



EDITED BY

Ankures Bhattacharya
West Bengal University of
Animal and Fishery Sciences

REVIEWED BY

Dr. Asik Ikbal
Department of Fisheries
Govt. of West Bengal

Dr. Supratim Chowdhury
West Bengal University of
Animal and Fishery Sciences

*CORRESPONDENCE

Beauty Ray
beautyray859@gmail.com

RECEIVED 2 May 2023

ACCEPTED 8 June 2023

PUBLISHED 16 June 2023

CITATION

Ray B, Nath S, Murmu P and
Das D (2023) Fermented fish
products of North-East India.
Chronicle of Aquatic Science
1(1): 23- 29

COPYRIGHT

This is an open-access article
distributed under the terms of
the [Creative Commons
Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/).
The use, distribution or
reproduction in other forums
is permitted, provided the
original author(s) and the
copyright owner(s) are
credited and that the original
publication in this journal is
cited, in accordance with
accepted academic practice.
No use, distribution or
reproduction is permitted
which does not comply with
these terms.

Fermented fish products of North-East India

B. Ray¹, S. Nath¹, P. Murmu¹, D. Das¹

¹Department of Fish Processing Technology, Faculty of Fishery Sciences, WBUAFS, Chakgaria, Kolkata-700094

Fermentation can be characterized as any method used to produce a good using a large culture of microorganisms. Lactic acid bacteria (LAB) are the principal microorganisms used in fermentation are often termed as probiotic, i.e., beneficial to human health. Basically, the fermentation process enriches and improves the flavour, aroma, and texture of food; preserves food by producing organic acids; improves nutrition; reduces endogenous toxins; shortens cooking time and reduces fuel consumption. The North-Eastern Indians produce various types of region-specific fermented foods having their own distinct substrates and techniques of manufacture. Due to the delicate flavor, excellent nutritional value and involvement of economic infrastructure, fermented fish products have become one of India's most popular native foods in the north-eastern region. Fermentation is such an age-old preservation practice especially for tiny sized freshwater fish such as *Setipinna* sp, *Puntis sphore*, and so on to produce products like shidal in Assam, ngari in Manipur, hentak, lona ilish, tungtap, and numsing in the northeastern India. The northeastern local population uses Indian fermented foods both as traditional medicine and part of their diet. A number of peptides generated from dietary proteins during fermentation of fish, are known to exhibit biological activities, such as antibacterial capabilities, blood pressure and cholesterol-lowering effects, antithrombotic and antioxidant activities.

Keywords

Fermented fish product, Shidal, Ngari, Hentak, Godak

Introduction

The North-Eastern India is surrounded by a latitude of 21050' and 29034'N and a longitude of 85034'N and 97050'E, respectively. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura are the seven states in India's north-eastern region, which covers about 8% of India's total geographic area (Das et al., 2016). Various kinds of tribal communities are constituting about 75% of the local population in this region (Das and Deka, 2012). Their language, lifestyle, food habits are different. They produce various types of fermented foods and beverages. Each region-specific fermented product has its own distinct substrates and techniques of manufacture. The word fermentation comes from the Latin verb *fervere*, which means "to boil" (Das and Deka, 2012). Fermentation can be characterized as any method used to produce a good using a large culture of microorganisms (Stanbury, 1999). One of the earliest and most affordable ways to keep food safe with high quality is through fermentation (Das and Deka, 2012). The procedure also improves digestibility and has positive effects on health (Jeyaram et al., 2009). Some specified compounds such as phytates, polyphenols, and tannins (Sharma and Kapoor, 1996) that might be present in raw foods may be destroyed or detoxified with the help of fermentation (Das and Deka, 2012). Due to the lack of sterility and the use of natural fermentation, fermented goods frequently have mixed microbial populations (Nout and Sarkar, 1999). Lactic acid bacteria (LAB) are the principal microorganisms used in fermentation (Rawat et al., 2018). The microorganisms used in fermentation are often termed as probiotic, i.e., beneficial to human health. When these probiotic microorganisms are cultured in food products, they improve the nutritional value of the food while also enhancing its medicinal potential (Rawat et al., 2018). Basically, the fermentation process enriches and improves the flavour, aroma, and texture of food; preserves food by producing organic acids; improves nutrition; reduces endogenous toxins; shortens cooking time, and reduces fuel consumption (Ahmed and Ganguly, 2014). Due to fishes' high perishable nature, fish preservation practices are need to be employed to delay the microbial spoilage. Modern and advanced fish preservation methods including canning, freezing, freeze drying, extrusion, irradiation, high pressure processing, pulse light technology, and

