is one of the oldest biotechnological processes around the world (Sekar and Mariappan, 2007). Traditional fermented foods are defined as foods produced by native people using their inherited knowledge and skillful technology from vicinity available plant or animal raw
Fermented product is prepared either naturally or by adding starter culture comprising efficient microorganisms which transform the substrates into edible products that are ethnically and socially conventional to the local people. Primeval people embraced diverse preservation methods to store superfluous food of any origin, particularly those foods which are periodic and have a small lifetime (perishable). At present, more than 5,000 diverse fermented foods are consumed by diversified people living worldwide, many of which are indigenous and manufactured in small amounts to meet the requirements of groups in a specific area (Ray et al., 2016). Fermented foods make up an important contribution to Indian diets in since time immemorial because fermentation is not expensive technology which preserves food, improves its nutritional value and enhances its sensory qualities (Marco et al., 2017). Fermentation involves the activity of microorganisms which play a vital role in enhancement of organoleptic characteristics, enrichment, health endorsing traits, and preservation of food product. Microorganism involved in fermentation are probiotic in nature i.e. they will provide health benefit to the consumer and are essential part of gut micro flora (Angmo et al., 2016). Most commonly found microorganisms are Lactic acid bacteria (LAB) accomplish a crucial role in the preservation and production of nutritious fermented foods (Satish et al., 2013). Two type of microorganism are found in fermented food product those are homo-fermentative and hetero-fermentative” Lactic acid bacteria which are grow readily in most food substrates and lower the pH of the food to a point where other opposing organisms are not able to grow (Angmo et al., 2016; Satish et al., 2013). Fermentation also helps in proliferation of digestibility, breakdown of complex carbohydrates into simpler one, improves bioavailability essential amino acids, vitamins, and minerals, and upsurges the whole quality, taste, and aroma of the food (Şanlie et al., 2017). Fermented food products act as nutraceutical agents to impart beneficial health effects (Sharma et al., 2013). The protein and vitamin deficiencies are the major problems of the third world countries, hence providing those countries fermented product can meet the requirement of the essential amino acid present in the food with increased nutrient level.

Fermented food products are also supportive in maintaining the healthy configuration of celiac micro biota that play a crucial role in protection from numerous illnesses and can sustain physiological homeostasis. We can also called fermented food product as naturally invigorated useful food. There are many varieties of fermented products persisting in the market and can be classified on the basis, which food product is been fermented. They are categorized as follows: (i) cereal-based (with/without pulses) fermented foods, (ii) cereal/pulse and buttermilk-based fermented food, (iii) cereal-based fermented sweets and snacks, (iv) milk-based fermented foods, (v) vegetable, bamboo shoot (BS) and unripe fruits-based fermented foods, (vi) meat-based fermented foods and (vii) pulse (legume)-based fermented food (Satish et al., 2013).

Beside this classification fermented food also differs according to the region. There are several regions in India as the change in region leads to the change in eating habits of the people and the way of fermenting different products also change.

Grain based fermented food products/beverages

Fermented food

Grains are the principal staple nourishing food of India. Consumption of grains in different
civilizations of India can be observed from the literature. All grains have good calorific value, largely from starch and proteins. Some of the grains exhibit antinutritional properties such as the presence of phytate and trypsin inhibitors. Processing techniques such as fermentation, germination, soaking, and cooking help to remove these antinutritional factors (Egounlety and Aworh, 2003).

