



# *The Notion of Pickling Fish using Fermented Bamboo Shoot (FBS) Extracts*

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## ***How to cite this article:***

**Bora, G. and Chutia, S. M. 2023. The Notion of Pickling Fish using Fermented Bamboo Shoot (FBS) Extracts. *Chronicle of Aquatic Science* 1(4): 36-47.**

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## **ABSTRACT**

Fish and meat products are an indispensable part of the human diet. They provide easily available proteins, minerals, and vitamins. The excellent digestibility and well-balanced compositions of essential amino acids make the fish a highly demanded article of human nutrition. Pickling is the process of preserving edible products in an acidic solution, usually vinegar, or in a salt solution (brine). The process of pickling is also known as brining and the resulting foods as pickles. So, we can replace vinegar with bamboo shoots as it has innumerable properties. Bamboo shoot is rich in nutrients, function as nutraceuticals, has high fiber content, almost no calories, low fat, and acts as an appetizer. The bamboo shoot has other health benefits like it is used to increase the immune system, helps in heart problems, reduces cholesterol level, reduces the risk of cancer, etc. Therefore, vinegar in fish pickles can be replaced by the addition of fermented bamboo shoot (FBS) extract.

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## **KEYWORDS**

Fermented bamboo shoot (FBS), Vinegar, Pickle, Brine, Pickling, Fish.

## Introduction

Pickling is one of the methods commonly practiced in the preservation of fruits and vegetables for human consumption and could be a suitable method for the preservation of avian and animal products like egg and meat as well. Food preservation in the form of pickles has been one of the strategies for lengthening the shelf life of fruits and vegetables. The word pickle has originated from the Dutch word 'pekel' that was used to refer to a solution of brine often spiced, for preserving and flavoring food (Bowen and Ralph, 2003). The term 'pickle' can be associated with processed fruits and vegetables in salt and spice mixture that have an extended shelf life, often with restored or enhanced beneficial properties of the entities involved. The art of making pickles is known as 'pickling' and it has been an integral part of all the communities and cultures across the globe for millions of years. The principal objective of pickling is to delay the spoilage and contamination of foodstuff by natural microflora. Moreover, the addition of some ingredients like spices in the pickling process enhanced the flavor and nutritive value of the end product. Pickling involves preserving the foodstuffs under low pH

conditions using brine, vinegar, or other acids (Krishnan *et al.* 2004).

This is a useful traditional method of preserving small fish varieties when caught in abundance. High perishability of fish and meat products is a serious problem in tropical countries like India due to prevailing climatic conditions. Pickle products may be a good alternative for solving this problem. Pickling of perishable foods in vinegar or edible oil with the addition of salts, spices provides a ready to eat product stable at room temperature (Kumar, 2001). Pickling, using organic acids, is easy and safe for the preservation of finfish and shellfish (Abraham and Setty, 1994). In pickling, the use of acetic acids is an important step to lower the pH. Thus the growth of micro-organisms can be prevented. The acidic medium of the pickle helps to arrest the growth of microorganisms (Gopakumar, 1997). The acidic medium of the pickle helps to arrest or inhibit the growth of pathogenic bacteria and food poisoning is rarely reported from vinegar cured food products. The main aim of giving importance on fermented bamboo shoot extract in pickle preparation to have a low pH value.

Bamboo shoots are young, new clumps/canes that are harvested for food before they are 2 weeks old or one-foot tall. Young and tender bamboo shoots are consumed as an ingredient of food. They are consumed in the form of vegetables, pickles, and salads in several countries (Das and Puzari 2007). The chemical analysis of bamboo shoot shows that it contains about 88.8 % moisture, 3.9 % protein, 0.5 % fat, 5.7 % carbohydrate, and 1.1 % minerals. Bamboo shoot contains two antioxidants namely 'Tricin' and 'Taxifolin' and their antioxidative spectrum of activity is equivalent to approximately 10 and 1 % of that of alpha-tocopherol respectively (Katsuzaki *et al.* 1999). The bamboo shoot has other health benefits like it is used to increase the immune system, helps in heart problems, reduces cholesterol level, reduces the risk of cancer, *etc.* Therefore, vinegar in fish pickles can be replaced by the addition of fermented bamboo shoot (FBS) extract.

