

Understanding of traditional knowledge and characterization of *telesech*- a fermented fish product of Tripura state

Deepayan Roy, R K Majumdar*, Satyendra Kumar Maurya, Hemant Hari Tripathi,
Bahni Dhar and Bhargavi M Priyadarshini

College of Fisheries, Central Agricultural University, Lembucherra, Tripura – 799210, India

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Fermented fish products are popular in the North east India because of their characteristic flavour and aroma. *Telesech* is a local name of salt-free fermented *Setipinna phasa* which is very popular amongst the people of Tripura in general. Higher cost of imported dry punti fish as well as high production cost and retail price of punti shidal necessitated the development of *telesech* from estuarine fish *Setipinna phasa*. The traditional method of its production has been studied and the biochemical, microbiological and sensory qualities of *telesech* has been evaluated. The pH, moisture, protein and lipid content of the product were found 6.21 ± 0.13 , 35.87 ± 3.25 , 28.38 ± 0.63 and 16.98 ± 1.71 , respectively, indicated their stability at ambient temperature. The quality parameters like TVBN, AAN, PV and FFA showed a higher value. The total plate count and total fungal count were observed as 6.42 and 4.02 log cfu/g, respectively. Predominant groups of bacteria were identified as *Staphylococcus* sp. and *Bacillus* sp. A sufficient numbers of Lactic acid bacteria (LAB) were also found. The product *telesech* was found to be contaminated with *Salmonella* which indicates lack of hygienic condition in processing and retail centres. Organoleptically the product was acceptable as the overall acceptability score was found 7.5 ± 0.37 .

Keywords: *Setipinna phasa*, *Telesech*, North east, Fermentation, *Bacillus* sp. and *Staphylococcus* sp.

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Introduction

Northeast India is very rich in its food culture, but it differs vastly from rest of the country in its taste as well as flavours. The region is a treasure on indigenous knowledge systems pertaining to agriculture, medicine, food and natural resources management¹. The ethnic North eastern people are very fond of fermented food products specially fermented fish products and these products serve a daily food recipe in the tasty dishes of NE Indians. Fermented food items specially fermented fish products are having some advantages over other food products like they increase digestibility, develop a distinct flavour, add palatability and improve pharmaceutical and nutritional values in addition to preservation function². The fish fermentation technology in the North eastern states was evolved by compulsion of people. Being the highest rainfall area of the world the North eastern states of India do not provide a suitable environment for drying of fish under sun. In order to utilize the huge resource of freshwater by

catches the fermentation technology was developed by the indigenous fishermen so that they could preserve the perishable fishes and sale them in the off-seasons when there was scarcity of raw fresh fish in the markets. It is fact that the taste and food habits of the rice-eater prefers to eat his rather tasteless rice mixed with little morsels of products bearing strong flavours. In this situation, the fermented fish could become an ideal option to cater their needs.

Northeast region is bestowed with many fermented fish products such as *telesech*, *ngari*, *hentak*, *lona ilish*, *tungtap* etc. These are very much popular due to their strong flavour. Fermentation involves breakdown of proteins in the raw fish to simpler substances which themselves are stable at normal temperature of storage. Fermentation is generally described as a process in which the complex protein molecules in the fish are broken down by the action of organic catalysts, enzymes or ferments, into simpler molecules. Breakdown of protein can be brought about by the action of exogenic as well as endogenic enzymes and sometime by microorganisms also. *Shidal* is very much popular fermented fish product due to its strong flavour. The typical strong flavour is

*Correspondent author:
E-mail: drrkmcof@gmail.com

due to break down of fish protein and lipid, which produce some peptides, amino acids, fatty acids, indole, skatole etc. producing a strong characteristic odour of *shidal* with higher digestibility as well as nutritive value³. Until few years back, *shidal* used to be prepared exclusively from *Puntius* sp. Only (usually from *Puntius sophore*). But the high retail price of *punti shidal* (due to higher cost of dry or wet *punti* fish) necessitated searching for alternative. As a result the technology for preparation of *telesech* using phasa fish (*Setipinna phasa*) has been evolved.