Different ethnic products can be made from a single grain variety or combination of many grains. Different varieties of grains such as cereal can be mixed with pulses to make delicious products like idli, dosa, dhokla, ambali, wari etc. it is mostly seen that fermentation is generally caused by lactic acid bacteria (LAB). idli, dosa, adai dosa, kallappam, ambali, dhokla (Table 1), are popularly known south indian food which are fermented from L. mesenteroides, E. faecalis, Pediococcus sp., Streptococcus sp and L. fermentum [2]. The preparation involves the batter formation from the basic ingredients and is then left overnight at room temperature for fermentation, occasionally sodium bicarbonate is added to provide anaerobic conditions for the growth of LAB (Satish et al., 2013). Sometimes yeast is also added to enhance the rate of fermentation (Satish et al., 2013). Fermented sweets and snacks are prevalently eaten up throughout India. Some fermented products from grains are also made and are consumed mostly during festive season or other special occasions. To make these sweet dishes mainly Wheat, rice and barley flours are principally used cereals as a major ingredient and Sugar or salt is added compulsorily in the fermented foods. These foods select only those microorganisms which can endure at low water activity. Commonly found fermented sweetened product in india are jilebi, seera, kulcha, gulgule, bhataru etc. the microflora found to be associated with these food products are L. fermentum, L. buchneri, L. plantarum, L. acidophilus, L. mesenter-oides, Lactococcus lactis, Streptococcus lactis (Satish et al., 2013). One of the sweet end fermented cereal product is sel roti, which is a rice-based fermented food, which is spongy and ring shaped and Lactobacilli, Pediococci, Enterococci, and Leuconostocs are the principal microorganisms (Sarkar et al., 2015). It is found that in jilebi and selroti sugar as high as 25% is added (Tamang et al., 2009a). Another important grain is pulses, which play a key role in human diet. Commonly used pulses in this type of fermented foods are chiefly Black gram, soybean, Bengal gram, red gram and green gram. Soybean food is a reasonable source of plant protein as compared to animal and milk products on the basis of protein cost per kg, which is easily accessible to the rural poor of the North-eastern region (Tamang 2015b), due to this reason soybean fermented product, are particularly consumed in northeast part of India. Here is enlisted fermented product from cereals, pulses or combination of both (Table 1).

**Fermented grain beverage**

In western countries, numerous varieties of beverages are prepared by means of barley malt, as a source of starch and saccharifying agent. In contrast, in the preparation of Indian traditional beverages such as ragi, rice and barley are used as a rich source of starch and saccharifying enzyme. Many varieties of alcoholic beverages are manufactured and consumed by ethnic people of India. Traditionally different fermented beverage are been produced at different part of India, depending upon the geographical condition, climatic condition and the raw food material chiefly available in that locality of area. Fermented beverages like Soor, ghanti, jann, daru are popular drink of himalyan belt or himalyan region, but there is a variation in the raw material used, rice, barley or finger millet is used as raw materials for the preparation of soor, which contains 35-40 % alcohol. The
people of Himalayan region such as Ladakh call Ghanti as chang. Jann is a traditional local drink of Uttaranchal, which is prepared from rice (Oriza sativa L.), koni (Setaria italica (L.) P. Beauv.), wheat (Triticum aestivum L.), jau (Hordeum vulgare L.) (Sekar and Mariappan 2007). It contains very low concentration of alcohol.

Daru is a distilled liquor containing ethyl alcohol at a much higher concentration prepared from rice, jaggery, koni, chuwa, oowa (Sekar and Mariappan 2007). On the other hand lungi, tchang, Jhar, Zutho, Jnard, Atingba, apong, judima and baathi janr are popular product of north eastern region specifically from Nagaland, Tripura, Sikkim, Meghalaya (Table 2).

Apong is prepared by a combination of ash of paddy husk and straws, cooked glutinous rice and traditional starter and moved into an earthen pot, and are allowed to ferment for 20 days at 30 to 35°C. Many studies have found apong to be helpful in preventing kidney stones formation (Ray et al., 2016).

Judima is prepared through mixing the starter powder humao with air dried boiled rice (1:100) and fermented at room temperature. The drink is very useful against infection and is anti-inflammatory, antiallergic, antioxidant, antibacterial, antifungal, antispasmodic, hepatoprotective, hypolipidemic, neuroprotective, hypotensive, antiaging, and antidiabetic (Ray et al., 2016). For zutho preparation cooled rice porridge is mixed with grist and poured into an earthen jar. The mixture is allowed to ferment for 3 days (Ray et al., 2016). This is known for enhancement of the immune system, lower the blood insulin level, prevent loss of appetite, lower bad cholesterol, assist in wound healing, and prevent infection (Teramoto et al., 2002). These fermented beverage is very useful for the human health.

