Fermentation Technology for Fish

Devananda Uchoi
Quality Assurance and Management Division
ICAR-Central Institute of Fisheries Technology, Cochin
Email: **uchoidev514@gmail.com**

Introduction

Fermentation of fish is practiced in different parts of the world and is most popular in Southeast Asian countries, including India. Fish and fishery products have been associated with the socio-economic life of the people since many years. Fermentation is one of the ancient and most economical curing methods adopted for preserving fish. In times when there were no modern preservation techniques such as canning, refrigeration, freeze drying, etc. fermentation played an important role for preserving foods. Some of the popular fermented fish products from Southeast Asian countries are *nam-pla* and *pla-ra* in Thailand, *phu quoc*, *shiokara* and *narezushi* in Japan, *budu* and *belacan* in Malaysia, *patis* and *buro* in Philippines, *nuoc-mam* and *mams-ca* in Vietnam, *makassar* and *trassi* in Indonesia, *ngapi* in Myanmar etc. Most of these products are either in sauce or paste form.

Some major fermented fish products from India are *ngari* and *hentak* in Manipur, *tungtap* in Meghalaya, *puthi shidal, lona ilish* &*phasa shidal* in Tripura, *nghaum*, *nghathu* &*dang pui thu* in Mizoram, *ngyii papi* in Arunachal Pradesh, *seedal* in Assam, etc. Most of these products are almost similar in manyaspects; however, the names vary due to different locality. In earlier days fermentation was used to preserve foods, and later came to be valued for medicinal and nourishing properties. Some of the fermented fish products are marketed in the name of functional foods by various companies. Eg. Intestive, Seacure, Seavive, etc.

Why to ferment fish?

Fish should be consumed in fresh condition, but fish due to its rich nutrients composition deteriorates very quickly. Therefore, there is a need to delay their degradation by application of some preservation technique. Fermentation is one such technique which is applied for the following reasons.

1. Preservation of fish/ to handle surplus catch/ prevent spoilage
2. To overcome fishing off-season
3. Flavour development
4. Nutrient enhancement
5. Value addition
6. To develop product variety
7. To develop unique taste (savory/umami)
8. Fish fermentation is still existing because the consumers enjoy the taste

How does fermentation preserve fish?

Fermentationis an ideal example of hurdle technology. It works as preservative technique by lowering the pH, redox potential (Eh) andwater activity (a_w) of the substrate.In modern technique, fermentation is sometime referred to as bio-preservation by addition of lactic

acid bacteria (LAB) to the fish to be fermented. LAB produces antimicrobials such as lactic, acetic acid, antimicrobial nisin, hydrogen peroxide and peptide bacteriocins. These active substances prevent pathogenic and spoilage bacteria to proliferate and thus helps to preserve the fish.

Table 1.Countries producing fermented fish product

Countries	Sauce	Paste	Retain original form
Japan	Phu Quoc	Nukazuke, Shiokara,	Narezushi, Funazushi
Thailand	Nam-pla, pla-ra,		Plasom, som-fug
Indonesia	Makassar,	trassi	
Malaysia	Budu, pekasam, belacan		
Philippines	Patis, buro,	bagoong (shrimp)	
Vietnam	Nuoc-mam,	Mams-ca	
Norway			Fermented salmon, saithe
Taiwan	Fish sauce		
Korea			Jeotgal (shrimp, oyster, fish)
Myanmar	Ngapi	Ngapi	
Bangladesh			Shutki, Lona ilish
India			Seedhal, ngari, Hentak, Lona ilis etc.
Greece	Garam		
Egypt			Feseekh (gray mullet)
Iceland			Hakarl (shark)
Sweden			Surstromming (herring)
China			Fermented silver carp
Brazil			Fermented sardine

(**Source:** Tamang and Kailastapathy, 2010)

Types of fermented fish products

1) Products retaining original shape:

Examples: Pedah siam (Thailand), makassar (Indonesia), Burong Isda (Philippines), shidal (India), Perkasam (Malaysia), Surstromming (Sweden)

Fig 1. Shidal **Fig 2.** Perkasam **Fig 3.** Surstromming

2) Products in the form of a paste:

Examples: Ngapi (Myanmar), mams (Vietnam), prahoc (Kampuchea), belachan (Malaysia), trassi (Indonesia), bagoong (Philippines).

