

Fish processing methods practiced by the people living in and around the Loktak lake, Manipur, India

Métodos de transformación del pescado utilizados por los habitantes del lago Loktak (Manipur, India) y sus alrededores

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ABSTRACT

The people living in and around the Loktak lake, Manipur, India depended on the natural resources of the lake like fishes, prawn, mollusca, mussel, vegetable items, fodder, fuelwood, thatch grasses, medicinal plants and handicrafts materials for livelihood and income generation. In the present study household survey was conducted by selecting 50 fish processors living in and around the Loktak lake as respondents. It was found that illiteracy was high among the respondents and fishing and agriculture were the main occupation of the respondents. The respondents were poor with 50% of them earning in lower income range of Rs. 10,001 to 20,000/-. The people living in and around the Loktak lake used to catch high quantity of fishes from the lake and practiced different traditional fish processing methods. The present study tried to document the traditional fish processing methods used by the people living in and around the Loktak lake. Result found that a total of 20 species of fishes were found to be processed by the people using 6 methods i.e. Roasting (*Arouba/Ayaiba*), Fermentation (*Ngari/Utong ngari*), Fish paste (*Hentak*), Drying in sun (*Yaiphou/Phabou*), Roasting and Smoking after splitting (*Ngaphak*) and Smoking (*Leirou*). These fishes were processed to preserve them for longer time or to sell the processed fishes or used for consumption purposes. Decline in the fish processing methods because of degradation of the lake is observed. Conservation and sustainable management of the resources of the Loktak lake is highly suggested.

Keywords: Natural resources, Livelihood, Species, Sell, Decline

RESUMEN

Las personas que vivían en el lago Loktak y sus alrededores, Manipur, India, dependían de los recursos naturales del lago, como peces, gambas, moluscos, mejillones, vegetales, forraje, leña, pastos de paja, plantas medicinales y materiales artesanales para ganarse la vida y generar ingresos. En el presente estudio, se

realizó una encuesta de hogares seleccionando como encuestados a 50 procesadores de pescado que vivían en el lago Loktak y sus alrededores. Se encontró que el analfabetismo era alto entre los encuestados y la pesca y la agricultura eran la ocupación principal de los encuestados. Los encuestados eran pobres y el 50% de ellos ganaba en el rango de ingresos más bajo de Rs. 10,001 a 20,000/-. Las personas que vivían en el lago Loktak y sus alrededores solían capturar una gran cantidad de peces del lago y practicaban diferentes métodos tradicionales de procesamiento de pescado. El presente estudio trató de documentar los métodos tradicionales de procesamiento de pescado utilizados por las personas que viven en el lago Loktak y sus alrededores. El resultado encontró que las personas procesaron un total de 20 especies de peces utilizando 6 métodos, es decir, tostado (Arouba/Ayaiba), fermentación (Ngari/Utong ngari), pasta de pescado (Hentak), secado al sol (Yaiphou/Phabou), Tostado y Ahumado después del desdoblado (Ngaphak) y Ahumado (Leirou). Estos pescados fueron procesados para conservarlos por más tiempo o para vender los pescados procesados o utilizados para fines de consumo. Se observa una disminución en los métodos de procesamiento de pescado debido a la degradación del lago. Se recomienda encarecidamente la conservación y la gestión sostenible de los recursos del lago Loktak.