Fermented plant sources (fruit, vegetables, whole plant part) food product/ beverage

Fermented plant food

The lactic acid fermentation of plant sources is used as a preservation method for the production of finished and semi-finished products. In eastern Himalayan regions of India an extensive range of fermented plant sources products are prepared for storing and consumption fermentation technology is a significant technique to store the perishable plant products as well as their parts in the absence of any refrigeration. There are many fruits vegetable and plant part fermented products listed below (Table 2). Mostly Bamboo Shoots Fermented products are consumed as a traditional food by ethnic people of North-eastern states of India (Sonar et al., 2015). In India, Bamboo Shoots are harvested yearly in Sikkim (26.2 tonnes), Meghalaya (435 tonnes) and Mizoram (426.8 tonnes) (Satish et al., 2013). After many studies made it is considered that bamboo shoots are considered low down in fat and cholesterol, very high in potassium, extracted from bamboo shoots (Choudhury et al., 2011). Fermented bamboo-based foods are considered to have many health benefits. Indigenous fermented bamboo shoot products of North east India are Soibum, Soidon and Soijin in Manipur Bamboo Tenga in Arunachal Pradesh. Moiya Koshak, Melye Amiley, Midukeye and Moiya Pangsgu of Debbarma, Chakma and Uchoi tribes of Tripura, respectively (Uchoi et al., 2015). Predominant micro flora associated with these products are L. brevis, L. plantarum, L. curvatus, P. pentosaceus, L. mesenteroides subsp. mesenteroides, L. fallax, L. lactis, L. citreum, and Enterococcus durans (Satish et al., 2013; Uchoi et al., 2015). Lactic acid fermentation vegetables such as gundruk, sinki, and khalpi are fermented vegetables of Sikkim and Bhutan product. Principal Lactic
Acid Bacteria involved in traditional fermented vegetables are *Lactobacillus brevis*, *L. plantarum*, *Pediococcus pentosaceus*, *P. acidilactici*, and *Leuconostoc fallax*. Some fermented fruit and vegetable products which are solitary prepared by certain tribes of Tripura. *Amlai Ntoi*, *Bikang*, *Bochumba*, *Kosoi*, etc., are traditional products prepared by *Uchoi* and *Jamatia* tribes by fermenting *Amla*, *Bombax ceiba* L. flower and bean, respectively (Uchoi et al., 2015). Ziang Sang and Tapyo is fermented leaf product of *Manipur* and *Arunachal Pradesh* (Satish et al., 2013). Microorganisms involved in these fermented vegetable food products are *Lactobacillus fermentum*, *Lb. plantarum*, *Pediococcus pentosaceus*, etc. (Uchoi et al., 2015). Given below is a list of plant sources fermented food product (Table 3).

**Fermented plant beverage**

Fermented beverage is supreme prevalent ethnic alcoholic drink prepared and mostly consumed in the festival period. Some popular traditional alcoholic beverages of North East India are *Apong* and *Ennog* in *Arunachal Pradesh*, *Bhaati*, *Jaanr* prepared by the *Gorkha* tribe (Uchoi et al., 2015). Traditional beverages have different forms which vary from crystal-clear products to turbid liquid or thick gruels and pastes (Sekar and Mariappan 2007). Varieties of are consumed all over the world. In India, the widely consumed wines are *toddy*, *jackfruit*, *fenny* manufactured from coconut palm (*Cocos nucifera* L.), *jackfruit* (*Artocarpus heterophyllus* Lam.), and *cashew* (*Anacardium occidentale* L.) respectively. The palm wine fermentation *Leuconostoc* sp. and *Zymomonas* sp. *Leuconostoc* sp. and *Lactobacillus* species wich are early bacterial inhabitants of the palm sap. *Saccharomyces cerevisiae* carries out the alcohol fermentation (Sekar and Mariappan 2007). Jackfruit wine is consumed by tribal people of Nagaland, Tripura and other eastern hilly areas of India. Given below is the tabulated form of fermented beverage (Table 4).