advanced packaging method are the recent advancement for fish processing and preservation. The traditional age-old practices like smoking, salting, drying, and fermentation are eternal for fish processing and preservation. Fermentation is a process in which sugars are transformed into a new product through chemical reactions carried out by microorganisms. A number of peptides generated from dietary proteins during fermentation of fish, are known to exhibit biological activities, such as antibacterial capabilities, blood pressure and cholesterol-lowering effects, and antithrombotic and antioxidant activities (Majumdar et al., 2015). A complex metabolic response between microorganisms, particularly lipolysis and lipid oxidation, results in the creation of flavored compounds as fish ferments (Feng et al., 2021). Due to its delicate flavor, excellent nutritional value and involvement of economic infrastructure, fermented fish products have become one of India's most popular native foods in the north-eastern region (Majumdar et al., 2016).

NORTHEASTERN TRADITIONAL FISH PRODUCTS

The Brahmaputra River and its lakes are the source of fresh water food fish for local northeastern ethnic groups, although, for commercial production, fish is procured from local markets, from distant markets of West Bengal and Andhra Pradesh; the part of Brahmaputra River of Assam and Bangladesh also supplies fish at every corner of north eastern villages (Keishing and Banu, 2015). Due to high perishability, harvested fish requires scientific preservation practices to be employed for longer shelf life such as traditional long-term fermentation, smoking, drying, and salting. Fermentation is such an age-old preservation practice especially for tiny sized freshwater fish such as *Setipinna* sp, *Puntis sphore*, and so on. Numerous fermented fish products including shidal, ngari, hentaak, lona ilish, tungtap, and numsing are produced in the northeastern area of India (Majumdar et al., 2015). The three most significant and well-known traditional fermented fish products from North-East India are hentak, ngari in Manipur, and shidal in Assam.

PRODUCTS AND PREPARATION PROCEDURE

Ngari: Ngari is created by fermenting sun-dried *Puntis sophore* (Ham), *Puntis ticto* (Ham), and *Setipinna* sp for five to six months at room temperature in an earthenware pot (Taorem and Sarojanlini, 2012). All populations in Manipur and the neighboring states consume Ngari, a popular traditional fermented fish product, as a daily required side dish known as Ironba (combined with potato, chillies, and cooked rice). Basically, it is eaten as a side dish and as a cuisine (Eromba) (Singh et al., 2018) and their shelf life is about 12-18 months (Singh et al., 2019). This fermented fish product Ngari is widely acceptable in various religious festivals of Manipur, and these domestic arts are passed down through the generations in Manipur.

Preparation procedure

The basic material used is sun dried *Puntis sophore*. Prior to fermentation, fish is rinsed with water in porous bamboo-based baskets and let to drain the water for 24-48 hrs (Keishing and Banu, 2015). The surplus water in the head and bones of fish is evacuated by compressing with leg and gunny bags in the next morning (Jeyaram et al., 2009). It is thought that oil produced from the head after pressing, starts fermentation. Mustard oil was applied to the interior surface of an earthen pot (45–50 kg capacity), which is locally known as Kharung (Keishing and Banu, 2015). For brand-new pots, 8–10 oil coatings with intervals of 7–10 days is necessary (Keishing and Banu, 2015). One coat of edible oil sufficient for high-quality fermentation. It's possible that oil coating is causing an anaerobic atmosphere inside the chamber. Finally, pressure compressed dry fish is placed securely inside the earthen pot. For this, skilled labor is employed. The earthen pot is then tightly bonded by wires to make handling easier and to prevent leaking and breakage. The earthen pot is then covered with thick mud or clay made from humus-rich fine soil as a permanent seal until maturation (Keishing and Banu, 2015). These packed pots can be stored at room temperature for 6–12 months in the dark (Jeyaram et al., 2009). After finishing the maturation period of fermentation, the sealing layer of the pot is removed; and the top fish layer known as phumai, fetchesless price as compared to inside pot content, termed as Ngari costs around Rs 500/- to Rs 600/- per kg (Singh