The product is presently very popular in Tripura though it has so many local names like *baspati*, *phasa shidal*, *telesech* but it is popularly known as *telesech*. In Manipur it is known as *Thum-thakpi*, *Thum nga*, *Samudra ngari*, etc. The appearance of the product is solid, bilaterally compressed and pasty and shape of the fish remains almost unchanged except little disintegration near belly and caudal portion. The colour of best quality product is dull yellowish that gradually becomes dull whitish to slight brownish and ultimately to deep brownish on continuous exposure to air. No systematic study of this technology particularly traditional process has yet been reported. Therefore, the present study deals with the traditional knowledge involved in *telesech* preparation, its nutritional aspects and the dominant bacterial groups present in it.

Materials and Methods

Biochemical analysis

The proximate composition of *telesech* available in the market was analysed and the TTA and pH was determined according to AOAC⁴. Total nitrogen was also measured by using the micro-kjeldahl method⁴. Ten percent trichloroacetic acid (TCA) extract was used to estimate non-protein nitrogen (NPN), total volatile basic nitrogen (TVBN) and alpha amino nitrogen (AAN) by using Micro-kjeldahl method according to AOAC⁴, Conway's micro-diffusion method⁵ and by using Pope and Steven's method⁶, respectively. Protein nitrogen was estimated by subtracting non-protein nitrogen from the total nitrogen. The peroxide value (PV) and free fatty acid (FFA) were determined on the chloroform extracts of tissue as per method suggested by Jacob⁷ and Takagi *et al*⁸, respectively. Thiobarbituric acid (TBA) value was determined by the method given by Tarladgis *et al*⁹. Minerals were analysed from the acid soluble ash using Atomic Absorption Spectrometer (AAS)⁴.

Microbiological and sensory analysis

Total plate count (TPC) and total fungal count (TFC) were done using standard methods described by USFDA and APHA^{10, 11}, respectively. Dominant bacterial colonies were isolated, purified and identified based on bacterial identification protocol given by Surendran *et al*¹² (Flowchart 1) and the biochemical tests were done as per procedure given by Austin and Austin¹³. Lactic acid bacteria (LAB) were enumerated on MRS agar (HiMedia M641) plate as per the method suggested by Thapa *et al*¹⁴. Pathogenic bacteria *Salmonella* and *Vibrio* were analysed by the methods given by Muzaddadi and Nayak¹⁵ and Panda and Nayak¹⁶, respectively.

Sensory evaluation of the market *telesech* sample was carried out using the 9-point hedonic scale by faculty, staff and students of the college who have previously participated in the sensory evaluation of similar products. Sensory quality of *telesech* sample was judged for appearance, colour, odour, texture and overall acceptability. The scores for colour was given by visual observation whereas, pressure by finger tips was used for texture scores¹⁷.