**Fermented milk and milk products**

Cattle were an integral part of the Vedic culture. Literature before 800 BCE refers to cow, buffalo, and goat milk, which were consumed either fresh or boiled (Sarkar et al., 2015). Milk and milk products are used up most prevalently due to their nutritive value, due to this reason milk is easily spoiled by pathogenic microorganisms, hence fermentation with the help of LAB is favored for prevention of nutrient quality of milk. LAB converts lactose (milk sugar) into lactic acid. Fermented milk products are mostly prepared by addition of LAB in the form of starter culture to milk (cow, buffalo or yak) and are allowed to ferment. One such popularly known fermented product which is most popular and commonly used traditional Indian fermented product *dahi or curd. Dahi* is a lactic acid fermented product of cow or buffalo milk or combination of both. It can be eaten directly as sweetened or salted form. It is also consumed with other food such as rice and *chapatti*. *Dahi* is rich in lactic acid bacteria and demonstrates probiotic effect, which helps in intestinal health (Sekar and Mariappan 2007). *Lassi* is a traditional milk beverage consumed in summer season which is prepared from *dahi*, by blended with water. To enhance the taste sugar, salt, and spices such as cumin seeds and coriander leaves can be added. *Lassi* is a probiotic product due to the presence of active cultures. Buttermilk is the liquid that is left over when butter is churned out of cream, consumed with or without added salt and spices (Sarkar et al., 2015). It has less fat content and fewer calories compared with regular milk or *dahi*. *Rabdi* is a famous dairy preparation in the north-west part of India. It is a lactic acid-fermented milk product with pearl millet (Table 5).
**Table 1: Grain-based fermented food**

| NAME                  | INGREDIENTS                                                                 | STATE                        |
|-----------------------|-----------------------------------------------------------------------------|------------------------------|
| Koozhu                | *E. coracana* (ragi) (ragi) flour, boiled rice, non-fat yoghurt              | Tamil Nadu                   |
| Pazhaiya soru         | Rice, curd and salt                                                         | Tamil Nadu                   |
| Idli                  | Rice, black gram dhal, Table salt, fenugreek seeds                          | South Indian                 |
| Dosa                  | Rice, black gram dhal (either raw or parboiled rice), Table salt             | South Indian                 |
| Adai dosa             | Boiled rice, Bengal gram, red gram, black gram, green gram                   | South Indian                 |
| Kallappam             | Boiled or raw rice, coconut toddy                                           | South Indian                 |
| Dhokla                | South Bengal gram dhal, rice and leafy vegetables                            | South Indian                 |
| Ambali                | Ragi (Millet) flour and rice                                                | Karnataka and Tamil Nadu     |
| Jilebi                | *Wheat, sugar and curd*                                                    | *South Indian*               |
| Galgule               | Wheat flour and starter material Malera                                      | Himachal Pradesh             |
| Seera                 | Wheat, sugar and ghee                                                       | Himachal Pradesh             |
| Chhuchipatra pitha    | Par-boiled rice, black gram, coconut, sugar and curd                        | Orissa                       |
| Bhatura or indigenous bread | Wheat and starter material Khameer/Malera                                  | Himachal Pradesh             |
| Kulcha                | Wheat and the starter Khameer/Malera                                        | Northern India               |
| Chitou                | Par-boiled rice and black gram                                              | Orissa                       |
| Sel roti              | Rice, banana, honey, ghee and spices                                       | H.P and Sikkim               |
| Manna                 | Wheat                                                                        | Himachal Pradesh             |
| Kurdi                 | Wheat                                                                        | North India                  |
| Askha, anarshe, aenkadu/askalu, patande | Rice                                                                 | Himachal Pradesh             |
| Torani                | Rice                                                                         | Orissa                       |
| Aet, aktori, baari, babroo, bhatoor, chhura, mande/manna, malpude, tcung, shunali | Wheat flour                  | Himachal Pradesh             |
| Chhangpa, doo, khawalag, marpinni/ marjag, tchog, thuktal               | Roasted barley flour                                                       | Himachal Pradesh             |
| Mangiangkori          | Buck wheat bran                                                             | Himachal Pradesh             |
| Endure pitha          | Fermented batter of parboiled rice and black gram                           | Odisha                       |
| Sinki                 | Fermented raddish taproot                                                   | Nepal, Darjeeling, Sikkim and Northeast                                   |
| Sez                   | Rice                                                                         | Uttarakhand, Himachal Pradesh                                           |
| Ragi hurihittu        | Popped finger millet flour                                                  | North east                   |
| Akhone                | Soybean                                                                      | Khasi and Garo in Meghalaya.                                             |
| Tiskori               | Wheat bran                                                                   | Himachal Pradesh             |
| Sour rice             | Raw rice                                                                     | Assam, Bengal, and Odisha                                             |
| Anarshe               | Gluten-Colloid Type Fermented Food                                           | Sikkim and Himalayan India                                          |
| Uttapam               | Rice and Urad Dahl                                                          | South India                  |
| Kinema                | Soybeans                                                                     | Darjeeling, Sikkim                                                         |
| Bari                  | Soybeans                                                                     | Sikkim                       |
| Hawaiiizaar, mata/akhuni | Soybeans                                                              | Manipur                      |
| Wari                  | Black bean and soybean                                                       | Uttar Pradesh                |
| Masyaura              | Black gram or green gram, Colocosia tuber, ashogourd or radish              | Darjeeling hills and Sikkim                                           |
| Bedvin roti           | Black gram, opium seeds or walnut                                           | H.P                          |
**Table 2** Grain based fermented beverage