et al., 2019). Ngari is popularly consumed in all the NE states and Myanmar as well.

Hentak: Traditional fermented fish paste prepared from sun-dried fish (*Esomus danricus*) is called hentak (Thapa et al., 2004). In Manipur, a thick paste known as "Hentak" is made by fermenting a mixture of sun-dried fish (*Esomus danricus* and *Puntius sophore*), petioles from Hongu (*Alocasia macrorrhiza*), and a small amount of onion (Meitei Tilhou) (Singh et al., 2018). Hentak is eaten as a curry and as a side dish with cooked rice. It is occasionally administered to expectant moms and patients who are recovering (Singh et al., 2018).

Preparation procedure

Esomus danricus is crushed to power during the indigenous preparation procedure. *Alocasia macrorrhiza* petioles are divided into pieces, cleaned with water, and left in the sun for an hour. The sliced pieces and fish in equal weight ratio are crushed to create a paste. The paste is transformed into little balls and placed in earthen pots for fermentation (Jeyaram et al., 2009) for a period about 15-20 days (Singh et al., 2018). After a few months of storage, the balls become firm. They are then mixed with little water to make a paste, which is then packaged into balls for reserve food storage (Jeyaram et al., 2009). In rare cases, onions can be used instead of *A. macrorrhiza* during preparing hentak, although having inferior quality with shorter shelf life (Singh et al., 2019).

Shidal: Shidal is a fish-based product from Northeast India that is salt-free, semi-fermented, and reddish brown in colour (Muzaddadi & Mahanta, 2013). Shidal is only made from *Puntius* sp. (often known as *Puntius sophore*), also known as Puntid shidal, or from the estuarine fish *Setipinna phasa*, also known as Phasa Shidal (Majumdar et al., 2016). In Assam, Tripura, Arunachal Pradesh, and Nagaland, it goes by the names seedal, seepa, hidal, shidol respectively (Thapa, 2016) and also Ngari in Manipur (Ahmed et al., 2016). The product has a solid, bilaterally compressed, pasty look, and the fish's shape is mostly unaltered; partial disintegration of fish's shape takes place near the belly and caudal region (Majumdar et al., 2016). The indigenous people consume shidal daily by preparing a variety of dishes such as shidal chutney, which has malaria-curing properties (Muzaddadi and Basu, 2012); mosdeng, a paste made by grinding roasted chilly, onion, salt and roasted

shidal; ghodak, is a semi-liquid paste made by grinding boiled vegetables, chilly, salt and roasted shidal; and berma butui which isa vegetables curry prepared with shidal (Uchoi et al., 2022).