Results and Discussion

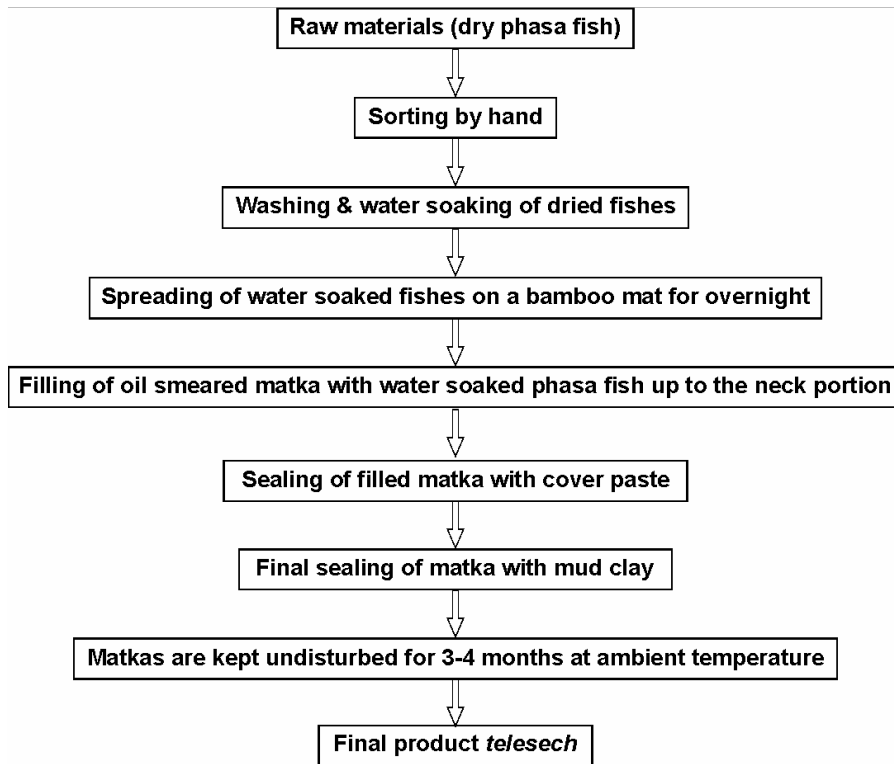
Understanding of traditional *telesech* production technology

Telesech is a semi-fermented product and usually no salt is added during its production. The fermentation process takes place in earthen containers (locally called *matka*) whose micropores are blocked with edible or fish oil to allow the fermentation process in micro-aerophilic condition. Due to addition of extra oil and use of semi fatty raw material i.e. dried Phasa fish (Plate 1a), rate of lipid oxidation is high in such products besides high total volatile basic nitrogenous compounds. Moreover, presence of little air inside the fermenting container facilitates the growth of aerobic bacteria. The traditional process of *telesech* production is given in Flowchart 2. Water soaking is the most crucial step which accelerates the fermentation process (Plate 1b). Generally short duration fermentation process needs more water soaking. The mouth portion of each *matka* is covered by using a thick layer of cover paste after filling up to the neck portion with water soaked fishes seems to form a good medium for growth of microbes and probably plays the major role for initiating the fermentation process. It is followed by application of a thick mud clay layer which is used as final sealing material of *matka* after filling of fish (Plate 1 c).

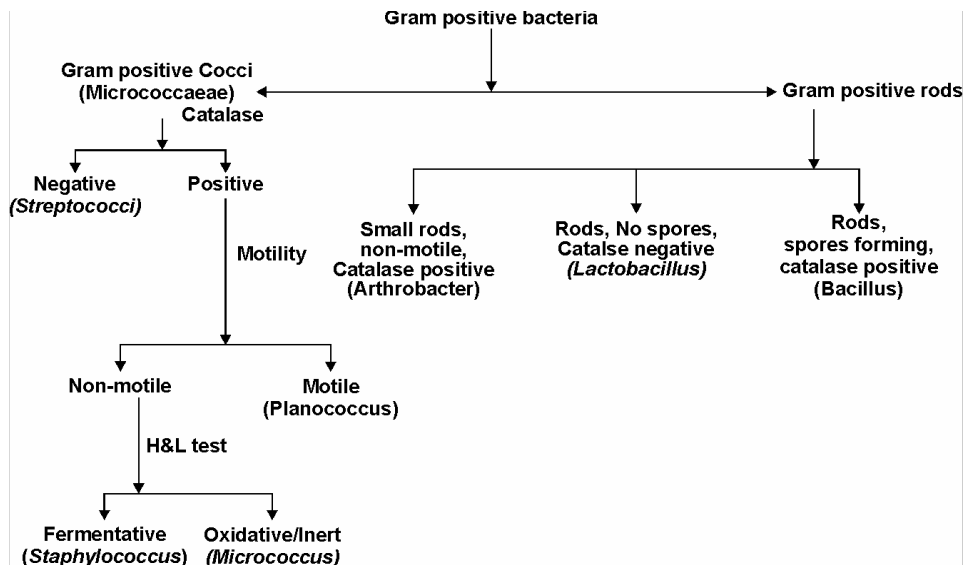
Generally the final product *telesech* is taken out from the earthen container after a minimum fermentation period of 3-4 months (Plate 1d). Mainly four *telesech* production centres are there in Tripura where *telesech* is prepared in large scale; besides these few small scale entrepreneurs are also there.

