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# Prevailing challenges in Processing of Fermented Fishery product '*Shidal*' in Tripura, India and Solutions

**Devananda Uchoi*, Pankaj Kishore, Anuj Kumar, Ranjit Kumar Nadella, Satyen Kumar Panda and A. A. Zynudheen**

*ICAR-Central Institute of Fisheries Technology, P. O. Matsypuri, Cochin - 682 029, India*

## Abstract

*Shidal* is a traditionally bio-processed fermented fishery product produced from minor carps particularly, *Puntius* sp. It plays a significant role in the diet of North-Eastern people in India. In Tripura and other North-Eastern states, *shidal* is consumed as health food by general public. Hygienic processing of *shidal* has received more attention in recent years as the number of consumers and demand for superior quality *shidal* is increasing. The study was undertaken in 14 dry fish markets from 4 districts of Tripura through market survey and personal interview to identify key challenges associated with processing of *shidal*. Data was collected from a total of 50 randomly selected respondents from commercial *shidal* processors (n=10), household *shidal* processors (n=10), retailers (n=20) and local vendors (n=10). It was found that for commercial *shidal* processors, supply of poor quality raw materials and lack of skilled workers were the major issues. In case of household processors, lack of adequate infrastructure and breakage of earthen pots were the main issues; whereas, for retailers and street vendors lack of proper packaging system was the main issue. Thus, the challenges in *shidal* processing were recorded and solutions are suggested which could help the policy makers to recommend guidelines for hygienic handling and processing of *shidal*.

**Keywords:** Dry fish market, North-East India, *Puntius* species, *Shidal,* Tripura

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**E-mail: uchoidev514@gmail.com*

## Introduction

Fermented fishery products are very popular and consumed by a large population of Tripura and other North-Eastern states, because of its unique taste, characteristic flavour and health benefits. Fermented fishery products are reported to be rich sources of nutrients, having balanced amino acids and fatty acids that provide physiological benefits (Shah, 2001). The most popular fermented fishery product in Tripura is *shidal.* Similarly, other fermented fishery products like *tungtap* (Meghalaya), *ngari, hentak* (Manipur), *seedal, sepaa, hidal* (Assam, Arunachal Pradesh and Nagaland) were also preferred in the respective places (Thapa et al., 2004). The freshwater fish, *Puntius* species are commonly used for *shidal* production.

*Shidal* has intimate association with the socio-cultural, faith and health for each ethnic group of people in Tripura. The indigenous people consume *shidal* daily by preparing different dishes such as *shidal chutney, mosdeng* (paste made by grinding roasted chilly, onion, salt & roasted *shidal*), *ghodak* (semi-liquid paste made by grinding boiled vegetables, chilly, salt & roasted *shidal*) and *berma butui* (vegetables curry prepared by adding *shidal*). *Shidal* is treated not only as a popular diet, but its consumption is considered to be of cultural significance by the indigenous people of Tripura, especially during festive season and religious ceremonies (Majumdar et al., 2016). In case of accidental ingestion of poisonous substance, indigenous people drink raw *shidal* extracts for partial relief. Further, there is a traditional belief within indigenous people that *shidal* might serve as a malaria curing diet (Muzaddadi & Basu, 2012). The demand of *shidal* keeps increasing in recent years in Tripura and other North-Eastern states. However, certain processing constraints hinder the processors to meet the market demand resulting in rise of the price. Rise in inputs

cost of dry fish, earthen pots (mutka), vegetable oil and daily wages of labourers are responsible for increase in the price of *shidal.* This ultimately resulted in production and supply of inferior quality *shidal* in the local markets (Upadhyay, 2016).

In Tripura, *shidal* is traditionally processed by local people of respective region having different skills and knowledge. These *shidal* processors both household and commercial follow traditional methods which had evolved over the years in several ways and was passed on from generation to generation by their respective family tradition. Therefore, *shidal* differs in quality when different maturation period and storage conditions are followed. The *shidal* processors also face several problems during processing and storage of *Shidal* (Upadhyay, 2016). Hence, the present study was undertaken to provide a comprehensive overview of the existing challenges in *shidal* processing in Tripura and to suggest possible solutions to overcome these challenges.

## Materials and Methods

In this study, four districts namely Gomati, South, Khowai and West in the state of Tripura, India were selected based on production and consumption of *shidal*. The data was collected through questionnaire in the month of November, 2019 by means of personal interview and market survey. A total of 14 dry fish markets were selected namely; Udaipur, Matabari, Amarpur, Karbook, Nutanbazar and Jatanbari (Gomati district); Santirbazar, Belonia and Chittamara (South district); Golbazar, Battala and Lake chowmuhani (West district) and Khowai & Teliamura (Khowai district) (Fig. 1). The respondents included were commercial *shidal* processors, household *shidal* processors, retailers and local vendors (Table 1) and belonged to age group of 40-60 years.