Palabras clave: recursos naturales, sustento, especies, vender, declive

INTRODUCTION

Traditional processing of fish, such as fermentation, salting, drying, and smoking are the principal method of fish preservation in Southeast Asia (Cooke et al., 1993). In the Indian subcontinent, the fermented fish, other food and beverages, prepared by using local food crops and other biological resources have been going on since time immemorial and is a common practice even today (Roy et al., 2004). The importance of fish in human nutrition in particular and for animal feed (fishmeal) as well as for other purposes cannot be gainsaid (Obande and Solomon, 2000). Ethnic people of North-East India catch fishes from the rivers and lakes (Tamang, 2001) some of these are traditionally preserved by adopting different methods. The fish processing is the process in which fishes are harvested and the final product is served to customers. Fish harvesting, processing, marketing, and distribution are part of livelihood of millions of people worldwide (Tawari and Abowei, 2011; Pradhan, et al., 2011; Kolawole et al., 2010). Fish is an important source of many types of animal proteins, but it is extremely susceptible to the environment. The fish-based products change the flavor and texture rapidly during storage after death. Hence, they need preservation or processing measure to avoid spillage (Gram and Huss, 1996; Ghaly et al., 2010). Fish is extremely perishable food item, soon after death begins to spoil. In the healthy live fish, all complex biochemical reactions are balanced, and the fish skin is sterile. After death however, irreversible change results in fish spoilage begin to occur, the resultant effect is decomposition of the fish (Akinola et al., 2006). Today, fish is the only important food source that is still primarily gathered from the wild rather than farmed-with marine capture historically accounting for >80% of the world's fish supply. Total landings from marine fisheries increased ~5-fold in the 40-year period from 1950 to 1990 (Mace, 1997). Fish has also been found to be low in cholesterol content, which allows for the

enhancement of improved human nutrition (Charcoft, 1976). Fish is also noted to be one of the safest sources of calories, protein, fat, calcium, iron, vitamin and essential amino acids (Olayide et al., 1975).

Mahish (2015) studied the traditional fish processing and economic status of fishermen of Chhattisgarh, India. Saisithi (1994) work on *Fish Sauce*, a type of traditional fermented fish, is a testimony that processed fish is consumed in different parts of the globe. This communication explored the communities involved in fish processing and the techniques used by them. *Nga-Ayaiba* (an indigenous fish product of Manipur) is one of the most indispensable food items of Manipur since time immemorial and is a non-fermented preserved fish product prepared from raw fishes by furnace drying technique (Meitei and Singh 2017). In Manipur, fresh fish and dry fish are equally preferred and in high demand. Different preservation and processing methods such as drying, smoking, fermentation, making fish paste etc. have been performed by women since time immemorial (Inaotombi and Mahanta, 2016). During harvesting when there is a large catch, fishes cannot be sold out immediately in fresh condition. In such situation, fishes are processed to preserve and also to consume during off season (Wanglar et al., 2018). Loktak Lake is located between 93°46' and 93°55' E and from 24°25' to 24°42'N in the southern part of the Imphal valley of Manipur. The lake is in oval shape with maximum length and width of 26 Km and 13 Km respectively. The depth of the lake varies between 0.5 to 4.58 m with average depth recorded at 2.7 m. It has a direct catchment area of 980 sq.km and indirect catchment area of 7157 sq.km. There are 55 rural and urban settlements around the lake with a total population of 100,000 (LDA and WISA, 1999). The livelihood of the local people living in and around the Loktak lake depended on fishing, collection of prawn, mollusca, mussel, vegetable items, fodder, fuelwood, thatch grasses, medicinal plants, and handicrafts materials from the lake. Fishing is one of the most important occupations of the people in the villages. People of the villagers used to sell both fresh and processed fishes for income generation. Many traditional methods were used by the people for processing fishes. Drying, salting, and smoking are the most common methods of traditional fishes processing. When large quantity of fishes are caught it is difficult for the fishermen to sell all the fishes so to prevent the caught fishes from decomposing or spoilage they used to processed it following different traditional fish preservation methods to preserve them for a longer period of time. Preserved fishes like fresh fishes can also be sold fetching good income they are also highly consumed and one of the favourite in almost every household of Manipur. The traditional methods of fish preservation also help in providing year-round availability of fishes.

Hence, in the present study an attempt has been made to study the traditional fish processing methods by the people living in and around the Loktak lake. The traditional knowledge of the communities used in processing fishes need to be documented, revived or conserved for future generations. The study will help in understanding the valuable traditional knowledge that practiced by the villagers in fish processing.