Preparation procedure

Puntius sp. is semi-dried (often in the sun) and used for the manufacture of shidal. The fish that has been partially or semi-dried allows a variety of microorganisms to proliferate that initiates fermentation (Ahmed et al., 2016). For shidal preparation oil smeared clay pot, locally known as 'matka' is used, where the smearing time takes 2-5 or 7-10 days (Majumdar et al., 2016). Previously sun-dried fish is cleaned and dried. This dring is followed by water soaking in a porousbamboo basket depending on duration of fermentation. For instance, fish are water soaked for 20 to 25 minutes for one-month fermentation, 15 to 20 minutes for two- to three-month fermentation, and 5 to 10 minutes for six-month fermentation (Majumdar et al., 2016). The matka, about 40 kg capacity, is then filled with the water-soaked fish; one matka with a need about 35–37 kg of dried punti. The matkas are sealed and left to ferment for 3-5 months at room temperature (Majumdar et al., 2016). Shidal typically takes four to six months to fully ferment and mature. Immediate after opening of sealed matka after fermentation, the color of the shidal is dull white that gradually turns from light brown to deep brown in continual exposure to air (Majumdar et al., 2009). Shidal is highly consumed due to its characteristic flavor and odor. But after full fermentation or maturation it starts losing its odor and flavor. It is thought that, seasoning with salt helps to maintain the distinctive flavor of shidal (Mahanta and Muzaddadi, 2012). For preservation of its natural flavor and fragrance, it is promptly wrapped in old newspapers or polythene after being dusted with about 5% common salt for sale purposes, which is also known as post fermentation or ex-situ preservation (Mahanta and Muzaddadi, 2012). Shidal is traditionally consumed by several tribes after being prepared using traditional recipes such as Godak (Debbarma, Uchoi, Chakma, Jamatia tribe), Shidal chutney (Bengali community), Chakhoe (Debbarma tribe), etc. (Uchoi et al., 2015). Ngari, in Manipur, documents almost similar procedure for preparation, although nomenclature and maturation time may vary as well.

Godak: A semifermented, unsalted fish product is called godak (Thapa, 2016). It is made with uncooked shidal (Dhar et al., 2012).

Preparation procedure

People find the smell of raw shidal repulsive unless they become acclimated to it. Shidal can either be cooked in a Godak dish by boiling it with other vegetables and plants or by making Shidal Chutney by combining various condiments and spices (Dhar et al., 2012). For godak preparation, freshly prepared *Puntius* shidal had been cleaned off and set away. After thorough washing and cutting, All the ingredients such as beans, green peas, green chilies, banana stems, bamboo shoots, and potatoes are thoroughly washed, cut, and placed in a round-bottomed aluminium container locally called dekchi; followed by boiling in hot water for another thirty minutes. After boiling the ingredients shidal is added and boiled again. The entire cooked ingredients are mashed with a bamboo stick after chilling for a while. The end result is godak, which has a semi-solid consistency (Dhar et al., 2012).

Japangangnagtsu: A northeastern crab (*Scylla* sp.)-based fermented culinary product is 'Japangangnagtsu.'. Crabs are thoroughly washed and cleaned followed by removal of the hard coatings. The meat is then combined with pulverised black til (*Sesamum orientale* L.), and it is either preserved in a pot wrapped in banana leaves, or *Phrynium pubinerve* leaf. The fermentation is finished after being kept near the fire for 3–4 days (Jamir and Deb, 2014).

Lona Illis: *Tenulosa ilisha*, also locally called as Ilish mach, is used to make the salt-fermented fish product lona ilish, which is mostly consumed by the Bengali community (Uchoi et al., 2015). The distinctive flavour and aroma, the signature sweet, fruity, acidic and salty test, makes this fish well-liked in NEI (Majumdar et al., 2016).

Preparation procedure

Adult hilsa have a fat content range from 14% to 25% (Majumdar et al., 2016). After, being properly gutted and washed, the fish is chopped diagonally such that the steaks/chunks are typically 1.5–2.0 cm thick. Each fish steak is extensively covered in salt (fish: salt = 4:1) (Majumdar et al., 2016), before being placed in a saturated brine to ferment until the characteristic flavor and texture

appear (Uchoi et al., 2015). After brining, lona ilish appears uniformly shining pink. A typical lona ilish has a consistent pink color and a glossy look, containing a potent aroma that combines saltiness with some sweet, fruity, and acidic overtones (Majumdar et al., 2016).