The commercial and household *shidal* processing units surveyed during the study is shown in Fig. 2.

A many commercial *shidal* processors three subgroups were categorized i.e., large scale processors (n=3), medium scale processors (n=3) and small scale processors (n=4) based on number of pots produced annually (Table 2).

The data collected includes demographic details of the respondents, primary and secondary raw materials, quality and their sources, process of *shidal* fermentation and different issues pertaining to *shidal* processing. The issues identified in this study were presented and solutions were suggested.

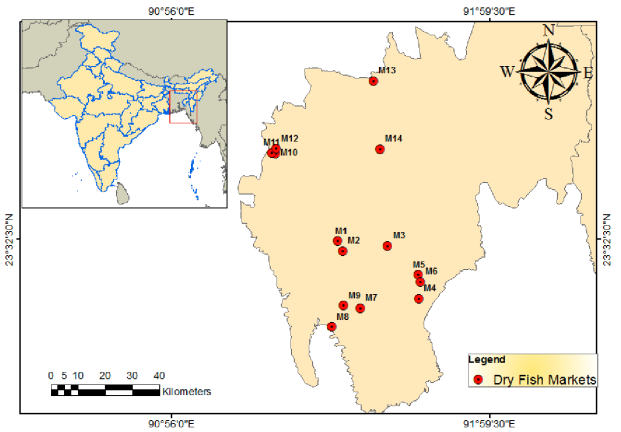


Fig. 1. Dry fish markets (M) selected during the study; M1- Udaipur, M2- Matabari, M3- Amarpur, M4- Karbook, M5- Nutanbazar, M6- Jatanbari, M7- Santirbazar, M8- Belonia, M9- Chittamara, M10- Golbazar, M11- Battala, M12- Lake chowmuhani, M13- Khowai and M14- Teliamura

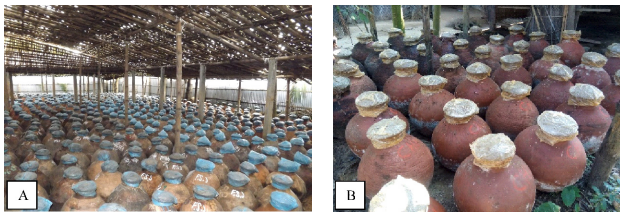


Fig. 2. Earthen pots kept for fermentation of *shidal* (A) Commercial processing units (B) Household processing unit

## Results and Discussion

From the study, it was observed that majority of the respondents involved in *shidal* processing, retailing and vending were poorly educated (secondary stage and below), belonged to economically weaker

Table 1. Details of respondent's category during the study

| People associated with *shidal* | No. of respondents |
|---|---|
| Household processors | 10 |
| Local vendors | 10 |
| Retailers | 20 |
| Commercial processors | 10 |
| Total: | 50 |

Table 2. Categorization of commercial *shidal* processors based on volume of production

| Sl. No. | Commercial *shidal* processor | No. of pots produced per annum |
|---|---|---|
| 1 | Small scale processors | 200 pots and below |
| 2 | Medium scale processors | 500-700 pots |
| 3 | Large scale processors | 1500-2000 pots and above |

section and earns Rs 50,000 to Rs 60,000 per annum. These people are engaged in this particular occupation because of their family tradition or for earning basic family needs. However, in case of commercial processing, the respondents were adequately educated (senior secondary to undergraduate stage) and earns Rs 5 lakhs to Rs 50 lakh per annum.

Some minor differences were noticed between household and commercial shidal processors which is shown in Table 3.

The list of raw materials required for preparing single pot of good quality *shidal* and their quantity is given in Table 4. The different places from where the primary raw material (dried *Puntius* fish) was procured for *shidal* production and its quality is presented in Table 5.