MATERIALS AND METHODS

The present study was conducted in the villages located in and around the Loktak lake by interviewing with 50 respondents who are fish processors using a pre-tested research schedule and focus group interview. The respondents were interviewed using a research schedule to assess their fish processing methods used

(Shivaji et al. 2015; Wanglar et al. 2018; Jakhar et al. 2020). During the survey information relating to the methods of fish processing, preservation, storage and other information related with the present study were collected.

The local names and specimen of the fishes processed by the respondents was collected and cross checked with the published literatures and identified (Jayaram, 2010; Vishwanath et al. 2014) with the help of experts of Loktak Development Authority (LDA), Manipur. For the correct nomenclature of fish species website such as <https://www.fishbase.in> were browsed. The data obtained from the survey was then compiled and interpreted.

RESULTS AND DISCUSSION

Different methods of fish processing are taken up to prevent from spoilage, preservation of fishes for a long time, retards the activity of bacteria, enhances the nutritional quality of foods, increase the taste, improving the health. In the present study illiteracy was high among the respondents because they were poor with low income and could not afford much money for education. There were no government or private employees found among the respondents and hence fishing and agriculture were the main occupation of the respondents.

Table 1 presents the socio-economic profile of the respondents. 80% of the respondents belonged to age group of 41-50 years, 12% were in between 51-60 years and 8% belonged to 61-70 years age group. 92% of the respondents were male while 8% were female. 90% of the respondents followed Hinduism and 10% were Islam. Fishing was the main occupation (100%) of all the respondents followed by 58% in agriculture and also 4% pursuing Handloom. With relation to the income of the respondents, 50% of them had total annual income in the range of Rs. 10,001 to 20,000/- followed by 18% in the income range of Rs. 20,001 to 30,000/- and 10% each in the range of both Rs. 30,001 to 40,000/- and Rs. 40,001 to 50,000/-. The lowest income was in the ranges of Rs. 60,001 to 70,000/- and Rs. 70,001 to 80,000/- which was 2% each. In terms of the educational level of the respondents overall 86% were illiterate, 8% had Primary (Nursery-Class VIII) education and only 6% were educated upto Secondary (Cl. IX-XII) level. Table 2 represents traditional practices used in processing of fishes. In all 20 species of fishes were found to be processed. Among them fishes such as *Chitala chitala* (Hamilton, 1822), *Anabas testudineus* (Bloch, 1792), *Osteobrama cotio* (Hamilton, 1822) and *Monopterus albus* (Zuiew, 1793) were found to be processed mainly. In fish preservation and processing 6 methods were found to be used. They were Roasting (*Arouba/Ayaiba*), Fermentation (*NgariUtong ngari*), Fish paste (*Hentak*), Drying in sun (*Yaiphou/Phabou*), roasting and smoking after splitting (*Ngaphak*) and Smoking (*Leirou*). Drying in sun (*Yaiphou/Phabou*), roasting (*Arouba/Ayaiba*) and roasting and smoking after splitting (*Ngaphak*) were the main processing methods for fishes practiced by the people. In the percentages of different fish processing methods, Roasting (38%) occupied the highest percentage followed by Drying in sun (24%) and the lowest was Smoking (6%) (Table 3). 6 different fish processing methods used by the respondents are presented below:

Table 1: Socio economic profile of the respondents

Particulars	N=50	Percentage
1) Age of the respondents		
1) 41-50 years	40	80
2) 51-60 years	6	12
3) 61-70 years	4	8
2) Gender of the respondents		
1) Male	46	92
2) Female	4	8
3) Religion		
1) Hinduism	45	90
2) Christianity	0	0
3) Islam	5	10
4) Occupation of the respondents		
1) Fishing	50	100
2) Agriculture	29	58
3) Handloom	2	4
4) Handicraft	0	0
5) Livestock rearing	0	0
6) Business	0	0
7) Migrant worker	0	0
8) Government employee	0	0
9) Private employee	0	0
5) Income of the respondents		
1) < Rs. 10,000/-	0	0
2) Rs. 10,001 to 20,000/-	25	50
3) Rs. 20,001 to 30,000/-	9	18
4) Rs. 30,001 to 40,000/-	5	10
5) Rs. 40,001 to 50,000/-	5	10
6) Rs. 50,001 to 60,000/-	4	8
7) Rs. 60,001 to 70,000/-	1	2
8) Rs. 70,001 to 80,000/-	1	2
9) Rs. 80,001 to 90,000/-	0	0
10) Above Rs. 90,000/-	0	0
6) Educational level of the respondents		
1) Illiterate	43	86
2) Primary (Nursery-CI. VIII)	4	8
3) Secondary (CI. IX-XII)	3	6
4) Under-graduate	0	0
5) Graduate and above	0	0

