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Short Communication

MICROORGANISMS AND THE NUTRITIVE VALUE OF TRADITIONAL FERMENTED FISH PRODUCTS OF NORTHEAST INDIA

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ABSTRACT
Fermented fish products have an important role in stimulating the appetite by providing unique aromas and flavours. Many kinds of fermented fish products can be found in various parts of north eastern India. Four basic methods of fish fermentation were identified in the region: fermentation with salting; drying and fermentation without salting; drying and fermentation with salting; smoking, drying and fermentation without salting. Raw materials include small and medium sized fresh water whole or partially dressed fishes along with some plant materials like Colocasia plant (*Alocasia macrorhiza*) or S*hizu* leaves (*Euphorbia nerifolia*) or *Tage* leaves (*Natsiatium herpeticum*) etc. Studies identified Lactic Acid Bacteria (LAB), *Bacillus* spp.*, Micrococcus* spp.*,* Yeast are involved in the fermentation process. The products are *Shidol*, *Namsing, Tungtap, Hentak* and *Lona ilish.* All products had high nutritive value.

KEYWORDS: Fermentation, Traditional fish products, Nutritive value, Microorganism, Northeast India.

INTRODUCTION

Geographically, North East India is located within the eastern Himalayas and Purvanchal Himalayas. The Eastern Himalayas region lies between the latitudes 26^0 40′- 29^0 30′ North and longitudes 88^0 5′- 97^0 5′ East comprising two north east states *viz* Sikkim and Arunachal Pradesh, besides eastern Nepal, Darjeeling hills in India, Bhutan and Tibetan autonomous Region in China (Tamang, 2010). The Purvanchal Himalayas lies between the latitudes 21^0 5′ - 28^0 23′ North and longitudes 91^0 13′- 97^0 25′ East, comprising the hills of Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

Fish and fish products have been associated with the socio economic life of the people of Northeast India from time immemorial. More than 98% of the people of the region consume fish as the main source of animal protein either in fresh condition or cured forms along with their staple food rice (Karthikeyan, 2007).

Fermentation is one of the oldest and most economical curing methods for producing and preserving food in the north eastern part of India (Tamang, 1998). Fish fermentation involves breakdown of protein in the raw fish either by the action of microorganisms or by the action of organic catalysts, enzymes or ferments into simpler molecules (Balachandran, 2001), which are themselves stable at normal temperature of storage. During the process of fermentation, locally available ingredient(s), of either plant or animal origin are converted biochemically and organoleptically into upgraded edible products either naturally or by adding starter culture(s) containing functional microorganisms, called fermented foods (Campbell-Platt, 1994). Different ethnic people of the north eastern region use indigenous fermented fish products to provide the basic components of their diet, with diverse characteristics of nutrition, flavor, palatability and texture. In addition to preservation, fermented fish products can also have the added benefits of enhancing flavor, increasing digestibility, improving therapeutic values. The degree of fermentation will depend on the proportion of salt used, fat content of the fish, dressing of the fish like complete or partial removal of the gut, the nature of the additives and the temperature at which the salted fish is maintained. *Ngari* and *Hentak* in Manipur, *Gnuchi, Sidra* and *Sukuti* in Darjeeling and Sikkim, *Tungtap* in Meghalaya, *Bordia, Sepaa* /*Shidol/Hidol, Namsing* in Assam and *Lona ilish* are some of the popular traditional fermented fish products in the region. This present study mainly addresses fermented fish products found in northeast India. Due to lack of scientific information about most of the products, the authors have emphasized processing technologies, which are traditionally employed by producers, microorganisms involved in fermentation process and nutritive value of the products.

MATERIALS AND METHODS

The study was carried out in different villages of the north eastern states of India, to document the traditional knowledge associated with the preparation process of different traditional fermented fish products, step by step. Plant and animal materials used during the preparation process were taxonomically identified. A questionnaire was prepared and filled through participatory interview at the site of the residence of rural people where the product was prepared by conducting group discussions among them. Secondary information was collected from books, reports, electronic and non-electronic sources.The proximate composition of fermented fish products was determined by AOAC, 2000. pH of sample was determined by method described by Suzuki (1981). About

5 g of sample was blended with 45 ml of distilled water and pH of the homogenate was measured by pH meter (Sartorius make).

RESULTS AND DISCUSSION

Ethnic people of the region catch fishes from the rivers, lakes, reservoirs and wetlands. Some of these catches are traditionally fermented. Four basic methods of fish fermentation were identified in the north eastern region: fermentation with salting; drying and fermentation without salting; drying and fermentation with salting; smoking, drying and fermentation without salting.

Different types of traditional fermented fish products of north east India

Shidol/Ngari

Shidol is a salt-free fermented fish product with a paste surface, which is widely used by the people of the North eastern states of India due to its flavour. It has several local names like *Shidol* in Arunachal Pradesh, Meghalaya, Mizoram and Tripura*, Hidol/ Sepaa/ Shidol* in Assam*, Ngari* in Manipur. *Shidol* is an important component of a popular oil-free preparation known as *Godhak* in the tribal food culture in Tripura (Majumdar, 2007). *Iromba* is an popular preparation of Manipur. *Shidol* is prepared exclusively from soft fin swamp barb, *Puntius sophore* (Ham, 1822), but now-a-days, S*hidol* prepared from other fish species like Gangetic hairfin anchovy, *Setipinna phasa* (Ham, 1822)*,* Indian river shad, *Gudusia chapra* (Ham, 1822) is also available in the market and has become popular in the region.