*Shidal* is a semi-fermented fishery product prepared from *Puntius* species. In most *shidal* processing sun dried *Puntius* fish was used as primary raw material (Fig. 3A). *Puntius* species commonly used for producing *shidal* in Tripura included *Puntius sophore, P. sarana, P. ticto, P. chola,* etc. Another species preferred other than *Puntius* was *Setipinna phasa* called *phasa shidal*. The earthen pots are made by a particular group of people in that locality as per the specifications provided such as capacity (40-50 kg), thickness (5-6 mm) height (70-75 cm), neck diameter (20 cm), middle-expanded part (50 cm) and made of clay soil (Fig. 3B). The approximate weight of the pots is 10-10.5 kg and cost ranged from Rs. 300-350 per pot depending on its quality. The oil smearing (vegetable oil) of inner surface of the earthen pots was done using a piece of cloth or gunny bags in order to close the micropores present in the wall of earthen pot (Fig. 3C). Subsequent oil smearing and sun drying of earthen pot was continued for 8-10 days until they become fully saturated with oil and unable to further absorb more oil even after prolonged drying (Fig. 3D). The dried *Puntius* fish was soaked in water for pre-determined time to

Table 3. Difference between commercial and household *shidal* processing

| | Commercial *shidal* processing | | Household *shidal* processing |
|---|---|---|---|
| a) | Raw materials was dried *Puntius* fish mainly sourced from outside state. | a) | Raw material includes both fresh and dried *Puntius* fish. The dried fish was procured from commercial processors while fresh fish was sourced from local markets. Sorting, gutting, washing and sun drying was done for fresh *Puntius* fish. |
| b) | Use traditional method of fermentation with slight modification as per requirement. | b) | Use traditional method of fermentation without modification. |
| c) | Oil consumption during smearing of earthen pots is higher. | c) | Oil consumption during smearing of earthen pots is lower. |
| d) | Production is in large quantity. | d) | Production quantity is small. |
| e) | Involves multiple workers. | e) | Involvement limited to family members. |
| f) | Different containers material has been tried such as stainless steel, aluminium and food grade plastics apart from earthen pots with low success. | f) | Only earthen pots are used. |

Table 4. Primary and secondary raw materials required for production of good quality *shidal*

| Sl. No. | Materials requirement (per single pot) | Quantity |
|---|---|---|
| 1 | Primary raw material (dried *Puntius* fish) | 40-50 kg |
| | *Secondary raw materials*: | |
| 2 | Cover paste (dry fish paste) | 0.5 kg |
| 3 | Clay (prepared from fine soil) | 1 kg |
| 4 | Cover-leaf (any suitable plant leaf sufficiently large in size) | 2 nos. |
| 5 | Oil (any vegetable oil, commonly mustard oil) | 0.5 L |
| 6 | Earthen pot/*mutka* (round or tapered bottom and narrow necked with capacity ranging from 40-50 kg capacity) | 1 no. |
| 7 | Gunny bag | 3 nos. |
| 8 | Grinder/Mortar & pestle | 1 no. |
| 9 | Mat (bamboo/plastic) | 1 no. |

Table 5. Source of primary raw material (dried *Puntius* fish) for *shidal* production in Tripura

| Sl. No. | Name of place | Quality of raw material |
|---|---|---|
| 1 | Mumbai (Maharashtra) | Medium to High quality |
| 2 | Kolkata (West Bengal) | Medium to High quality |
| 3 | Jagiroad (Assam) | Medium to High quality |
| 4 | Lucknow (Uttar Pradesh) | Medium to low quality |
| 5 | Bihar | Medium to low quality |
| 6 | Gujarat | Low quality |

attain desirable moisture content followed by partial drying overnight at room temperature. The partially dried *Puntius* fish is then packed tightly layer by layer into a previously oil smeared earthen pots up to the neck portion (Fig. 3E & 3F). Cover paste was made from broken pieces of dry fish after grinding with addition of oil and water to form fine paste (Fig. 3G). The mouth portion of the pots are sealed with the cover-paste and further covered with a cover-leaf to avoid flies (Fig. 3H). Broad plant leaves such as banana, colocasia, etc. were used as cover leaf which cover the entire mouth portion of the earthen pot. The pots are then kept undisturbed for 2-3 days and finally sealed with thick clay to create microaerophilic environment inside the pots. Fine soil was collected and mixed with water to form thick clay which was used in final sealing of earthen pot (Fig. 3I). Filling of clay in the gaps was done as and when cracks appear on the clay seal to avoid insect infestation. The pots were then kept undisturbed in a dry and sheltered place at an ambient condition for 4-6 months for fermentation. After maturation, the clay and putrefied paste are removed to get the final product (Fig. 3J).