| Name    | Ingredient                                      | State           |
|---------|-------------------------------------------------|-----------------|
| Lungi   | rice                                            | Tripura         |
| Soor    | Rice, barley, finger millet                     | Himalayan belt  |
| Jhara   | Rice and fresh plants                           | West Bengal     |
| Tchang  | millet                                          | Sikkim          |
| Jhar    | millet                                          | Sikkim          |
| Jaan    | Fermented cereals                               | Uttarakhand     |
| Daru    | Ric, jaggarey and wheat                         | Himalayan belt  |
| Zutho   | Rice flour                                      | Nagaland        |
| Jnard   | Finger millets                                  | Nepalese and Tibetans |
| Atingba | Hamei (natural starter)                         | Manipur         |
| Apong   | mixture of ash of paddy husk and straws, cooked glutinous rice, and traditional starter | North-east India |
| Judima  | Glutinous variety of rice                       | Northeast       |
| Bhaati jaanr | Glutinous variety of rice                       | Northeast       |
| Ghanti  | Fermented musk                                  | Himanchal Pradesh |

**Table 3** Fermented plant based products

| FERMENTED FOOD | INGREDIENTS                                      | STATE                                      |
|----------------|--------------------------------------------------|--------------------------------------------|
| Gundruk        | Leaves of mustard/ radish/cauliflower             | Arunachal Pradesh                          |
| Sinki          | Radish root                                      | North East Indians                         |
| Sauerkraut or Sauerkohi | Cabbage                                          | India                                      |
| Anishi         | Yam                                              | Nagaland                                   |
| Soibum or soijim | Bamboo shoots                                | Manipur, Nagaland                          |
| Soidon         | Bamboo shoots                                    | Manipur                                    |
| Kardi or handua | Bamboo shoots                               | Orissa                                     |
| Bamboo tenga   | Bamboo shoots                                    | Arunachal Pradesh                          |
| Hikhu          | Bamboo shoots                                    | North-east India                           |
| Hiring         | Bamboo shoots                                    | North-east India                           |
| Ekung          | Bamboo shoots                                    | Manipur                                    |
| Eup            | Bamboo shoots                                    | Arunachal Pradesh                          |
| Khorisa-tenga, ushoi, amil, romba | Bamboo shoots                                | North-east India                           |
| Mesu           | Bamboo shoots                                    | Darjeeling hills and Sikkim               |
| Khalpi         | Cucumber                                         | Sikkim                                     |
| Rai (brassica juncea) seeds | Mustard seeds                               | North-east India                           |
| Goyang         | magane-saag (*Cardamine macrophylla* Willd.) leaves | Darjeeling hills and Sikkim               |
| Inziangsang    | Mustard leaves                                   | Nagaland, Manipur                          |
| Kanji          | Carrot or beet root, rice, mustard               | North India                                |
| Moiya pangsung | Bamboo shoots                                    | Uchoni tribe Tripura                       |
| Moliya koshak  | Bamboo shoots                                    | Debbarma tribe Tripura                     |
| Midukeye       | Bamboo shoots                                    | Chakma tribe Tripura                       |
| Melye amiley   | Bamboo shoots                                    | Tripura                                    |
| Amlai ntoi     | Raw amla fruit                                   | Uchoni tribe Tripura                       |
| Kosoi          | Lima bean                                        | Jamata tribe Tripura                       |
| Bikang         | Sword bean                                       | Uchoi tribe Tripura                        |
| Bochu-mba      | *Bombax ceiba* flower                            | Tripura                                    |
| Ziang-sang     | Fermented leaves                                 | Manipur and Arunachal Pradesh              |
| Topyo          | Fermented leaves                                 | Manipur and Arunachal Pradesh              |
| Rep            | Fermented leaves                                 | Manipur and Arunachal Pradesh              |
Table 4: Fermented plant based beverage