### **Review on the use of traditional preservatives on pickles**

A lot of works has been done in preparation of fish pickles using vinegar in different parts of India. However, the literature on fish pickles using traditional preservatives is very few. Chavhan *et al.*

(2013) studied the effect of incorporation fermented bamboo shoot (FBS) on pork pickle, found that the pH value of pickles with different combinations ranged around 4.5. Concerning TBA values, the fermented bamboo shoot (FBS) extract (100%) had shown the best activities followed by a combination of 50 % vinegar and 50 % fermented bamboo shoot (FBS) extract. They concluded that fermented bamboo shoot may be a good substitute of vinegar in preparation of pork pickle. Changmai *et al.* (2006) after study on smoked pork products and bamboo shoot extract, found that the shelf life of cooked smoked pork products with bamboo shoot extract could be extended with the addition of fermented bamboo shoot (FBS) extract. The shelf life of the study of the products at room temperature reveals that all products could be stored safely up to 90 days or beyond.

Anderson *et al.* 2009; Lattimer and Haub 2010; Brennan *et al.* 2012 studied that the fiber in bamboo shoots consists of hemicelluloses, cellulose, and lignin and classified in nutrient detergent fiber (NDF) and acid detergent fiber (ADF). The fiber is inert, has zero calories, and now also available in powder form commercially. Dietary fibers reported reducing the risk of cardiovascular diseases, hypertension,

diabetes, obesity, cancer, and various gastrointestinal problems. Nirmala *et al.* 2014 studied that Phenol is another bioactive compound that is abundantly available in the bamboo shoots. The quantity of phenols in fresh bamboo shoots ranges from 191 mg/100 g in *Bambusa balcooa* to 443.97 mg/100 g in *B. tulda*. Phenols are reported to have various positive health benefits such as antioxidant, anti-inflammatory, anti-allergic, antimicrobial, cardioprotective, and vasodilation.

Pervin *et al.* (2010) compared fish pickle prepared from *Amblypharyngodon mola* incorporated with olive and tamarind found that both the product were found to be good. Pickle prepared with tamarind and olive has a moisture content of 43.85% and 50.89% respectively. The protein and lipid contents of tamarind added pickle were 19.13 and 35.64% respectively; pickle with olive contained less protein content compared to tamarind added mola pickle. Lipid contents were almost the same in both cases. Ash content of two pickles was also found similar (1.00%). The quality of mola pickles stored either in cool condition (4°C) with vinegar or at room temperature was found good for consumption up to 90 days of storage. Assam being a predominantly fish-

eating state, 90 percent of its population consumes fish (Chutia *et al.*, 2018). Eventually, Kakati *et.al* (2005) also reported that the fish pickle had very good sensory quality and high consumer acceptance. The TVBN and non-protein nitrogen (NPN) increased significantly during storage whereas the salt soluble nitrogen decreased significantly indicating protein denaturation. The peroxide value and the free fatty acid level increased and the pH decreased significantly during the storage period. The microbial count showed minimal change and sensory quality decreased during storage.

### **Fish-based fermented pickles**

Pickling is one of the safest means of natural preservation of fish. The pickling conditions are believed to suppress the growth of all pathogenic organisms (pH below 4.0) and have a considerable storage life (Waghmare, George, & Sonavane, 2017). A variety of fish-pickles have been reported. Two types of fish pickles were prepared from two freshwater fishes (*Amblypharyngodon mola* and *Puntius ticto*) using LAB, which their organoleptic quality assessed during six months of storage at ambient temperature. However, pickle prepared from *A. mola* was found to be slightly better and more acceptable by the

consumers. A study was undertaken for preparing a pickled commodity utilizing meat of the carp, rohu (*Labeo rohita*). The meat pieces were subjected to different preprocessing treatments (i.e., salting, drying, frying, baking, smoking, and pickling) in various combinations. However, the most satisfactory combination was formed to be marinating of fish pieces (for 15 min) followed by smoking (for 3 h at 60 °C) and frying (for 30 s at 180 °C) in refined vegetable oil. The sensory scores for odor, texture, taste, and overall quality of fish pickle (pH 4.5) was found more suitable and became accepted by the consumers (Waghmare *et al.*, 2017).