Table 2: Traditional fish processing methods

Scientific name of fishes	Local name of fishes	Methods use in processing of fishes
1) <i>Chitala chitala</i> (Hamilton, 1822)	Kandla	Roasting (<i>arouba/ayaiba</i>)
2) <i>Glossogobius giuris</i> (Hamilton, 1822)	Nylon ngamu	Fermentation (<i>ngari/utong ngari</i>), roasting (<i>arouba/ayaiba</i>)
3) <i>Amblypharyngodon mola</i> (Hamilton, 1822)	Muka nga	Fish paste (<i>Hentak</i>), roasting (<i>arouba/ayaiba</i>)
4) <i>Chanda nama</i> Hamilton, 1822	Ngamhai	Roasting (<i>arouba/ayaiba</i>)
5) <i>Macrobrachium dayanum</i> (Henderson, 1893)	Khajing	Roasting (<i>arouba/ayaiba</i>)
6) <i>Channa striata</i> (Bloch, 1793)	Porom	Drying in sun (<i>yaiphou/phabou</i>), fish paste (<i>Hentak</i>), roasting and smoking after splitting (<i>Ngaphak</i>)
7) <i>Cyprinus carpio</i> Linnaeus, 1758	Common carp	Fish paste (<i>Hentak</i>), roasting and smoking after splitting (<i>Ngaphak</i>)
8) <i>Puntius sophore</i> (Hamilton, 1822)	Phabou nga	Fermentation (<i>ngari/utong ngari</i>), roasting (<i>arouba/ayaiba</i>), drying in sun (<i>yaiphou/phabou</i>)
9) <i>Trichogaster fasciata</i> Bloch & J. G. Schneider, 1801	Ngabema	Fermentation (<i>ngari/utong ngari</i>), drying in sun (<i>yaiphou/phabou</i>), roasting (<i>arouba/ayaiba</i>)
10) <i>Channa punctata</i> (Bloch, 1793)	Ngamu	Smoking (<i>leirou</i>), roasting (<i>arouba/ayaiba</i>)
11) <i>Cirrhinus mrigala</i> (Hamilton-Buchanan, 1882)	Merigan	Roasting (<i>arouba/ayaiba</i>), drying in sun (<i>yaiphou/phabou</i>)
12) <i>Heteropneustes fossilis</i> (Bloch, 1794)	Ngachik	Drying in sun (<i>yaiphou/phabou</i>)
13) <i>Labeo rohita</i> Hamilton, 1822	Rohu	Roasting (<i>arouba/ayaiba</i>), roasting and smoking after splitting (<i>Ngaphak</i>)
14) <i>Esomus danricus</i> (Hamilton, 1822)	Ngashang	Fish paste (<i>Hentak</i>), drying in sun (<i>yaiphou/phabou</i>)
15) <i>Anabas testudineus</i> (Bloch, 1792)	Ukabi	Smoking (<i>leirou</i>), drying in sun (<i>yaiphou/phabou</i>), roasting (<i>arouba/ayaiba</i>)
16) <i>Pethia manipurensis</i> (Menon, Rema Devi & Vishwanath, 2000)	Ngakha Meinganbi	Fish paste (<i>Hentak</i>)
17) <i>Osteobrama cotio</i> (Hamilton, 1822)	Ngaseksha	Fermentation (<i>ngari/utong ngari</i>)
18) <i>Monopterus albus</i> (Zuiew, 1793)	Ngaprum	Drying in sun (<i>yaiphou/phabou</i>)
19) <i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	Grass carp	Roasting (<i>arouba/ayaiba</i>)
20) <i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	Silver carp	Roasting (<i>arouba/ayaiba</i>)