Proximate parameters of *telesech*

The proximate and quality parameters of market sample of *telesech* are given in Table 1. The pH, TTA, moisture, ash, crude protein and crude lipid of *telesech* was found around 6.21, 0.21, 35.87, 9.29, 28.38 and 16.98 %, respectively. It was reported



Flowchart 1—Identification of bacteria (Surendran *et al.*, 2003)



Flowchart 2—Traditional method of *telesech* preparation



Plate 1—Traditional method of *telesech* preparation in Tripura state: a. Raw material (dried phasa fish; b. Oil smearing of matkas; c. Matka sealed with mud clay; d. Final product, telesech; e. Yellow and white colour colonies are dominant group 10^{-3} dilution; f. Streaking of Yellow colour colonies on Nutrient Agar media; g. Streaking of White colour colonies on Nutrient Agar media; h. Growth of Yellow colour colonies on Baird Parker Agar (BPA) media

36.44 % moisture, 10.22 % ash and 36.25 % protein from market sample of fermented *Setipinna* sp. From Manipur¹⁸. For market available *punti shidal* of Jagiroad market in Assam 33.44 % moisture, 7.19 % ash, 38.35 % crude protein and 20.31 % crude fat was reported¹⁹. The higher moisture values for *telesech* may be due to long exposure in open condition and due to improper handling. Moreover, use of salt-dried raw material may be another reason for higher content

of moisture in market sample of *telesech*. The higher pH value (6.21) in *telesech* sample correlates with less TTA value which may be due to low lactic acid formation during anaerobic breakdown of stored carbohydrate in the fish muscle. A pH value of 5.66 and TTA value of 0.98 % was reported for market sample of *lona ilish* from Tripura²⁰. The pH content of market available rice bran fermented sardine was reported around 5.32^(Ref. 21).

The moisture content was reported in ranges from 39.62 to 46.89 % in *Chepa shutki*, a semi fermented fish product prepared from *Puntius* sp., collected from the markets of Bangladesh²². Protein content of market available *Lanhouin* product, a fermented fish product of Republic of Benin was reported around 24.6-26.5 %²³. Good quality raw material is essential to produce quality end product. It was reported that good quality dry *S. phasa* was obtained on moderately sunny but windy days²⁴. The phasa fish (*S. phasa*) collected during the winter period (October-December) is considered to be the best raw material to obtain quality *telesech*. This may be attributed to the fact that this period coincides with the time of the maximum fat content of the fish²⁵. Total ash content was found to be 7.03 %. Mineral contents of *telesech* are given in Table 1. Minerals like calcium, magnesium, iron and copper was estimated (mg/100 g) and found as 176.09, 25.42, 7.78 and 0.16, respectively in market sample of *telesech*. Higher calcium content estimated may be due to presence of sufficient pin bones which could not be separated during collection of flesh from *telesech* for analysis.

Biochemical quality of *telesech*

The biochemical quality of *telesech* from market was estimated and the values of NPN, PV, TBA, FFA, AAN and TVBN were found as 1.67, 64.16, 0.94, 117.57, 390.73 and 210.92 respectively (Table 2).