In earlier days, *shidal* processors harvest fresh *Puntius* fish from beels, wetlands, channels, paddy fields, ponds and lakes for *shidal* production, but now-a-days they are available in limited quantity due to change in habitat and water bodies. Therefore, the primary raw material need to be sourced from outside the state. The major issues with primary raw material were unavailability of fresh *Puntius* fish, inferior quality of dried *Puntius*, high transportation cost of dried *Puntius*, price fluctuation and inadequate storage facilities for both primary raw material as well as filled pots during fermentation especially in case of household processors (Fig. 4A & 4B). To overcome unavailability of fresh and dried *Puntius*, rearing of *Puntius* fish in ponds and lakes can be carried out. Munilkumar & Nandeesha (2007) have reported culture possibility

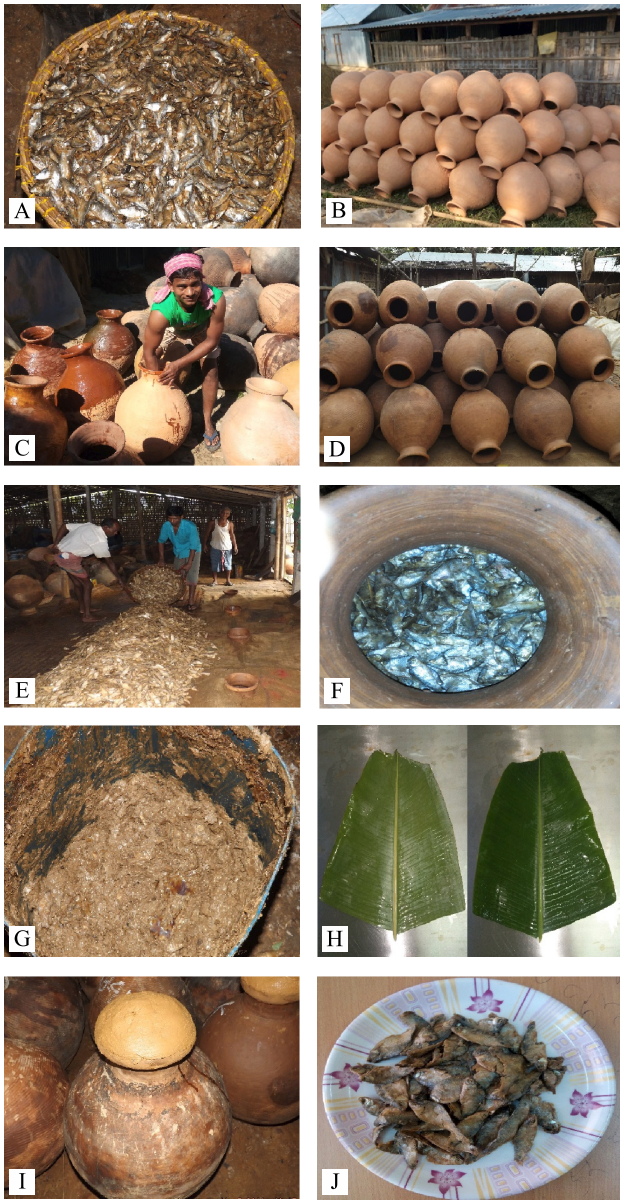


Fig. 3. Process steps in *shidal* preparation (A) Primary raw material (B) Cover paste (C) Oil smearing (D) Sun dried earthen pots (E) Packing of fish in earthen pots (F) Fish filled upto neck (G) Cover paste (H) Cover leaf (I) Clay seal and (J) Final product

of *Puntius* fish in North-Eastern waters. This results in the availability of *Puntius* locally and can reduce the outside state transportation cost. Dried *Puntius* can be sourced from known and approved supplier in order to ensure good quality. Bulk quantity of primary raw material can be procured and stored in good storage facilities (dry, shaded and covered place) until further use to overcome price fluctuation and storage facility issue. Separate facilities for storage of filled pots should be created to prevent the detrimental effects of environmental conditions during fermentation.

The issue with the availability of the earthen pots was limited number of pot maker and seller. Other common problems are breaking of pots during oil treatment and packing of raw material (Fig. 4C). To solve this issue, more people must be encouraged into earthen pot making. Advanced technique inclusion in pot manufacture will avoid unnecessary breakage of pots. *Shidal* processors may provide work order to pots maker and seller on contract basis and ensure the pots are available throughout the *shidal* processing season. Skill development of labours need to be done through by proper training and they should only be preferred for packing of pots.

In household *shidal* processing unit inadequate shade facilities for keeping of filled pots was observed (Fig. 4D). To overcome this issue proper shade facilities should be created by the processors to protect the filled pots from direct sunlight and rain.