Tungtap: In northeastern India, the Khasia and Jaintia tribes' community of Meghalaya, frequently eat tungtap, a fermented fish paste (Das et al., 2016; Rapsang and Joshi, 2012). Practically, tungtap is used as a pickle and flavour enhancer rather than fish paste or sauce dishes (Thapa et al., 2004; Rapsang and Joshi, 2012).

Preparation procedure

Sun-dried *Danio* spp. is basically, used for tungtap preparation (Thapa et al., 2004). The traditional technique of preparation involves thoroughly washing the fish followed by drying in the sun for three to four days; addition of some fish fat (fish oil) to produce a semi-anaerobic environment followed by fermentation of the dried *Danio* sp. for four to seven days (Satish Kumar et al., 2013) by storing in earthen pots (Rapsang and Joshi, 2012; Thapa et al., 2004). The remarkable autolytic degradation of the fish tissues during fish fermentation are the proteolysis and liquefaction (Rapsang and Joshi, 2012) that leads to pickle like appearance.

Ithitongka: The Moyon tribe of Chandel district, Manipur prepares and consumes Ithitongka, a distinctive form of fermented fish (Wahengbam et al., 2020).

Preparation procedure

Small fish from nearby rivers and streams are first taken out, cleaned, washed and put into a young bamboo trunk, the mouth is then tightly wrapped with turmeric leaves. Until its outer layer is partially burnt, this sealed bamboo is held in the fire. Partial cooling for a specific time is done to avoid spoilage, however, the whole set up is placed over fire without cooking it, thus, can be kept for up to two weeks. When there is a good fish catch, this fermented fish with a distinctive smell and flavor is mostly made for domestic consumption (Singh et al., 2019).

Utonggari: The regional or rural waterbodies of assam are rich in local fish species named as phobou, which is used as a raw material for preparation of fermented fish (Utonggari).

Preparation procedure

The fish is dried, compressed and placed in an earthen pot, covered with mud and left to ferment for around two to three months. The entire clay pot may occasionally be coated with mud and banana leaves to create an airtight seal. After two to three months, the fermented fish is taken out from the earthen for consumption along with bamboo shoots and leafy vegetables (Singh and Singh, 2007).

HEALTH BENEFITS OF FERMENTED PRODUCTS

The northeastern local population uses Indian fermented foods both as traditional medicine and part of their diet. Many of the items have been utilized as a special diet or medicine for years because the locals found that they had a positive impact during illnesses (Satish Kumar et al., 2013). The Meitei community's elderly women are familiar with the Yongchak Iromba meal, which combines Ngari-dry fish of the *Puntius* sp. or *Eromus dandricus* is mixed with Iromba. This dish is regarded an appetizer and is popular among the Meitei community's elderly women (Satish Kumar et al., 2013). According to Muzaddadi and Basu (2012), the indigenous people of North-Eastern India believe in treatment of malaria by using shidal. Hentak is eaten with cooked rice as a seasoning and as a curry both. At times, Hentak is administered to expectant moms and patients who are recovering (Satish Kumar et al., 2013). To delay the growth of spoilage and pathogenic bacteria, care must be made to ensure hygienic handling procedures and food safety during the fermentation process. These domestic culinary practices are passed down through generation after generation over the years, and the fermented fish products make their own signature as a part of many North-Eastern religious festivals and cultural decree as well.

CONCLUSIONS

Likewise, the geographical variation, regional cultural diversity, and the versatility of available raw material, particularly in the North-East Indian states, Indian fermented food products are diversified as well. Literature review reveals that many research works were carried out and documented regarding the standardization of the

recipe, quality characteristics, the storage stability and nutritional profile of these North-Eastern fermented fish and fishery products, although commercialization is limited. However, in the northern part of West Bengal, people of royal Rajbanshi community, also produce a fermented fish product in their own traditional way, locally known as Rajbanshi shidal, although the cuisine and recipe are quite different from north-eastern shidal. This Rajbanshi shidal, the traditional culinary practice of West Bengal is minimally explored, thus got least exposure; the recipe is not standardised yet. Moreover, literatures are almost nil on the preparation, nutritional profile and shelf-life analysis of this fermented fish paste product reflecting a genuine research gap regarding exploration of traditional dishes of West Bengal. Thus, future research can be done by standardization of the recipe of Shidal preparation by Rajbanshi people of Dooars of North Bengal. Additionally, analysis of the nutritional profile and shelf-life assessment can also be done by evaluating the biochemical, physical, textural, microbiological and sensory attributes of shidal.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