Table 1—Biochemical characteristics of market sample of *telesech* [Mean \pm SD (n=3)]

pH	6.21 \pm 0.13
TTA (%)	0.21 \pm 0.16
Moisture (%)	35.87 \pm 3.25
Ash (%)	9.29 \pm 0.16
Crude protein (%)	28.38 \pm 0.63
Total nitrogen (%)	4.54 \pm 0.10
Protein nitrogen (%)	2.87 \pm 0.10
NPN (%)	1.67 \pm 0.07
Total lipid (%)	16.98 \pm 1.71
PV (mmoles O ₂ /Kg fat)	64.16 \pm 2.56
TBA (mg malonaldehyde/Kg meat)	0.94 \pm 0.01
FFA (as % oleic acid)	117.75 \pm 2.67
AAN (mg %)	390.73 \pm 1.61
TVBN (mg %)	210.92 \pm 3.80
Calcium (mg/100 g)	176.09
Magnesium (mg/100 g)	25.42
Iron (mg/100 g)	7.78
Copper (mg/100 g)	0.16

Similar biochemical quality parameter for market sample of *punti shidal* was also reported²⁶. Higher values of PV, AAN and TVBN in the present study may be due to the long exposure of the product in open condition which makes it susceptible for more microbial and enzymatic activity and that resulted higher values of low molecular nitrogenous and lipid oxidised products. A higher value of TVBN around 264.7 to 389.9 mg/100 g was reported for market *Lanhouin* product²³. The higher values of NPN, TVBN and AAN of *telesech* indicate high degree of fermentation. The fish would be rejected for human consumption when the TVN level exceeds approximately 500 mg N/kg²⁷. The high PV content may be attributed to the corresponding generation of FFA mostly due to microbial hydrolysis of lipid^{23, 28}. A high value of TBA was also reported for *Lanhouin*, a fermented fish product of Republic of Benin²³. The TBA values represent the degree of rancidity in the products and the values above 3-4 indicate quality loss²⁹. However, the TBA value in the present study was in the acceptable limit indicating less formation of malonaldehyde in the product. Therefore, secondary lipid oxidation was limited in this product and this may be due to micro-aerobic condition as well as absence of pro-oxidants such as metallic container, salt, etc. A higher value of PV and FFA after fermentation was also reported in *Lanhouin*²³. The high values of FFA may be due to lipid hydrolysis during storage¹⁸.

Microbiological quality of *telesech*

Microbiological characteristics of market sample of *telesech* are given in Table 2. The total plate count (TPC) and total fungal count (TFC) values were 6.42 and 4.02 log *cfu/g*, respectively. Almost similar values also reported for market *punti shidal*²⁶. The higher count of microbes may be due to keeping pattern i.e. in open matkas for longer time and unhygienic handling. Similar TPC value also reported

Table 2—Microbiological quality of market sample of *telesech* [Mean \pm SD (n=3)]*

Total Plate Count (TPC)	6.42 \pm 0.35
<i>Bacillus</i> sp.	2.20 \pm 0.04
<i>Staphylococcus</i> sp.	3.37 \pm 0.06
Lactic acid bacteria (LAB)	4.19 \pm 0.09
Total Fungal Count (TFC)	4.08 \pm 0.04
<i>Salmonella</i> sp.	detected in very small count
<i>Vibrio</i> sp.	absent

*values given in log *cfu/g*

for *Lanhouin*²³. The total plate count and total fungal count in *Ngari*, *Hentak* and *Tungtap* was reported to be ranged from 4.3-7.3 and <1-3.5 log *cfu/g*, respectively³⁰. Similar TPC and TFC values also reported in case of some traditionally processed fish products of the eastern Himalayas³¹.

The dominant bacterial colonies were randomly selected by their morphological characters from different dilutions of TPC plates. It was found that in every dilution plates yellow and white colour colonies formed the dominant groups of bacteria (Plate 1e). After further purification and isolation the yellow and white colour colonies (Plate 1f and 1g) were bio-chemically identified and it was found that the yellow colour colony was *Staphylococcus* sp. and the white colour colony was *Bacillus* sp. The confirmatory bio-chemical tests for *Staphylococcus* sp. and *Bacillus* sp. (as per Austin and Austin, 2007)¹³ are given in Table 4 and 5, respectively. For further confirmation identified *Staphylococcus* sp. and *Bacillus* sp. were streaked in to Baird Parker Agar (BPA) medium (Plate 1h) and Dextrose Tryptone Agar (DTA) medium, respectively. The streaked bacterial colonies showed their growth with typical colony characteristics. The TPC value was recorded as 6.42 log *cfu/g*, consisting mostly of *Bacillus* sp. (2.20 log *cfu/g*) and *Staphylococcus* sp. (3.37 log *cfu/g*) which contributed 34.26 % and 52.49 % of total count, respectively.