Table 3: Percentages of different fish processing methods

Particulars	N=50	Percentage
1) Percentages of different fish processing methods		
1) Roasting (<i>Arouba/Ayaiba</i>)	19	38
2) Fermentation (<i>Ngari/Utong ngari</i>)	6	12
3) Fish paste (<i>Hentak</i>)	7	14
4) Drying in sun (<i>Yaiphou/Phabou</i>)	12	24
5) Roasting and smoking after splitting (<i>Ngaphak</i>)	5	10
6) Smoking (<i>Leirou</i>)	3	6

1. Roasting (*Arouba/Ayaiba*)

The fish to be roasted is applied with salt on both sides and put in a wire net for about half an hour till the colour of the fish turns into golden brown. Once a side is roasted then the fish is turned over, so the other side also gets roasted. This method protects the fish the growth of microorganisms and the spoilage caused by them. Wanglar et al. (2018) reported that fishes like murels, eels, *Garra* sp. and catfishes are processed by roasting. Similar type of study was conducted by Wang et al. (2012) who reported that roasting and smoking are two commonly used methods for cooking seafood and meat products and are generally adopted during commercial foodservice operations.

2. Fermentation (*Ngari/Utong ngari*)

In this process fish species such as *Puntius sophore* (Hamilton, 1822) are wash thoroughly and dry in the sun by spreading them for two days. To remove excess water the fishes were then pressed hard using legs covered with gunny bags or stone rollers. The pressed fishes are then transferred in a big earthen pot which are applied with a layer of mustard oil in the inner wall and pressed tightly with a bamboo pole or with legs. The mouth of the pot is sealed tightly with thick mud or clay. The pot is kept for fermentation for 6 to 12 months before opening for consumption. Fermentation (*Ngari/Utong ngari*) is an important method for processing fishes. Ahmed et al. (2013) studied about the quality analysis of *shidal* - a traditional fermented fish product of Assam, North-East India in eight different districts of Assam. Anihouvi et al. (2012) also reported that fermentation was also found to be an important method for fish preservation particularly because poor quality fish or unpopular species of fish are usually processed in this way and for this reason fermentation helps to salvage fish which would otherwise have been thrown away.

3. Fish paste (*Hentak*)

This is a fermented fish paste prepared from small fishes like *Esomus danricus* (Hamilton, 1822) or *Puntius sophore* (Hamilton, 1822). The fishes after washing are allowed dry in the sun for 2 days. These fishes are added with onion, banana, mustard seed, oil, etc. and crushed into powder forming a paste. The paste is then finally rolled into ball and kept in an earthen pot for 7-10 days in sunlight. For making Fish paste (*Hentak*) semi-dried small fishes (usually *Puntius* sps.) are grounded into powder or paste form by mixing with slices of semi dried petioles of *Arum* (*Colocasia* sps.) to make fish paste *Hentak* in Manipur, India as reported by Inaotombi and Mahanta (2016). Similar study was conducted by Thapa (2016) who noted *Hentak* as an ethnic fermented fish paste of Manipur prepared from a mixture of sun-dried fish powder and petioles of aroid plants from fish species like *Esomus danricus*.

4. Drying in sun (*Yaiphou/Phabou*)

Drying of fishes in the sun or sun drying is a very common traditional method used in processing fishes. It is very easy, economical, and hygienic methods of processing fishes. In this method fishes are dried under the sun until the body moisture of the fishes dried up due to the heat from the sun. Fishes are put under the sun and allowed to fully dried by putting in a bamboo made rack and spreading the fishes over a mat. *Channa striata* (Bloch, 1793), *Puntius sophore* (Hamilton, 1822), *Trichogaster fasciata* J. G. Schneider, 1801, *Cirrhinus mrigala* (Hamilton-Buchanan, 1882), *Heteropneustes fossilis* (Bloch, 1794), *Esomus danricus* (Hamilton, 1822), *Anabas testudineus* (Bloch, 1792) and *Monopterus albus* (Zuiew, 1793) are those species of

