

Traditional wisdom of *Meitei* community regarding elimination of cyanogenic glycosides in bamboo shoot food products

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Bamboo shoot is a wild food resource which is used as traditional delicacy by the ethnic people residing in Manipur, since time immemorial. They are consumed fresh, fermented or pickled. The preparation method of these food products is a traditional art which is handed over from generation to generation. Bamboo shoots are low in calories, high in dietary fibers and rich in various nutrients like protein, carbohydrates, amino acids, minerals, fat, sugar and inorganic salts, however, bamboo shoots are known to contain plant toxins (cyanogenic glycosides) which are harmful to human health. The paper documents the traditional methods used by the *meitei* community of Manipur for preparation of various bamboo shoot based food products and analysis of cyanide content in these food products.

Keywords: Bamboo shoot, Cyanide, *Meitei* tribe, Manipur

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Bamboos are perennial evergreen plants belonging to grass family Poaceae. The bamboo plant consists of aerial stems known as culms, which arise from a network of rhizomes and bears branches and leaves. A new emerging tender young culm containing nodes and internodes in a vertically miniaturized form is known as bamboo shoot. The young shoots are tightly clasped with overlapping sheaths that have to be removed to extract the edible part. New culms or juvenile shoots in bamboos usually develop with the beginning of the monsoon season during which the young edible shoots are harvested. Fresh shoots have a crisp, crunchy taste, and sweet flavour, imparting a unique taste. Bamboo shoots are low in calories, high in dietary fibers and rich in various nutrients like protein, carbohydrates, amino acids, minerals, fat, sugar and inorganic salts¹⁻⁶, however, bamboo shoots are found to contain high amount of natural plant toxin, the cyanogenic glycosides specifically taxiphyllin⁷. These toxic substances when ingested in significant amount or when they are not processed appropriately can be potentially harmful to human health thereby causing food poisoning. Cyanogenic

glycosides are nitrogenous phytoanticipins and are used by various plants as effective defensive mechanism against predators⁸. Cyanogenic glycoside is not toxic on its own. However, when cell structures of a plant are disrupted, cyanogenic glycoside will be brought together with the corresponding β -glucosidase enzyme. It will be subsequently broken down to sugar and a cyanohydrin which rapidly decomposes to an aldehyde or a ketone and releases the toxic hydrogen cyanide. The hydrogen cyanide so formed, inhibits the enzyme cytochrome oxidase which then stops the oxidative phosphorylation process and utilization of intracellular oxygen ceases and causes cardiac arrest in human body⁹. It happens when the plant is chewed releasing the toxic cyanide to the predator. In the same way, toxic cyanide is released when the plant is cut into small pieces during food preparation. The concentration of HCN recommended by WHO for cassava flour is 10 parts per million (ppm) and concentration of 100 ppm is regarded lethal for humans¹⁰. Manipur located in North East India is inhabited by various ethnic groups of which the *meiteis* form the primary ethnic group constituting about 60% of the population residing in the valley areas. Since time immemorial, bamboo

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shoot is a popular raw material for preparation of traditional food items in different processed forms¹¹. The preparation method is a traditional art which is handed over from generations to generations. The present study documents the traditional methods used by the *meiteis* community of Manipur for preparation of various bamboo shoot based food products and analysis of cyanide content in these food products.

Methodology

For documentation of the traditional process for preparation of bamboo based food products, a survey was carried out in villages of valley areas of Manipur. Informants were mostly womenfolk aged over 40 yrs old who has thorough knowledge of preparing bamboo based food products. Local fermented bamboo shoot food production units in valley areas of Manipur were also visited for the study.