Sidra fish (*Puntius sarana* H.) pickle is a popular dish in Nepal, Bhutan, and provinces of North East India (Sikkim and Darjeeling hills). Fishes are gathered, cleaned, sun-dried (for 4–7 days), and stocked at ambient temperature (for 3–4 months). The microbial diversity of sidra pickle includes (*Lb. plantarum*, *Lactococcus lactis*, *Ln. mesenteroides*, *E. faecium*, *E. faecalis*, *P. pentosaceus*, and *Weissella confusa*) and yeasts (*Candida chiropterorum*, *C. bombicola*, and *Saccharomyces* sp.) (Thapa, 2016). Fermented fish pickles are related to staple foods in the locality of south-east Asia,

commonly as a condiment for rice dishes (Majumdar *et al.*, 2015). Tungtap, a fermented fish pickle, prepared from species of *Puntius* and/or *Danio* in North-east India. The LABs involved in the fermentation of tungtap are *Lb. plantarum*, *Lb. amylophilus*, *Lb. fructosus*, *Lb. coryniformis* subsp. *torques*, *Lc. lactis* subsp. *cremoris*, *E. faecium*, *Bacillus subtilis*, *B. pumilus*, and species of *Saccharomyces*, *Micrococcus*, and *Candida* (Kakati & Goswami, 2013). Shidol is a salt-free fermented fish with a paste surface, which is widely used by people of the North-eastern states of India. Shidol is produced by spontaneous or controlled fermentation. It is formed particularly from soft fin swamp barb (*Puntius sophore*); however, nowadays, shidol is made from additional fish species, like Gangetic hairfin anchovy (*Setipinna phasa*), and Indian River shad (*Gudusia chapra*). Shidol is not at any time consumed in its fermented form. A chutney or sauce-like recipe (shidol bharta) is prepared as a side dish for rice or bread (Kakati & Goswami, 2013). However, pathogenic contamination like *Staphylococcus aureus*, *Streptococcus* sp., and *E. coli* have been revealed in fermented fish pickles (Kakati & Goswami, 2013).

## Why choose bamboo shoots over vinegar as a preservative

1. Rich in nutrients: Shoots have a high content of protein (amino acids), carbohydrates, minerals, and several vitamins.
2. Function as nutraceuticals: Nutraceuticals are ordinary foods with components or ingredients imparting a specific medical or physiological benefit other than a purely nutritional effect. Bamboo shoots contain phytosterols and a high amount of fiber that can qualify as “nutraceuticals” or “natural medicines.” Phytosterols have cholesterol-lowering activity.
3. High fiber content, almost no calories: Bamboo shoots are a good source of edible fiber (6 to 8 g/100 g fresh weight), which helps in lowering the blood cholesterol. Dietary fibers are vegetable fibers

obtained from fiber-rich parts of plants. They are neutral in taste and odor-free and have no calories and fats. Bamboo fiber is available as a white powder with at least 95% fiber. Many companies market such as fiber additives that are rich sources of dietary fiber.

4. Low fat: Fat content is extremely low in bamboo shoots (2.46 g/100 g) that are, therefore, very good for weight-conscious and dieting people.
5. Appetizer: The high cellulosic content of bamboo shoots stimulates appetite. Being crisp, crunchy, and tender with a sweet flavor, shoots have a unique and delicious taste that function as an appetizer.

Bamboo shoots are not only rich in nutrients but also contain bioactive compounds therefore it can be used as an ingredient in functional foods (Nirmala & Bisht, 2012).