| Fermented beverage       | Ingredients                              | State                  |
|--------------------------|------------------------------------------|------------------------|
| Rokshi                   | Plants and plant parts                   | Sikkim                 |
| Jaan                     | Banana, pumpkin and orange               | Uttarakhand            |
| Daru                     | Fruits                                   | Uttarakhand            |
| Jackfruit wine           | Jackfruit                                | Nagaland, Tripura and eastern hilly areas |
| Toddyy                   | Coconut palm                             | India                  |
| Fenny                    | Cashew                                   | India                  |
| Ziang-dui                | Brassica leaves                          | Manipur                |

Table 5: Fermented milk and milk products

| FERMENTED FOOD           | INGREDIENTS                                              | STATE                  |
|--------------------------|----------------------------------------------------------|------------------------|
| Curd (dahi, thayir)      | Milk                                                     | India                  |
| Chhurpi or durkha or churapi | Yak milk is preferred for making this cheese, fresh milk may be used | Arunachal Pradesh      |
| Chhur chirpen            | Yak milk and cut fruits of crab apple (Thung)            | Arunachal Pradesh      |
| Chhurkham                | Chhurpi and fresh milk                                   | Arunachal Pradesh      |
| Chhu                     | Yak or cow milk                                          | Sikkim                 |
| Philu or Philuk          | Cow or yak milk                                          | Sikkim                 |
| Shyow                    | Cow/yak milk                                             | Sikkim                 |
| Gheu                     | Cow milk                                                 | Sikkim                 |
| Mohi                     | Cow milk                                                 | Sikkim                 |
| Somar                    | Cow milk                                                 | Sikkim                 |
| Maa                      | Yak milk                                                 | Sikkim                 |
| Jhol                     | Buttermilk/curd                                          | Himachal Pradesh       |
| Khadi                    | Buttermilk/curd                                          | Gujarat                |
| Misti doi                | partially sweetened milk                                 | Bengal, Gujarat        |
| Shrikhand                | Curd                                                     | southern India         |
| Lassi                    | Curd                                                     | North India            |
| Ginna                    | colostrum                                                | India                  |
| Rabdi                    | Maize flour and buttermilk                              | North India            |
| Buttermilk               | Left over of churned cream                               | Gujarat and Rajasthan  |
| Sandesh                  | chenna                                                   | All over India         |
Table.6 Fermented meat and sea products

| Fermented food | Ingredients                                  | Place                        |
|----------------|----------------------------------------------|------------------------------|
| Ngari          | Puntius sophore (Phoubu) Fish                | Manipur and Assam            |
| Hentak         | Esonus danricus (Fish), petioles of A. macrorhiza | Manipur                     |
| Tungtap        | Danio sp. (Fish)                             | Khasi tribe Maghalaya        |
| Fermented fish | Puntias sophore                              | Manipur                      |
| Lona ilish     | Tenualosa ilisha                             | North-eastern India          |
| Crab           | Crabs, Sesamum orientale                     | North-eastern India          |
| Utonggari      | Local fish (named ‘phobou’)                  | Assam                        |
| Lang kargyong  | Beef                                         | Eastern Himalayas            |
| Yak kargyong   | Meat of yak                                  | Eastern Himalayas            |
| Faak kargyong  | Pork                                         | Eastern Himalayas            |
| Kheuri         | Yak/beef meat                                | Sikkim                       |
| Lang satchu    | Beef                                         | Sikkim                       |
| Yak satchu     | Red meat of yak                              | Sikkim                       |
| Suka Ko Masu   | Red meat of buffalo or goat                  | Darjeeling hills and Sikkim  |
| Chilu          | Yak/beef/lamb meat                           | Sikkim                       |
| Chartayshya    | Red meat of goat                             | Western Himalayas            |
| Geema          | Red meat of goat                             | Western Himalayas            |
| Arjia          | Red meat of goat                             | Western Himalayas            |
| Shidal         | Puthi shida                                  | North east India             |
| Karoti         | Fermented fish                               | Assam                        |
| Bardia         | Fermented fish                               | Assam                        |