For traditional *Shidol* preparation, the raw fresh fish species were washed and allowed to sundry for 4-5 days. They were placed in airtight earthen pots (round bottomed and narrow necked earthen vats, the capacity of which ranges from 10-40 kg) with the dry fish after soaking for 5-10 minutes and drying in the shade, allowing to drain out the excess water. Soaking of raw materials is very important in the preparation of *Shidol* and crucial for obtaining the best quality product. The earthen pots are kept ready before filling with the dried fish by repeated smearing of oil and subsequent drying under sun (fish oil extracted from the entrails of *Puntius sophore* or other fresh water fishes, through an indigenous crude method or vegetable oil are used for smearing). The earthen pot*s are* saturated with oil to prevent the permeability of air. Unlike the other fermented fish products, salt is never added during the preparation of *Shidol*. The filled earthen pot is then sealed air tight, with a cover paste made of waste of dried fish with water followed by a polythene sheet, finally with a layer of mud in the mouth portion of the pot, thus providing an anaerobic condition inside and stored at room temperature for 3-6 months for fermentation.

Microorganisms involved during fermentations: *Lactococcus lactis subsp cremoris, Lc. plantarum, Enterococcus faecium, Lactobacillus fructosus, Lb. amylophilus, Lb. coryniformis subsp torques, Lb. plantarum, Bacillus subtilis, B. pumilus, Micrococcus,* Yeast: *Species of Candida* and *Saccharomycosis* (Thapa *et al.,* 2004).

Nutritive value: Moisture: 33.44%, Protein: 38.35%, Fat: 20.31%, Ash: 7.19%, pH: 6.1.

Namsing

Namsing is prepared from the small and medium sized freshwater fish species such as *Puntius* spp, *Amblyphryngodon mola, Channa spp, Mastacembellus* spp*, Labeo bata*, *Anabus testideneus*, *Colisa* spp, *Danio* spp, *Botia* spp etc. along with some plant materials like Colocasia plant (*Alocasia macrorhiza*) or S*hizu* leaves (*Euphorbia nerifolia*) or *Tage* leaves (*Natsiatium herpeticum*) by the *Mising* community of upper Assam and *Rajbonshi* community of lower Assam. During the preparation of the product, the fresh fishes are gutted and washed properly. The dressed fishes are smoked for 2-3 hours and sun dried for a few hours so that they can be easily crumbled. Then the dried fishes are crushed to powder using a traditional grinder. An equal weight of cut pieces of plant materials are then crushed along with the fish powder to make a paste. The ingredients like ginger, garlic, turmeric, chilli powder are mixed according to their taste. Salt is not used during the preparation. Small balls are prepared from this paste and allowed to dry. The dried balls are then put in bamboo tubes of 1.5–2 ft long and sealed airtight. The bamboo tubes are kept over fireplace for fermentation for 30 days.

Microorganisms involved during fermentation: Unknown.

Nutritive value: Moisture: 38.65%, Protein: 34.27%, Fat: 14.50%, Ash: 14.50%, pH: 6.8.

Hentak

Hentak is a semi-fermented fish paste product, prepared by *Meitei* community of Manipur using mainly a small fresh water fish species *Esomus danricus* (Ham). *Esomus danricus* is washed thoroughly, sun dried and crushed to a powder. Petioles of *Alocasia macrorhiza* are washed and dried under sunlight for few hours. An equal amount of cut pieces of dried *Alocasia macrorhiza* are crushed along with the fish powder to make a paste. Small balls of the size of an egg are prepared from this paste and are kept for four days for fermentation inside an earthen pot in air tight condition. After a few days, of interval the, balls are taken out and kneaded with mustard oil and again kept for fermentation in the earthen pot repeatedly, until the desired texture of the product is achieved. The product attaining such a stage can be kept for six months as small balls by wrapping with clean banana leaf which is placed inside the earthen pot which is covered by lids and reinforced by a paste mixture of raw cow dung and clay @ 1: 1. After six months of storage, the product is ready for human consumption.

Microorganisms involved during fermentation: *Lactococcus lactis subsp cremoris, Lc. plantarum,Enterococcus faecium, Lactobacillus fructosus, Lb. amylophilus, Lb. coryniformis subsp torques, Lb. plantarum, Bacillus subtilis, B. pumilus, Micrococcus,* Yeast: *Species of Candida and Saccharomycosis* (Thapa *et al.,* 2004).

Nutritive value: Moisture: 44.26%, Protein: 22.84%, Fat:6.19%, Ash: 14.96%, pH: 6.4.