Assay for cyanide content

The cyanogenic content of the bamboo shoot was analysed by picrate paper procedure¹². The method was performed with the help of cyanide analysis kit which was procured from Dr J Howard Bradbury, Research School of Biology, Australian National University, Australia. Twenty five mg of raw bamboo shoot was pounded in a pestle mortar and placed in a flat bottomed plastic bottle. Immediately 0.5 mL of 0.1 M phosphate buffer (at pH 6) was added and mixed together. Immediately a yellow picrate paper attached to a plastic strip was added in the bottle and closed tightly. Another sample was prepared as above but with no bamboo shoot, to serve as a blank. As a control (or standard) to check on the method, a Whatman filter paper disc loaded with buffer and linamarase in a bottle was placed one upon another and a pink linamarin paper was added. To it 0.5 mL water and a yellow picrate paper was added. Immediately the bottle was closed with a screw cap lid. The bottles were allowed to stand for 16-24 hrs at room temperature (20-35 °C). The bottles were opened and the colour of the paper was matched against the colour chart supplied in the test kit. From the colour chart, the amount in ppm was read. The total cyanogen content in ppm was obtained by multiplying the value from the colour chart by 100/z where, z is the weight of the sample. Also it was checked that the blank corresponds to zero. Three triplicates for each experiment were performed. The same process was repeated for the different

processing method employed for bamboo shoot food products.

Bamboo shoot pickles

The edible young shoots are chopped into slices and soaked overnight in water. The shoots are then boiled in water and dried under sun. In 2 cups of the bamboo shoots, 4 teaspoon of mixture of spices powder is added which is prepared by grinding 4 tbsp mustard seeds, 2 tbsp fenugreek seeds and 10 or drier red chillies, turmeric powder and salt. Extracted juice from 2 limes is added to the mixture. Half cup of oil is heated, 6-8 whole peeled garlic bulbs, 1 tbsp mustard seeds, and 3-4 dry red chillies are added and mixed well with the bamboo shoot mixture. It is then cooled and added to the above mixture.

Fried raw Bamboo shoot

The overlapping sheaths of the young shoots are removed to extract the edible part. The shoots are chopped into small pieces and soaked overnight. The shoots are then washed repeatedly with water and fried in oil by adding spices powder, turmeric, chilli and salt.

Fermented Bamboo shoot

There are three types of fermented bamboo shoot products, viz. *soijin*, *soidon* and *soibum*. Two types of fermentation methods were found, viz. Andro type and Kwatha type. In Andro type, the bamboo shoots are defoliated, sliced and pressed and covered tightly in earthen pots and kept for 6-12 months. During the course of fermentation, the mash volume reduces and additional fresh bamboo shoot slices are added till the pot is filled and fermentation is allowed to proceed. In *Kwatha* type, a large bamboo basket is lined fully with plastic sheets. Earlier leaves were used for the lining. The bottom of the basket is perforated for draining fermented juice during the fermentation process. Defoliated, sliced bamboo shoots are packed tightly to its capacity and sealed with plastic sheets and weights are put on top for deep pressing and allowed to ferment for 6-12 months. The immature stage of the above fermentation product is known as *soijin* and the completely fermented one is called as *soibum*. *Soidon* is prepared from succulent tender apical meristem of a specific bamboo species, *Teinostachyum wightii* (Munro) Bedd.. The tender apical meristem are cut, unwanted parts are removed and cut into pieces longitudinally. Fermentation in earthen pots is done by adding starter (usually

fermentation soup from previous batch). The fermentation is carried out in open container for up to 5-6 days with constant stirring.

Bamboo shoot chutney

The fermented bamboo shoots are mostly consumed as *chutney* locally called as *ironba*. The fermented shoots are soaked in water preferably with some salt. It is then washed with water repeatedly. The shoots are then squeezed dry by clasp tightly between the hands. It is then boiled or steamed with potatoes, chillies, and fermented fish (locally known as *ngari*) and mashed together. The *chutney* is garnished with local herbs like spring onions, coriander, *Houttuynia cordata* Thunb. (*toningkhok*), *Ocimum americanum* L. (*mayangton*), etc. Sometimes the raw bamboo shoots are also used for preparing *chutney*. The sliced bamboo shoots are soaked overnight, washed repeatedly in water and boiled/steamed and *chutney* is prepared accordingly.