**Table:** Available macronutrients, dietary fibre (g per 100 g fresh weight), vitamin C, phenols (mg per 100 g fresh weight) in the fresh juvenile shoots of some bamboo species

| Species           | Proteins   | Starch     | Vitamin C   | Dietary Fibre | Phenols       |
|-------------------|------------|------------|-------------|---------------|---------------|
| <i>B. balcooa</i> | 2.91± 0.02 | 1.54± 0.02 | 2.21 ± 0.01 | 6.75 ± 0.08   | 191.37 ± 2.62 |

|                        |             |             |             |             |                |
|------------------------|-------------|-------------|-------------|-------------|----------------|
| <i>B. tulda</i>        | 3.69 ± 0.03 | 0.59± 0.12  | 1.42 ± 0.06 | 3.97 ± 0.02 | 443.97± 6.09   |
| <i>B. nutans</i>       | 2.84 ± 0.12 | 0.21± 0.02  | 1.19 ± 0.10 | 2.28 ± 0.01 | 275.36 ± 24.04 |
| <i>D. giganteus</i>    | 3.11 ± 0.17 | 0.51± 0.06  | 3.28± 0.02  | 2.65 ± 0.03 | 222.40± 6.26   |
| <i>D. hamiltonii</i>   | 3.72 ± 0.12 | 0.47± 0.03  | 2.45± 0.08  | 3.90± 0.03  | 264.83± 6.75   |
| <i>D. membranaceus</i> | 3.38 ± 0.10 | 0.23± 0.04  | 1.58± 0.06  | 2.91± 0.06  | 302.73± 18.53  |
| <i>D. strictus</i>     | 2.60 ± 0.07 | 0.31 ± 0.05 | 2.43 ± 0.11 | 2.26 ± 0.01 | 271.23± 5.64   |

**Preparation of fish pickle by incorporating FBS extract:**

**Collection of raw materials:**

Fresh fish *Puntius spp.* should be collected from the local market for the present study in iced condition and will be bought to the processing hall. Fishes must be thoroughly washed with potable water, scale and gut content could be removed and washed again thoroughly in potable water.

**Preparation of bamboo shoot extract:**

The tender bamboo shoot can be collected locally, washed using potable water after removing the outer surface of the shoot. Shoots are then sliced into small pieces, ground using mixture grinder adding little quantity of water. The minced bamboo shoot should be allowed to ferment for 21 days. The typical ripening smell (very sharp,

pungent with strong smell) will develop due to the fermentation process. The raw extract may be first separated from the fermented bamboo shoot with the help of muslin cloth by pressing and filtered bamboo shoot through Whatman filter paper no 1 to get the clean extract. The bamboo shoot extract may be stored in a clean glass bottle and keep in a refrigerator at 4<sup>0</sup>C until further use.

Because freshly foraged bamboo shoot contains toxic hydrocyanic acid, before it's ready to be used in cooking, bamboo shoot needs to be pre-cooked with rice bran flour ("nuka") to remove the toxic. By cooking bamboo shoot with rice bran, bran's starch removes the toxin from bamboo shoot and absorbs it. Also, by adding dry red pepper, it helps to remove bitterness from bamboo shoots. It's a traditional simple process, which we still

practice every time we get fresh bamboo shoots. The longer you keep it (without pre-cooking), the more the bitterness in bamboo shoot increases.