Fig 4. Trassi **Fig 5**. Ngapi

3) Product in a liquid form:

Examples: Budu (Malaysia), patis (Philippines), nuoc-mam (Vietnam), nam-pla, pla-ra (Thailand).

Fig 6. Pla-ra

Fig 7. Major fermented fish products in India

Puthi shidal (Tripura), Phasa shidal (Tripura), Lona ilish (Tripura), Ngari (Manipur), Hentak (Manipur, Tungtap (Meghalaya), Seedal (Assam), Dang pui thu (Mizoram), Nagaland phasa shidal (Nagaland), Ngyii papi (Arunachal Pradesh) [Names of product start from left to right]

Steps for shidal preparation

1. Raw materials (dry puti fish)
2. Sorting by hands
3. Sun drying in open space
4. Water washing and overnight partial drying at room temperature
5. Packing of oil smeared matkas with partially dried fish and filled up to neck portion
6. Sealing of mouth portion with cover paste
7. Covering of the paste with paper or banana leaves and keep it undisturbed for 3-4 days
8. Removal of the cover-leaf and application of thick layer of mud on the mouth
9. Keeping the matkas undisturbed for 3-4 months for fermentation at ambient temperature
10. Final product shidal after 3-4 months by removing the mud and putrefied paste

Benefits of fermented fish

1) Beneficial bacteria in fermented fish compete and eliminate all the nasty bacteria and help to maintain good gut micro-flora.

2) Fermented fish has strong antioxidant scavenging capability against free radicals and reactive oxygen species
3) Fermented fish are rich in protein hydrolysates, improving our body's ability to utilize amino acids in the production of muscle and in tissue repair
4) Easier to digest and nutrients are easily assimilated.
5) Retains enzymes, vitamins, and other nutrients as no heat is applied.
6) Improve appetite.
7) Fermentation causes cleavage of food proteins by microbial or indigenous proteases which yield bioactive peptides, leading to substantial increase in the biological properties of the food substrates with protein, essential amino acids along with essential fatty acids, vitamins, minerals, etc.(Steinkraus, 2002).
8) Many peptides released during fermentation of food proteins exhibit biological activities, such as antimicrobial properties, blood-pressure lowering effects, cholesterol lowering ability, antithrombotic and antioxidative activities (Hartmann and Meisel, 2007).

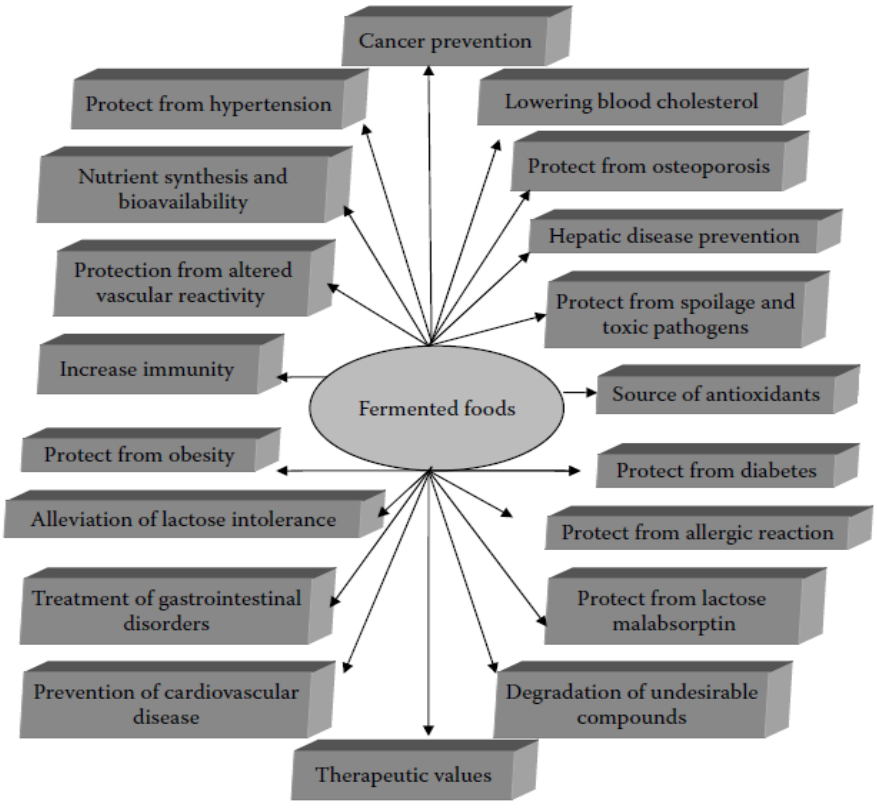


Fig 8. Various health benefits of fermented food

(**Source:** Tamang and Kailastapathy, 2010)

What can fermented fish present to us?

