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Review Article

PRODUCTION PROCESS, NUTRITIONAL COMPOSITION, MICROBIOLOGY AND QUALITY ISSUES OF SHIDAL, A TRADITIONAL FERMENTED INDIGENOUS FISH PRODUCT: A REVIEW

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Abstract: *Shidal* is a salt-free, solid, semi-fermented fish product which is commonly consumed in all the North Eastern states of India (Arunachal, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura). By and large, the tribal and the Bengali population of the zone are fond of this product because of its characteristics taste and flavor. Shidal is prepared from a small sized fish mainly *Puntius sp* and also known as *seedal, seepa, hidal* and *shidal* in Assam, Tripura, Arunachal Pradesh, Nagaland and *Ngari* in Manipur. Its preparation involves several steps including semi-drying of *Puntius sp.* (usually done in the sunlight), filling them in vats or earthen pots for fermentation for 4-6 months following a standard procedure during which the final product has a semi solid appearance. Once the pot is opened, shidal cannot be stored for a long period of time. There exists two commonly practiced methods for preparation of this semi-fermented fish product which includes the village fishers' indigenous method and the modified method for commercial purpose. A chutney or sauce-like recipe, locally called shidal bhorta, is prepared as a side dish for rice or bread. The traditional fermented product such as shidal in Assam is prepared at the household level through the indigenous practices of food processing and preservation. Despite its very odd taste and aroma, people gradually acquired a liking for it, primarily because it served them as a source of food in off fishing season and secondarily, it also provided them a different recipe with change in taste against their daily monotonous diet i.e. rice- fish dish .In fact, the poor economic condition is another major reason for the acceptance of such a product. The offensive smell could not repel the people from accepting the product; on the other hand, certain new/ innovate recipes were added including oil supported by frying or boiling during *shidal* dish preparation. As a result of these initiatives, *shidal* gained popularity in this region and became delicacy for most of the tribal, Bengali and other people of the states for its characteristics taste and flavor. Various scientific investigations have revealed the presence of several microflora with varying percentages in association with the fermented and sundried *shidal* as they might play an important role during fermentation.

Keywords: Semi-fermented, Shidal, *Puntius* sp.

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INTRODUCTION

North-East India is characterized by a diverse population of people with different ethnic background. Most of the people of this region are tribal and bear their own methods of fermenting food materials for the purpose of preservation and taste enhancement and they have been carrying these from time immemorial. All the fermented products are region specific and have their own unique substrates and preparation methods. Materials such as soybeans, bamboo shoots and locally available vegetables are commonly fermented by most of the tribes. The fermented alcoholic beverages prepared in this region are unique from the rest of the world in several aspects and bears deep attachment with the socio-cultural lives of the people. The starter cultures used and the utilization of indigenous microbes reflect the expertise of these people in customary microbiology. Microbes such as *Saccharomyces cerevisiae*, *Candida* sp., Lactic Acid Bacteria (LAB) and *Bacillus* sp. have been found to be abundant of common occurrence in these products. These products also serve as a source of economy to many of the rural people, who prepares them at home and market locally. Detailed studies on the nutritive and medicinal value of these products can provide valuable information would prove beneficial in the use of these products on a wider scale. Formulation of new techniques to increase their shelf life would help in the commercialization of these products [1].

In South East Asia, fermentation, salting, drying and smoking are employed as the principal methods for fish preservation [2]. In North East India, fermentation is one of the oldest and most economical methods for producing and preserving food. The fermentation process causes enrichment and improvement of food through flavor, aroma and change in texture, preservation by producing organic acids, nutritional enrichment, reduction of endogenous toxins and reduction in the duration of cooking and thereby fuel requirement. In some cases, the pharmacological and nutritional value of the product is enhanced including the digestibility [3]. Depending on the product and consumer preferences, its appearance and flavor may be enhanced. Fermentation may make the product more enjoyable and safer. Probiotics or “good bacteria” are also formed through the process of fermentation.