In commercial processing, large quantity cover paste preparation is difficult as the processors do not have mechanical system. Therefore, lack of equipment for cover paste preparation is a problem as the conventional mortar cannot support for large scale


Fig. 4. Problems associated in *shidal* processing (A) Inadequate primary raw material storage facilities (B) Inadequate pots storage facilities in household processsing unit (C) Pot breakage during oil treatment and (D) Lack of proper shade facilities in household processor

production. To address cover paste issue, economically feasible grinding machine can be fabricated locally as per specification required by *shidal* processors. This would reduce labour and production cost in addition to time saving. Mud for making clay seal should be free from pathogenic microorganisms. Otherwise the microbes present in the clay might interfere with the development of characteristic flavour and aroma of *shidal*. To overcome this issue, the mud need to be procured from pollution free area.

Oil smearing process considerably takes a long time, delaying the production cycle. New pots are also found to absorb more oil (1-1.5 L) while smearing as compared to used pots. Generally, 500 ml oil is sufficient to smear one pot. It has been reported that, earthen pots which are made from fine black soil absorb less oil during smearing and provide less permeable to air (Muzaddadi & Basu, 2012). Many processors are of the opinion that the older the pot is, the better the quality *shidal* and lesser the cost of production as they absorb less oil. For old pots, 2-4 days of oil smearing and subsequent sun drying is sufficient thereby saving oil and time.

Water soaking duration affects the product's quality, period of fermentation and shelf-life. Soaking of raw material is very important in the preparation of *shidal* and is crucial for obtaining the best quality *shidal* (Majumdar et al., 2016). Household *shidal* processors do water soaking in river or pond. But commercial processors have separate concrete water tank for this purpose. It was observed that in many processing units this tank was kept open without proper cover during off season. As a result, it gets polluted with algal growth, microbial and physical contaminants. To prevent such contamination, water soaking tank should be covered properly during non-usage. During partial drying of *Puntius* after soaking, flies should be restricted. In this regard standard operating procedures should be followed by the processors to prevent pest infestation.

Shelf life of *shidal* is short and undefined as it varies from batch to batch. Rapid quality deterioration of *shidal* occurs due to rich nutrients and favourable moisture content (30-35%) for microbes, leading to poor shelflife (Muzaddadi & Basu, 2012). This was found to be the main problem faced by the retailers and vendors of *shidal*. Because of this issue, the retailers and vendors seldom sell their product at lower price in order to clear the product before deteriorating. Therefore, proper packaging system is required to improve the shelflife of *shidal*. Food grade plastic container and suitable laminated plastic package may be adopted by processors, retailers and vendors to get satisfactory shelf life of *shidal*.

Potential biological hazards in *shidal* such as foodborne pathogen, parasite, bacterial and mycotoxin could occur in unhygienically prepared *shidal*. Hygiene indicator organism such as *Staphylococcus aureus* including yeast and molds have been reported to be associated with contaminated *shidal* product (Uchoi et al., 2018). The water used for sprinkling on the products for keeping the product moist is another potential source of contamination with *E. coli* and other faecal coliforms. In northeast Thailand, fermented fish dishes such as *pla-ra* and *pla-som* are popular traditional fermented fish food which acts as the main source of fish-borne trematodes (FBT) transmission (Grundy et al., 2012). Therefore, health and personal hygiene of the labourers should be considered seriously for hygienic production of *shidal*. Good manufacturing practice (GMP) and sanitation standard operating procedure (SSOP) will improve hygiene condition in the processing unit.

Potential chemical hazards in *shidal* could occur through adulterated primary raw material. As the raw materials are transported in dried and semi-dried condition warms, insects, flies and maggot easily get attracted to it. In order to prevent insects and worms in primary raw material few scrupulous people have been reported to use chemical such as formalin, insecticide and pesticide during transportation. It has been noticed that fertilizer (urea) was used to accelerate maturation of *shidal* which was unhealthy for consumers. Presence of histamine (95-118 mg $kg^{-1}$) in *shidal* was also reported as potential chemical hazard (Uchoi et al., 2018). Nevertheless, the concentration of histamine in *shidal* was much lower compared to fish sauce of South-east Asian countries which were reported with high histamine content above 1000 mg $kg^{-1}$ (Kirschbaum et al., 2000). To address this issue, superior quality primary raw material may be used. Starter cultures or old stock of *shidal* can be used to accelerate the fermentation process.

*Shidal* plays a significant role in the daily nutrition of people from North-East region of India. The challenges documented in this study revealed that

several factors are responsible for production of inferior quality *shidal*. The solutions suggested for the identified problems would aid the *shidal* processors in tackling the challenges related to *shidal* processing. Although, challenges exist in processing of *shidal*, opportunities are still there for establishment of small to large scale *shidal* processing units in North-East India through adoption of hygienic processing such as GMP and SSOP along with adequate packaging system.

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