Bamboo shoot curry

Curry of bamboo shoot is mostly prepared from fermented shoots preferably from *soibum*. The fermented shoots are soaked in water for sometime preferably with salt. It is then cooked with other vegetables like pumpkins, potatoes, green peas, etc., in different recipes. Some people also consume the shoots by frying with fishes or meat. The raw bamboo shoot is used as curry in a special delicacy locally known as *ooti*. The sliced raw bamboo shoots are soaked in water overnight along with dry peas. The sliced shoots are washed in water and are cooked along with the dried peas and one teaspoon of baking soda (NaHCO_3). This delicacy is a must in offerings to God during the *Rathayatra* festival in the month of July.

Bamboo shoot salad

The raw shoots are chopped into slices and are soaked overnight along with some dry peas. The soaked peas along with the sliced bamboo shoots and some dry chilli are cooked together with little water either in a pressure cooker or are boiled for half an hour. The cooked shoot is then squeezed dry by clasp tightly between the hands. The cooked peas are toasted in a heated pan till they are dry and are pounded coarsely in a mortar. Local fermented fish (local name: *ngari*) is roasted on fire until done. The roasted fermented fish, salt and the chillies are

blended together. It is then again blended together with the pounded peas into a coarse mixture. The blending can be done by hand or a pestle. The squeezed bamboo shoots are then mixed thoroughly with the above mixture. This delicious salad even though fiery is beautifully tempered with local nutritional and digestive herbs like spring onions, Coriander, *Houttuynia cordata* Thunb. (*toningkhok*), *Ocimum americanum* L. (*mayangton*), etc. It is served as an accompaniment with meals.

Medicinal uses of bamboo shoots

Bamboo shoots are regarded as future health food due to its high nutritional content. The shoots are low in fats, cholesterol, high in dietary fibres and rich in mineral content and also has antimicrobial properties. Bamboo shoots have been regarded as a traditional Chinese medicinal material for more than 2000 yrs. In the traditional system of Indian medicine, the silicious concretions found in the shoots are called '*banslochan*' and in the Indo-Persian and Tibetan system of medicine, it is called '*tabashir*' or '*tawashir*' and commonly called as '*bamboo manna*' in English⁶. Modern research has revealed that bamboo shoots have a number of health benefits, from cancer prevention and weight loss to lowering cholesterol level, improving appetite and digestion¹³.

Because of its high content of potassium, bamboo helps to maintain normal blood pressure and is labeled as a heart-protective vegetable¹⁴. Its relatively high content of up to 4 % cellulose increases the peristaltic movement of the intestines and helps digestion. It also prevents constipation and decreases body fat¹⁴. Due to high content of dietary fibres and presence of phytosterols, bamboo shoots are known to lower cholesterol level. Shoots of *B. Arundinacia* / *B. bamboos* contain choline, betain, nuclease, urease, cyanogens, glucosides and are used in the treatment of diarrhoea, thread worm and cough. Shoots and dried pith of *D. strictus* contain silicious matter and have tonic and astringent action. The juice of pressed bamboo shoots possesses protease activity that helps in digestion of proteins. Boiled bamboo shoots are used as appetizers and the decoction of shoots are used for cleaning wounds and maggot infected sores and ulcers¹⁴. With different flavones and glycosides, bamboo shoots have excellent anti-microbial qualities and its shoots are used in preparation of steroidal drugs. Fermented bamboo shoot was accompanied with production of sitosterol-a phytosterol which is

the precursor of many pharmaceutically important steroidal drugs¹⁵. An antifungal protein called “*Dendrocin*” which exhibited inhibitory effect on mycelial growth of *Fusarium oxysporum*, *Botrytis cinerea* and *Mycosphaerella arachidicola* was isolated from fresh bamboo shoots⁶. The shoots were also found to have antioxidant activities. An anti oxidative compound identified as *tricin* and *taxifolin* were isolated from bamboo shoot. The shoots also contain anti-carcinogenic agents and making them a regular part of diet effectively reduces the free radicals that can produce harmful carcinogens⁶.