1. Nutrition
2. Health

3. Wealth
4. Beauty
5. Strength

1) NUTRITION

Table 2. Free amino acids (mg/100 ml) composition of fish sauces

Amino Acid	*Nam pla*	*Nuoc mam*
Aspartic acid	760	1150
Threonine	460	700
Serine	360	610
Glutamic acid	950	1370
Proline	230	330
Glycine	340	360
Alanine	700	1010
Valine	590	830
Cysteine	0	0
Methionine	230	270
Isoleucine	360	390
Leucine	450	490
Tyrosine	50	60
Phenyl alanine	310	420
Tryptophan	90	90
Lysine	890	1360
Histidine	320	460
Arginine	0	80

Source: From Ninomiya, K. 2002. *Food Review International* 18: 23–38; Yoshida, Y. 1998. *Food Reviews International* 14: 213–246.

Table 3.Nutritional composition of ethnic fish products of eastern Himalayas

		Percent (%)			Food value	Minerals (mg/100 g)				
Product	pH	Moisture	Protein	Fat	(kcal/100 g)	Ca	Fe	Mg	Mn	Zn
Suka ko maacha	6.4	10.4	35.0	12.0	395.2	38.7	0.8	5.0	1.0	5.2
Gnuchi	6.3	14.3	21.3	14.5	404.9	37.0	1.1	8.8	1.1	7.5
Sidra	6.5	15.3	25.5	12.2	394.6	25.8	0.9	1.6	0.8	2.4
Sukuti	6.4	12.7	36.8	11.4	402.6	17.7	0.3	1.4	0.2	1.3
Ngari	6.2	33.5	34.1	13.2	381.6	41.7	0.9	0.8	0.6	1.7
Hentak	6.5	40.0	32.7	13.6	408.0	38.2	1.0	1.1	1.4	3.1
Tungtap	6.2	35.4	32.0	12.0	384.4	25.8	0.9	1.6	0.8	2.4
Karati	6.3	11.8	35.0	12.4	404.0	ND	ND	ND	ND	ND
Bordia	6.4	12.0	24.5	12.3	400.3	ND	ND	ND	ND	ND
Lashim	6.4	9.6	28.3	11.8	407.8	ND	ND	ND	ND	ND

Note: Data represent the means of five samples. ND, not determined.

(**Source:** Jyoti Prakash Tamang, 2009)

2) **HEALTH**

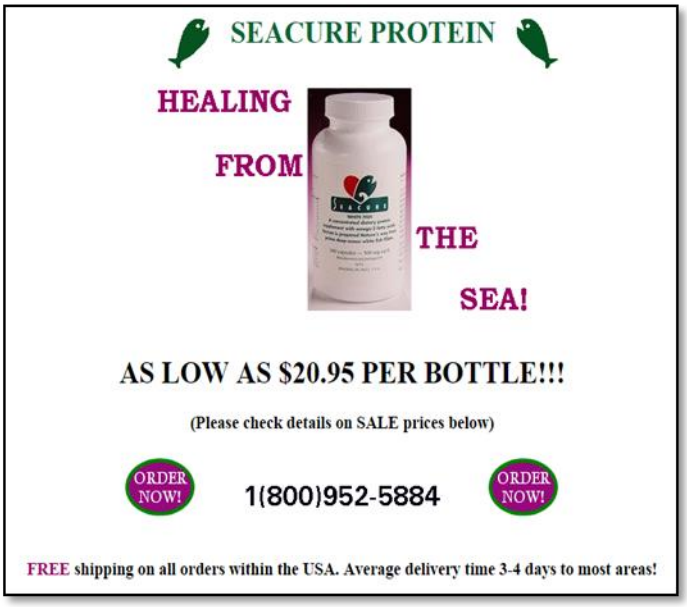
Antioxidant bioactive peptides inhibits angiotensin-I-converting enzyme (ACE) which lower blood pressure.The bioactive peptide with sequence Leu-Gly-Leu-Asn-Gly-Asp-Asp-Val-Asn, exhibited high levels of antioxidant activity (Ranathunga S., 2006). Boost immune system-by protecting cell damage (WBC) from free radicals.Anti cancer peptide from anchovy sauce have apoptosis inducing activities in human carcinoma cells which could be potentially useful in preventing the spread of cancer (Lee et al. 2004, Ngo et al. 2012). The product is reported to prevent arthritis, psoriasis caused by compromised immune.