### **Preparation of fish pickle by incorporating bamboo shoot extract:**

For the preparation of fish pickle, *Puntius spp* should be collected, iced, and brought to the processing hall. Fishes must be gutted, de-scaled, washed with potable water, and cut into pieces of 1 cubic cm. After weighing mix the fish thoroughly with 3% of its weight of salt and keep for two hours. Lightly salted and partially dried fish also may be used. Fry the fish in a minimum quantity of oil. Set apart the fried fish. Fry the ingredients (mustard, green chilies, garlic, ginger) in the remaining quantity of oil and then add chili powder, pepper powder and turmeric powder and mix well over low flame for a few minutes. Remove from fire, add fried fish, and mix well. When cooled, add bamboo shoot extract in place of vinegar in the same amount, powdered cardamom, clove, cinnamon, sugar, and remaining salt and mix thoroughly. A sufficient quantity of boiled and cooled water may be added to cover the ingredients well. After cooling, sodium benzoate (200 ppm) can be added to

the contents. Transfer to clean, sterile glass bottles and seal with acid-proof caps. Take care to see that there is a layer of oil over the contents in the bottle. Flexible pouches made of 12 micron polyester laminated with 118 micron LD-HD co-extruded film can also be used for packing the pickle. The following parameters should be studied at a one-month interval to assess the quality and ascertain the shelf life of the product.

### **Proximate composition:**

Moisture content, Protein content, total fat content, and Ash content should be determined by following the methods as per AOAC (AOAC, 1975).

### **Biochemical analysis:**

The different essential analysis could be performed by the following standard methods:

- The total volatile base nitrogen (TVB-N) can be estimated by Conway's micro diffusion method (Conway, 1947).
- Alpha Amino Nitrogen (AAN) may be estimated by Pope and Stevens (1939) method.
- Peroxide Value (PV): Homogeneous samples (10g) may be extracted with chloroform. The peroxide value of



the samples could be determined by the method of Jacobs (1958).

- Free Fatty Acid (FFA): homogeneous samples (10 g) can be extracted with Chloroform. The free fatty acid (FFA) may be determined according to the method described by Nambudiri (1985).
- pH: 5 g of the sample can be mixed well with 45 ml of distilled water and pH should be measured by using a pH meter.

**Microbiological Analysis:** This is an important analysis to be carried out after the preparation of fish pickle for quality assurance. The microbial quality of the product could be determined by following standard methods outlined in USFDA (2001) and (APHA, 1976). 10 g of the sample will be weighed aseptically and homogenized with 90 ml physiological saline (0.85%) in a Homogenizer/ Blender. Then serial decimal dilutions will be carried out using the same diluents.

- Total plate count will be counted on Nutrients Agar for duplicate plates incubated for 48 hours at 37°C.
- The enumeration of Yeast and Moulds will be carried out using the spread

plating procedure on Potato Dextrose Agar incubated for 72 hours at 37°C.

- For *Escherichia coli* enumeration, duplicate spread plates of Tergitol-7 Agar will be prepared using appropriate dilutions. The plates will be incubated for 48 hours at 37°C.
- Faecal *streptococci* and *Staphylococcus aureus* determination will be carried out in Kenner Faecal (KF) Agar and Baired Parker (BP) Agar respectively using spread plate technique incubated at 37°C for 48 hours.
- For enumeration of *Salmonella spp.* 25g of fish sample homogenized with 225 ml of lactose broth and incubated at 37°C for 24 hours for pre-enrichment. 1ml of the pre-enriched sample will be transferred to 10 ml of Selenite cystine broth and 10 ml of Tetrathionate broth and incubated at 37°C for 24 hours for enrichment. A loopful of enriched sample is streaked on to Bismuth Sulphite Agar or Xylose Lysine Deoxycholate Agar and incubated at 37°C for 48 hours.

### Sensory Evaluation

Sensory evaluation of the product can be carried out using a 9-point

hedonic scale by a trained taste panel consisting of 10 members. The sensory quality of the product can be assessed for attributes such as appearance, color, taste, texture, odor, and overall acceptability.

### **Conclusion:**

The conceptualization and visualization of fish pickling using bamboo shoots is very new. Different studies are there using bamboo shoots in pork pickles. Since bamboo shoot has many fringe benefits over vinegar, so it can be implemented. Bamboo shoots are rich in nutrients, cheap, high fibre content, low-fat content, and also acts as an appetizer. There is a huge scope in the future as bamboo shoots with fish provide immense nutrients to the consumers. So, the implementation of bamboo shoots should be standardized and commercialized.

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