Conflict of interest

The authors declare that the manuscript was formulated in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

REFERENCES

Das, A. J., & Deka, S. C. (2012). Fermented foods and beverages of the North-East India.

Jeyaram, K., Singh, T. A., Romi, W., Devi, A. R., & Singh, W. M. (2009). Traditional fermented foods of Manipur.

Wahengbam, R., Thangjam, A. S., Keisam, S., Asem, I. D., Ningthoujam, D. S., & Jeyaram, K. (2020). Ethnic fermented foods and alcoholic beverages of Manipur. *Ethnic Fermented Foods and Beverages of India: Science History and Culture*, 349-419.

Majumdar, R. K., Roy, D., Bejjanki, S., & Bhaskar, N. (2016). Chemical and microbial properties of shidal, a traditional fermented fish of Northeast India. *Journal of Food science and Technology*, 53, 401-410.

Feng, L., Tang, N., Liu, R., Gong, M., Wang, Z., Guo, Y., ... & Chang, M. (2021). The relationship between flavor formation, lipid metabolism, and microorganisms in fermented fish products. *Food & Function*, 12(13), 5685-5702.

Zang, J., Xu, Y., Xia, W., & Regenstein, J. M. (2020). Quality, functionality, and microbiology of fermented fish: a review. *Critical Reviews in Food Science and Nutrition*, 60(7), 1228-1242.

Taorem, S., & Sarojanlini, C. (2012). Effect of Temperature on Biochemical and Microbiological qualities of Ngari. *Nature and Science*, 10(2), 32-40.

Thapa, N., Pal, J., & Tamang, J. P. (2004). Microbial diversity in ngari, hentak and tungtap, fermented fish products of North-East India. *World Journal of Microbiology and Biotechnology*, 20, 599-607.

Singh, S. S., De Mandal, S., Lalnunmawii, E., & Senthil Kumar, N. (2018). Antimicrobial, antioxidant and probiotics characterization of dominant bacterial isolates from traditional fermented fish of Manipur, North-East India. *Journal of food science and technology*, 55, 1870-1879.

Majumdar, R. K., Bejjanki, S. K., Roy, D., Shitole, S., Saha, A., & Narayan, B. (2015). Biochemical and microbial characterization of Ngari and Hentaak-traditional fermented fish products of India. *Journal of Food Science and Technology*, 52, 8284-8291.

Dhar, B., Roy, D., Majumdar, A., & Roy, N. (2012).

Indigenous knowledge on processing of 'Godak'—a delicacy of the tribal population in Tripura and its nutritional quality. *Keanean J Sci*, 1, 75-79.

- Keishing, S., & Banu, T. (2015). Fermented fish (ngari) of Manipur—preparation technique and its potential as a functional food ingredient. *Elixir Food Sci*, 85, 34502-34507.
- Thapa, N. (2016). Ethnic fermented and preserved fish products of India and Nepal. *Journal of Ethnic Foods*, 3(1), 69-77.
- Rapsang, G. F., & Joshi, S. R. (2012). Bacterial diversity associated with tungtap, an ethnic traditionally fermented fish product of Meghalaya.
- Uchoi, D., Roy, D., Majumdar, R. K., & Debbarma, P. (2015). Diversified traditional cured food products of certain indigenous tribes of Tripura, India.
- Majumdar, R. K., Roy, D., Bejjanki, S., & Bhaskar, N. (2016). An overview of some ethnic fermented fish products of the Eastern Himalayan region of India. *Journal of Ethnic Foods*, 3(4), 276-283.