The remaining less dominant bacterial group was not identified. *Staphylococci* and *Bacilli* were also reported as the dominant groups of bacteria isolated from some fermented fish products^{30, 32-33}. Among the pathogenic bacteria *Salmonella* was detected in the market *telesech* sample which may be due to unhygienic handling during processing and retailing whereas, *Vibrio* was found absent in the same sample. In addition to these a sufficient number of Lactic acid bacteria (LAB) was also found (4.19 log *cfu/g*) when market sample of *telesech* was plated in *Lactobacillus* MRS Agar medium.

Sensory quality of *telesech*

The sensory quality of *telesech* has been studied and given in Table 3. Appearance, colour, odour, texture and overall acceptability were scored and found as 7.5, 7.25, 7.0, 7.5 and 7.5, respectively. The product gradually loses its characteristic odour during displaying in open condition for long time which may be the reason behind comparatively lower score in odour value. The overall acceptability of the product

Table 3—Sensory scores of market sample of *telesech* [Mean ± SD (n=10)]

Quality Attributes	Scores
Appearance	7.5 ± 0.58
Colour	7.25 ± 0.78
Odour	7.0 ± 0.50
Texture	7.5 ± 0.96
Overall acceptability	7.5 ± 0.37

Table 4—Identification of *Staphylococcus* sp. (Austin and Austin, 2007)

Biochemical tests	Reaction	
	According to Austin and Austin's book	Observation in this study
Gram stain	Positive and coccus in shape	Positive and coccus in shape
Motility	non-motile	non-motile
Coagulase	+	+
Catalase	+	+
Oxidation-Fermentation	+/+	+/+
Cytochrome oxidase	-	-
Indole	-	-
Methyl Red (MR)	+	+
Voges- Proskauer (VP)	+	+

Table 5—Identification of *Bacillus* sp. (Austin and Austin, 2007)

Biochemical tests	Reaction	
	According to Austin and Austin's book	Observation in this study
Gram stain	Positive and rod in shape	Positive and rod in shape
Motility	non-motile	non-motile
Catalase	+	+
Oxidation-Fermentation	+/+	+/+
Indole	-	-
Voges-Proskauer (VP)	+	+

mainly depends on the intensity of aroma and flavour. The characteristic aroma and flavour of fermented fish products may be due to complex interaction of enzymatic activity and oxidation as well as bacterial production of volatile fatty acids during the fermentation process³⁴. The overall acceptability (7.5) of the product graded as acceptable for consumption.

Conclusion

This study provided information on traditional practice of *telesech* production in Tripura besides its biochemical and microbiological quality. Results showed that *telesech* is a good source of nutrition in

terms of protein, lipid and minerals. But the biochemical quality attributes were found towards slightly higher in range which may be due to more breakdowns of protein and lipid during post fermentation period which may be solved through proper packaging of post fermented *Setipinna phasa*. The sensory analysis revealed that the product bears good taste, texture, odour and appearance. Though *Staphylococcus* sp. and *Bacillus* sp. were found as dominant group of bacteria but presence of *Salmonella* sp. in the product indicate the traditional producers do not maintain adequate hygiene and sanitation in the processing plant. Therefore, it can be suggested that good hygiene and sanitary condition should be adopted in the fermentation unit along with handling of raw materials, maintaining wash water quality including other processing steps and also in the retail markets in order to safeguard the products for consumers' health.

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