Fish sauce, Jeotgal, Shrimp paste, Shidal, Hentak and Ngari are the popular indigenous fermented fish products worth mentioning. *Ngari*, a traditional fermented fish product prepared from sundried *Puntius* sp. were fermented in different temperature and its biochemical and microbiological qualities were analyzed. Changes in the different proximate and nutritional parameters were observed. *Vibrio parahaemolyticus* and Pathogenic bacteria

such as *Salmonella* and *E. coli* were not detected during the course of study. *Aspergillus* spp. and *Penicillium* spp. were the dominant fungal species during the period of fermentation. The results showed that several microflora with varying percentage were found to be associated with the fermentation of sundried *P. sophore* and they might play an important role during fermentation [4].

Indigenous fermented foods such as *shidal* contribute a large portion of daily food intake in North-Eastern States of India. It is a salt-free, solid, semi-fermented fish product and prepared from a small sized fish mainly *Puntius sp*. [5]. It has several local names like *seedal, seepa, hidal* and *shidal* in Assam, Tripura, Arunachal Pradesh, Nagaland and *Ngari* in Manipur. *Shidal* probably, came in to existence in the North- Eastern region of India long back, but in any case before the British era. The people in North Eastern states did not know about the use of salt before the British introduced, but it became a highly valued and scarce commodity. This prevented utilization of the value oriented salt for fish preservation .So much so, fishers went on preserving fish following several methods in which salt was not involved. Thus, baked by prolonged experiences in fish preservation in various ways, fishers ended up with the present day method where fishes are stored in earthen pots for months together without adding any food additives/preservatives. The outcome is a solid, chocolate coloured product with a semi- pasty surface having a very strong unpleasant smell and this product is '*shidal*'.

Shidal preparation involves several steps including semi-drying of *Puntius sp.* (usually done in the sunlight), filling them in vats/earthen pots for fermentation for 4-6 months following a standard procedure during which the final product has a semi solid appearance [6]. The semi-dried or half dried fish allows itself to be a host of microorganisms which would start the fermentation. Anaerobic microorganisms work to create this while the fish remain within the sealed vats/pots. But the initial drying causes partial dehydration which help in preventing the rapid putrefaction before the fermentation process could begin. The long fermentation imparts the strong smell and taste to the product and the oil acting as a protective cover discouraging the action of putrefying microorganisms [7, 8].

Biochemical and microbiological analyses of shidal:

Sarojnalini and Vishwanath [9] studied the chemical composition, total bacterial counts and digestibility of *Hentak* and *Ngari*, the two fermented fish foods consumed in Manipur. They have analyzed and found that the compositions of *Hentak* and *Ngari* were, respectively: cholesterol, 2.67 and 8.37 mg/g; Ca, 12.60 and 6.88 mg/g; Fe, 1.29 and 0.51 mg/g; and total

viable bacterial counts, 4.8 x 10^8 and 5.0 x 10^7 cells/g. According to them, *Hentak* appears to be a better food in view of its higher Ca, Fe, essential amino acids, lipids and low cholesterol content.

Muzaddadi and Basu [10] studied the biochemical and sensory changes during preparation of *Seedal*. They established five stages during fermentation by distinct microbial, biochemical and sensory characters. A good quality *Seedal* with characteristic smell was observed in the final stage i.e after 4th month of maturation. It had a moist and soft surface, hard texture below the surface, dark reddish brown colour and strong characteristic smell, with TPC value around 10^4cfu/gm, titrable acidity 1.78% and pH around 6.3.

Vishwanath and Sarojnalini [9] studied *Hentak*, a fermented paste product of Manipur, prepared from *Esomus danricus* and showed the changing profile of total oxalate content during fermentation.

Sarojnalini and Suchitra [10] isolated and identified bacteria from Ngari (a fermented fish product of Manipur), prepared in large-scale industries. The starter culture isolated from 'Ngari', consisting of 3 species of *Bacillus* and 3 species of *Micrococcus* which served as inoculums for the initiation of fermentation at 30 °C in laboratory conditions. Proper fermentation was noticed in 40 days in starter culture inoculated fish whereas in naturally fermented fish, fermentation was noticed after 5 to 6 months. Their results confirmed that bacteria are responsible in the ripening process of '*Ngari*'. They also observed total bacterial count 10^6 and 10^8 cfu g^{-1} in naturally fermented and inoculated samples of *Ngari* in Manipur respectively. They could not detect Coliforms, *Escherichia coli* and *Salmonella* during the fermentation period. Sensory qualities of the products so obtained were comparable with that of commercial '*Ngari*'. The spoilage indices such as thiobarbituric acid (TBA) number and total volatile base nitrogen (TVBN) were within the acceptable limit. Thapa *et al.* [11] studied about microbial diversity in *ngari*, *hentak* and *tungtap* of North East India by collecting six samples of each from Manipur and Meghalaya fish market. They reported that, the LAB, endospore forming rod, yeast and aerobic mesophilic counts ranged from 4.0 to 7.2, 3.3-4.6, <1-3.5 and 4.3-7.3 log cfu/gm respectively.