fishes which are processed by drying in the sun. Drying in sun (*Yaiphou/Phabou*) is a common fish processing methods practiced for processing fishes. Similar finding was reported by Chanu and Singh (2017) who found *Puntius* spp., *Esomus danricus*, *A. mola* etc. as mostly commonly species of fishes which are processed by sun drying. The study is also in similarity with Solanki (2020) who reported different types of fish drying available with used of sun light likes drying on sand, drying on mate, drying on rack, drying on bamboo pole, drying with rope, drying with green house type drier etc and mostly fishermen used sunlight drying in open condition in Gujarat, India.

5. Roasting and smoking after splitting (*Ngaphak*)

In this processing method is applied to large fishes. The fishes are dissected with a knife dorsally on one side of the vertebral column from head to tail and removed the intestine and wash thoroughly. By spreading out the two lateral sides the dissected fish is then flattened. The processed fish is kept on the wire net or bamboo woven mesh and is smoked in the flame for half an hour till the colour of the fish turns into yellowish brown. It is then preserved in a bamboo basket. The fishes can also be roasted. Large fishes such as *Anguilla bengalensis* and *C. carpio* are mostly smoked by smoking after splitting Wanglar et al. (2018). The study is in agreement with Michael et al. (2019) who observed fish smoking as one of the most widely used traditional fish processing methods employed to preserve the vast quantities of fish landed in the season of glut in Ghana. Chanu and Singh (2017) also reported sun drying and smoking as the main processing techniques used by the people living in Karang Island of Loktak lake, Manipur.

6. Smoking (*Leirou*)

Another traditional method of processing of fish is smoking usually done in fish species like *Cyprinus carpio* Linnaeus, 1758. It is another fish preservation technique widely accepted in the state. It is done in a kiln or a room, which is specially prepared for it. Species such as *Saccharum arundinaceum*, *Phragmites karka*, *Saccharum narenga*, *Saccharum spontaneum* etc. and other trees species found in the villages are used as fuelwood during smoking. For Smoking (*Leirou*) of fishes firewood were used. Jakhar et al. (2020) also observed that fisher folks living near the rivers and reservoirs of Chhattisgarh preserve the surplus catch through traditional drying and smoking. Kalita et al. (2020) also reported that smoking is another common type of traditional fish processing found in Southwestern Assam in India.

In the present study it is observed that the resources of the Loktak lake specially the population of fishes have been found degrading because of increasing dependency on the lake and human activities like unsustainable agricultural practices, water pollution, siltation, construction of Ithai dam, encroachments in the lake by constructing fishponds, construction of roads and settlements. Since fishing is the main occupation of the people living in and around the lake it is also noted that because of decrease in the fish resources the fishes processing methods are also declining and also the livelihood of the people are greatly affected resulting in poor income of the people. The study found that fishes are important resources of the Loktak lake on which the livelihood of the people living in and around the Loktak lake depend. Because of modernization and development and depletion of fish resources from the lake the traditional fish processing methods are also on the verge of degradation. Depletion of the fishes population in the lake because of certain human activities resulted in low processing of fishes, poor income and high illiteracy rate of the people. There are several

advantages of processing fishes. The methods of processing should be done in hygienic condition and the consumption of processed fishes should not cause any health hazards. Incorporation of modern methods of processing in the traditional fish processing methods will help in maintaining sanitation during processing methods and production of hygienic processed fishes. Hence, improvements in the method of traditional fish processing is suggested. Conservation and sustainable management of the resources of the Loktak lake is highly suggested so that the resources of the lake specially fishes are available abundantly and the income of the people are not affected.

ACKNOWLEDGEMENTS

The authors are grateful to the Project Director, Loktak Development Authority (LDA), Imphal for granting permission to carry out this study. Authors also gratefully acknowledged those respondents who spared their valuable time during the survey and shared important informations.

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Received: 31th January 2023; Accepted: 20th March 2023; First distribution: 24th April 2023.