Tungtap

Tungtap is a popular fermented fish (*Puntius* spp. and/or *Danio* spp.) product, commercially prepared and consumed by the *Khasi* and *Jaintia* tribes of Meghalaya. In the traditional methods of preparation, fishes are washed properly and dried under the sun for 3-4 days. The

fish are salted: fish ratio of 1: 10. The dried fishes in 30-40 kg batches are supplemented with some amount of fish fat to create a semi anaerobic condition and packed in earthen pots. The pot is sealed using fish scale, mud, oil slurry or polythene sheet to make the pot air tight and is stored at room temperature (18-28^0 C) for 3-6 months for fermentation. Once the fermentation process is complete the product is taken out and sold in the market. *Tungtap* is consumed as pickle and taste enhancer. (Rapsang and Joshi, 2012).

Microorganisms involved during fermentation: *Lactobacillus amylophilus, Lb. coryniformis subsp torques, Lb. plantarum, Lb. fructosus, Lactococcus lactis subsp cremoris, Lc. plantarum, Enterococcus faecium, Bacillus subtilis, B. pumilus, Micrococcus,* Yeast: Species of *Candida* and *Saccharomycosis* (Thapa *et al.,* 2004).

Nutritive value: Moisture: 35.40%, Protein: 32.0%, Fat: 12.0%, Ash: 18.9%, pH: 6.2 (Thapa and Pal, 2007).

Lona ilish

Lona ilish is a salt fermented fish product from *Hilsa, Tenualosa ilisha* (Ham-Buch, 1822) is very popular in Northeastern parts of India and Bangladesh due to its typical flavor and aroma. During preparation of *Lona ilish,* fresh or iced *Hilsa* fish are first washed, descaled and beheaded without removing gut and cut diagonally into steaks of about 1.25 to 2.0 cm thickness. The fish steaks are then dry salted and kept 24-48 hr. in a bamboo basket with a covering. During this time the fluid from the fish is allowed to drain. The salted fish steaks are then packed tightly in tin containers usually of 18 L capacity. When the tin is almost filled, previously boiled and cooled saturated brine is poured slowly to fill the voids between the steaks and maintained a level of brine about 2 cm above the steaks. The tin is then closed with a lid, which is tied with a wire. The packed tins are stored for fermentation for a period of 4-6 months (Majumdar *et al.,* 2005).

Microorganisms involved during fermentation: *Bacillus* spp*., Micrococcus* spp. (Majumdar and Basu, 2010).

Nutritive value: Moisture: 54.35%, Protein: 2.81%, muscle, Fat: 9.41%, Ash: 16.73%, pH: 5.66 (Majumdar and Basu, 2010).

Importance of traditional fermented fish products

The ethnic fermented foods are the food security of north east India, coming to the rescue of and the people at the time of famine, extreme environment, manmade disasters and also source of revenue for people to sustain their livelihood. Fermented fish products have different advantages:

During fermentation microorganisms convert the chemical constituents of raw substrates and enhance the nutritional value of products, improve flavor and texture, preserve the perishable foods and extend the shelf life, fortify the product with health-promoting bioactive compounds, vitamins and minerals, degrade undesirable compounds and anti nutritive factors, produce antioxidant component and anti microbial compounds and stimulate the probiotic function (Farhad *et al.,* 2010).

Improve nutritional value: Bioenrichment of food substrates by traditional fermentation with protein, essential amino acids and vitamins enhancing nutritive value of raw material (Tamang, 1998). Total amino acids, free amino acids and fatty acid contents are increased during fermentation of fish (Rabei *et al.,* 2009; Chang *et al.,* 1994).

Enrichment of diet: imparts typical flavor and texture to the product.

Preservation of foods: During fermentation of fish, pH value is reduced of the substrate, making the products more acidic in nature and inhibits the growth of pathogenic microorganisms thus extending the shelf life of the fermented products.

Probiotic properties: Probiotic are defined as mono-or mixed cultures of microorganisms which, when applied to man, beneficially affect the host by improving the properties of the indigenous microflora (Holzapfel *et al.,* 1998).Adherence is one of the most important selection criteria for probiotic bacteria (Shah, 2001). High degree of hydrophobicity by LAB isolated from indigenous fermented foods of the region indicates the potential of adhesion to gut epithelial cells of human intestine, advocating their probiotic character (Dewan, 2002).

CONCLUSION

Fermented fish products from northeastern India vary in form, raw material and fermentation type. Most of them have not been studied in detail, thus scientific information relating to those products is meagre. More studies identify lactic acid bacteria involved in the fermentation which suggests improved product quality can be achieved by using selected lactic acid bacteria. Rich microbial diversity associated with the fermented fish products harness indigenous micro biota for spontaneous fermentation. This also correlates with the indigenous knowledge of rural people to preserve and supplement microorganisms for production of fermented fish products.

Fermented fish products available in region are rich in protein content and provide many different flavors which meet various consumer appetites. Unfortunately, most of these products are only available locally. Thus, a product in one region will be very difficult to find in other places.

Govt. and non-govt. organizations should come forward to commercialize fermented delicacies outside the region and efforts should be made towards successful farming and breeding of species used for preparation of fermented fish products to make it commercially sustainable.

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