Assessment of nutritive value:

Khanum *et al*. [12] studied the nutritional characteristics of a semi-fermented fish product, commonly known as *chepa shutki* in Bangladesh. They have analyzed the product and found that the crude protein, crude fat, and crude ash contents were 33.2, 17.0 and 12.2%, respectively. The calcium, phosphorus, magnesium and iron contents of *chepa shutki* were

higher than those of similar kinds of Japanese processed fish. The amino acid score of the protein was found to be 100, based on the provisional amino acid scoring pattern [13]. Based on their findings, they have ultimately concluded that *chepa shutki* can be considered a high-quality protein food.

Many investigators [14-16] also studied the biochemical composition and nutritive value of sun dried *Puntius sophore*, which was used in the preparation of *Ngari,* a fermented product of Manipur. According to their analysis, it contains 18.1% moisture, 45.0% protein, 18.5% lipids and 11.0% ash. The in vitro digestibility of protein was found to be 44.1% in 2 hours by pepsin and 55.7% by pepsin + trypsin in 24 hours. The α-amino nitrogen was 32.6 mg/g of total nitrogen. The total volatile base nitrogen (TVBN, 4.6 mg/g) value, thiobarbeturic acid number (TBA, 0.507 mg/1000g) and peroxide value (4.2 millimoles/g) were within the acceptable limits.

Nayeem *et al.* [17] studied traditional semi-fermented fishery product (*Chepa shutki*) of Bangladesh collected from the value chain and assessed the quality of it. They analyzed the proximate composition of *Chepa shutki* obtained from producer, wholesaler and retailer and found that protein and lipid contents were highest in case of *Chepa shutki* obtained from producers and lowest from wholesalers. On the other hand, moisture and TVBN content was lowest in producer's sample and highest in *Chepa shutki* collected from wholesaler. According to them, the moisture content varied from 39.62 to 46.89% with the highest value recorded in product obtained from retailer and lowest from the producer.

Nutritional composition, yield and consumers' acceptability of a ground semi-fermented fish product prepared from the underutilized fish species of the Bay of Bengal have been studied by Mansur *et al*. [8]. They prepared the product by a traditional semi-fermentation method, identical for the preparation of *Sheedal shutki*, and was subsequently dried in oven, ground, packed in polyethylene bags and stored in ambient condition. Quality in terms of nutritional composition was found comparable to other fish products of Bangladesh. They could be able to show that the new product is equally acceptable.

Mahanta and Muzaddadi [18] analysed the various parameters related to microbial, biochemical and sensory changes at 15 day intervals and the quality was compared with the control (without salting) to see the periodic quality loss. The 2% salt treated *shidal* (T1) showed comparatively stable pH (4.6 to 4.8) with negligible variation throughout the storage period while in control and 5% salt treated *shidal* (T2), pH increased significantly ($P<0.05$) after 75 days of storage and reached 7.09 from an initial pH of 4.4. Moisture, ash, salt,

protein and fat content of all the samples did not vary significantly *(*P>0.05*)* during the storage period up to 60 days indicating insignificant effects by the treatments on proximate composition. The peroxide value, free fatty acid and thiobarbituric acid showed slower rate of increments and insignificant changes in the treated samples than in the control. Total plate count did not change significantly *(*P>0.05*)* and remained near 7 log cfu g^{-1}. Total fungal count was low in almost all samples. The sensory scores indicated longer shelf life of 90 days for T1 and T2 while the control had shelf life of 60 days [15].

Quality evaluation studies:

The proximate composition and standardization of preparation process has been reported by Muzadaddi [19] and Muzaddadi and Basu [20, 21]. They also concluded that the poor economic condition, high transportation cost and less availability of fresh fish are the main reason for the acceptance of this product though it has off smell.