3) WEALTH

Apart from fermented fish product, different supplementproducts from fermented fish have been commercialized and marketed which fetch good price. These products are beneficial in many ways. These products are 'Intestive', 'Seacure', 'Seavive',

'Seacure'are product prepared by the help of marine micro-organism which digest whole fish fillets into protein fragments mostly 2 and 3 AA long (di-peptides and tri-peptides). 'Seacure' protein supplement does not involved heat and chemicals having smaller fragments and made easy for the human body to absorb.'Seacure'help to maintain memory.It helps to speed the healing of wounds after surgery, car accidents, sports injuries and falls. It helps the digestive tract repair itself. Helps prevent irritable bowel syndrome, ulcerative colitis, Crohn's disease, ulcers and leaky-gut syndrome. Reduce the side effects of chemotherapy. Help premature babies to gain ideal body weight faster.Helps individuals with HIV/AIDS to maintain their weight and avoid muscle loss and diarrhoea.'Intestive' strengthen immune system, stimulate body to repair itself as well as burn fat and build lean muscle.It is useful when there is inflammation and pain coming from the digestive tract.

'SeaVive' increases-number of circulating WBC, stimulates phagocytes and elevates levels of non-specific antibodies.



4)BEAUTY

Fermented fish products slow down the aging process as the antioxidant peptides prevent immature cell death leading to longer life span.The antioxidant peptides prevent skin cancer, wrinkle formation, etc. (F. Domenico, 2007)which is the considered to maintain beauty of a person.

5)STRENGTH

'Seacure' also helps the elderly to maintain their strength and stamina. The nutrients are quickly digested, assimilated and thus produce energy. The microfloracontained in the product fight against pathogen thereby boosting our immune system and helps maintain healthy body which keep a person strong and fit.

Why some people avoid fermented fish products?

People avoid fermented fish products generally due to intense strong flavour, unfamiliar taste, physical appearance, lack of knowledge about its benefits and cultural barrier.

Risks in fermented fish

The risk associated with fermented fish product is botulism. Alaska has more cases of botulism than any other state in the United States of America. This is caused by the traditional Eskimo practice of allowing animal products such as whole fish, fish heads, sea lion and whale flippers, birds, etc. to ferment for an extended period of time before being consumed. The risk occurs when a plastic container is used for this purpose instead of the old-fashioned, traditional method, a grass-lined hole, as the botulinum bacteria thrive in the anaerobic conditions created by the air-tight enclosure in plastic.

To avoid such risk, the pH of the product must be maintained below 4.5 because *Clostridium botulinum* cannot produce toxin at pH below 4.5.

Conclusion

Replace artificial industrial foods with natural food such as fermented foods. Consume proper balanced diet in order to remain healthy. Prefer fish over meat if possible. And numerous research scopesare left under this field which can be explored.

References

- Ababouch, Lahsen (2005) "Preservation techniques" FAO Fisheries and Aquaculture topics. Rome. Updated 27 May 2005.
- Alzamora, Stella; Tapia, Maria Soledad; López-Malo, Aurelio (2000). Minimally Processed Fruits and Vegetables: Fundamental aspects and applications. Springer. p. 266. ISBN 978-0-8342-1672-3.
- Hartmann, R., & Meisel, H. (2007). Food-derived peptides with biological activity: from research to food applications. Current opinion in biotechnology, 18(2), 163-169.
- Ninomiya, K. (2002). Umami: a universal taste. Food reviews international, 18(1), 23-38.
- Steinkraus, K. H. (2002). Fermentations in world food processing. Comprehensive Reviews in Food Science and Food Safety, 1(1), 23-32.
- Tamang JP, Kailasapathy K, editors. Fermented foods and beverages of the world. CRC press; 2010; 460 p.
- Tamang, J. P. (2009). Himalayan fermented foods: microbiology, nutrition, and ethnic values. CRC Press.
- 'Why does Alaska have more botulism'. Centers for Disease Control and Prevention (U.S. federal agency). Archived from the original on 7 August 2006. Retrieved 18 July2011.
- Yoshida, Y. (1998). Umami taste and traditional seasonings. Food Reviews International, 14(2-3), 213-246.

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