Ginna is a colostrum-based Indian sweet. It is also known as jumnu, posu, or kharvas in different regions of India (Sarkar et al., 2015). According to resent studies Colostrum is a rich source of immunoglobulin’s, and iron binding lactoferrin protein, and nutrients such as vitamin A and minerals (Swami et al., 2012).

Yak milk is also used for manufacturing of a number of dairy products like Kurut, Chhurpi, Chhur churpen, Churkham, Chhu, Philuk, Shyow and Maa. Chhurpi has a white, soft with a mild to strong flavoured taste and is consumed as curry mix (Tamang et al., 2007c). Chhu a product predominantly consumed in Sikkim, Darjeeling hills, Arunachal Pradesh and Ladakh. Shyow is a thick gel curd like product, prepared from yak milk is mainly fermentation is by LAB bacteria LAB strains yield various enzymes such as esterase, phosphatase, leucine-arylaminidase, b-galactosidase and peptidase which inhibited pathogens such as Enterobacter agglomerans, Enterobacter cloacae and Klebsiella pneumonia (Satish et al., 2013).

Fermented meat and sea products

Meat is highly prone to microbial spoilage. Traditional processing of meat is done by various methods such as Drying, smoking and fermentation. In India, societies of the North-eastern region ferment meat of yak, goat, pig, fish and crab for longer preservation period. Kargyong is an traditional sausage-like fermented product from yak, beef and pork. Kargyong are of three varieties prepared and consumed: yak kargyong (yak meat), lang
kargyong (beef) and faak kargyong (pork) (Satish et al., 2013). Yak kargyong is a popular fermented sausage in Sikkim, Ladakh, Tibet, Arunachal Pradesh and Bhutan in the Himalayas. Usually fishes are also preserved by traditional method that are sun drying, salting fermentation and smoking. Fermentation of fish is brought about by autocatalytic enzymes from fish and microorganisms in the presence of high-salt concentration (Majumdar and Basu, 2010). In Northeast India, conventionally preserved fish products are Ngari and hentak in Manipur and tungtap in Mehalaya Karoti and Bardia in Assam. Shidal and Lona ilish in Tripura, Gnuchi, Sidra and Sukati in Sikkim (Uchoi et al., 2015). Fermented fish product of ngari, hentak and tungtap have LAB associated with them namely Lactococcus lactis, L. plantarum, Enterococcus faecium, Lactobacillus fructosus, L. amylophilus, L. coryniformis, L. plantarum, Bacillus subtilis B. pumilus, Micrococcus sp. Candida sp., and Sacchromycopsis sp (Jeyaram, 2009; Uchoi et al., 2015). Lona ilish is another popular salt fermented fish product which is prepared from as Ilish maach mainly by the Bengali community people of this state. Microorganism associated with it is Lactococcus lactis subsp cremoris, Lc. plantarum, Enterococcus faecium, Micrococcus (Uchoi et al., 2015). Given below is the table of different fermented meat and fish product and the place they are associated with (Table 6).

Indian fermented food products have a great diversity due to the diversity in the geographical condition, different culture of different region and the raw material present in abundant amount especially in North East Indian states. Traditional fermented products of India are prepared at house hold level through the homegrown practices of food processing and preservation, but there is lacking of hygienic knowledge and specific microorganism for the production of these products. There should be proper knowledge of Good Manufacturing Practice (GMP), microbe and safety of the product so that the product can be marketed and by producing they can be a source for earning to the villagers. There is necessary requirement to settle new biotechnological tools for standardizing them and discovering them in the local markets for their marketable potential.

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