A study on *Chepa Shutki* of Bangladesh has been carried out by Khanum *et al*. [22]. They analyzed the volatile compounds in *Chepa Shutki,* which is responsible for its strong smell using Gas chromatography-mass spectrometry (GC-MS) and compared with those in *izushi* (Japanese processed-fermented fish product) and *iwashi no nama boshi* (Japanese processed but non-fermented fish product). A total of 21, 10 and 11 compounds were identified, respectively, in *Chepa Shutki, izushi* and *iwashi no nama boshi. Chepa Shutki* contains 4 acids, 7 alcohols, 6-aldehydes, 3 ketones and 1 furan. Among the identified compounds ethanol, hexanal, propanal and 1-pentan-3-ol were found common in all the fish products. Except these, *Chepa Shutki* contained acetic acid, butanoic acid, 1-butanol, 3-methyl-1-butanal, 3-methylbutanal and pentanal. Although majority of the lipid derived compounds were aldehydes, alcohols and ketones, *Chepa Shutki* contained more acid as acetic acid and butanoic acid then the other two. Sour flavor of *Chepa Shutki* may be derived from these acid compounds.

The storage stability of a Bangladeshi traditional semi-fermented fish product, *chepa shutki*, was evaluated by Khanum *et al*. [22]. They have stored the product for 3 months at 20°C and 35°C under 40% and 80% relative humidity, which were apparently similar atmospheric conditions to those of the winter and summer in Bangladesh, respectively. The fatty acid composition did not change markedly during storage. They found that the initial carbonyl value (COV) and thiobarbituric acid reactive substances (TBARS) value of the sample were 28.4 meq/kg and 36.1 mg malondialdehyde (MDA)/kg of oil, respectively. These values only slightly changed during 3 months of storage regardless of the storage conditions. The COV

and TBARS values were in the range of 19.8-22.0 meq/kg and 31.4-36.4 mg MDA/kg of oil, respectively. Their results indicated that the lipids of *chepa shutki* were essentially not susceptible to oxidative deterioration.

Majumdar [22] worked on *Phassya shidal*: A traditional fermented fish product of North-.East and concluded that it can be used as a substitute of punti shidal. This variety of shidal is gaining popularity especially in the rural markets due to its low cost than that of punti shidal.

Many investigators [23, 24] also studied the preparation and marketing of *shidal* based ready-to-eat products and reported that raw *shidal* could be utilized to prepare delicious dish as per the traditional recipes. Since the raw *shidal* bears a pungent smell ready-to-eat *shidal* products can be prepared in packaged form so that *shidal* eater can avoid cooking.

Ahmed *et al*. [25] analysed the proximate composition and bacteriological analyses of *shidal* sampled from producers as well as retailers of eight different districts of Assam. In proximate principle analysis, lower level of protein and fat content in the products obtained from retailers indicated the relative nutrient losses occurring at different stages of marketing chain. High total volatile base nitrogen (TVB-N), peroxide values and moisture along with promising microbial load in the retailer's samples reflected poor quality, whereas those obtained in producer's samples were within the acceptable limit. None of the samples revealed presence of the coliform bacteria, *Escherichia coli* and *Salmonella* sp. Yeast and fungal colonies were detected in the samples. Ahmed *et al.* [26, 27] also isolated and identified the presence of *Bacillus spp.* and *Lactobacillus plantarum* from the fermented fish product followed by its molecular characterization and profiling.

CONCLUSION AND FUTURE DIRECTION

There is a need of awareness about the basic hygienic knowledge of production for Good Manufacturing Practice (GMP) and safety of the marketed food products as per HACCP system are the major issues to be focused with immediate attention. Over the years, there were no systematic and deliberate efforts made by researchers for introduction of production technology through hygienic, utilization of pure microbial starter cultures and optimum process control. Still the local manufactures are depending on the age-old traditional art. Recent works comparing the effect of different starter culture of indigenous microflora has shown significant difference in the taste, aroma and chemical composition of the traditional fermented food. There has been a growing interest world over to explore and collect microbial germplasm in search of gene pool, which can help biotechnologist to develop value added products for human welfare.

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