Results and discussion

The cyanogen in bamboo is taxiphyllin (which is a p-hydroxylated mandelo-nitrile triglochinin), one of the few cyanogenic compounds that decompose quickly when placed in boiling water¹⁶. Bamboo becomes edible because of this instability. It is also reported that processing techniques like slicing, soaking, steaming, boiling, drying, fermentation, etc., eliminates the toxic compound to a great extent¹⁷.

Fig. 1 shows the cyanide content of raw bamboo shoot soaked in distilled water for different time intervals. It is observed that there is decrease in the cyanide content with increase in soaking time. At 3 hrs of soaking it is observed that there is 60 % reduction in cyanide content.

Fig. 2 shows the cyanide content of the bamboo shoot boiled in distilled water for different time intervals. It is observed that cyanide content decrease with increase in boiling time. At 60 min of boiling in water, 95 % reduction in cyanide content is observed.

The cyanide content of bamboo shoot measured during the course of fermentation (after every month) is shown in Fig. 3. It is observed that there is gradual decrease in cyanide content during the fermentation process. At 12 months of fermentation, the cyanide content is found to reduce to 90 %. Fermented bamboo shoot is produced by natural lactic acid fermentation. It has been reported that natural lactic acid fermentation of sliced mash of bamboo shoot begins as soon as proper packing condition is given¹⁸. With the rapid utilisation of sugars by the microbes, acids are accumulated. The accumulated acid catalyses the degradation of taxiphyllin into glucose and hydroxyl benzaldehyde cyanohydrin. Benzaldehyde cyanohydrin then decomposes to hydroxybenzaldehyde and hydrogen cyanide¹⁸. The sharp decrease in the HCN during the initial period of fermentation may be aided by the presence of specific plant glucosidase as some

of the plant cells are alive after packaging resulting in the action of glucosidase on taxiphyllin. The plant glucosidase thus have a role in freeing of the HCN from taxiphyllin during initial period of fermentation course¹⁹. Reduction in cyanogenic content during the course of fermentation in bamboo shoot has been recorded by number of investigators²⁰.

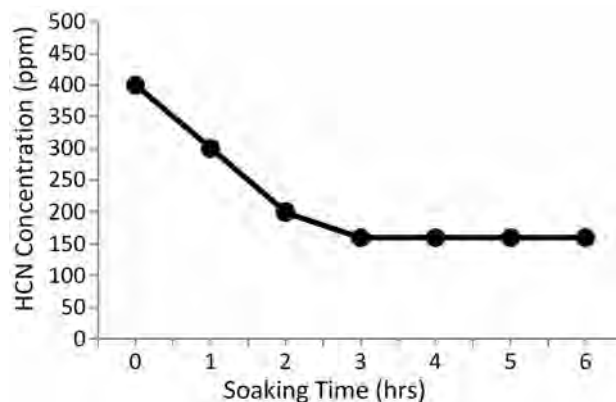


Fig. 1—Cyanogen content (ppm) of bamboo shoot during the course of soaking in water (in hrs)

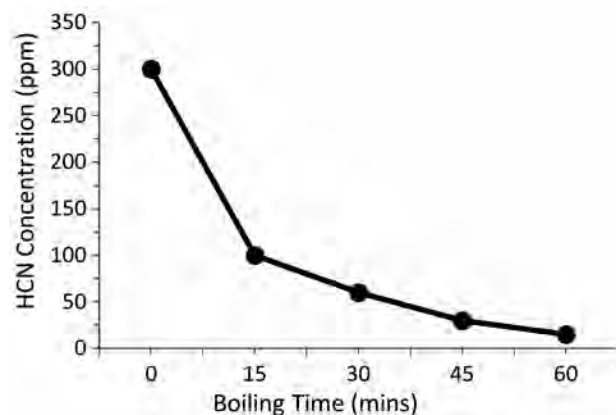


Fig. 2—Cyanogen content (mg/kg) of bamboo shoot during the course of boiling in water (in min)

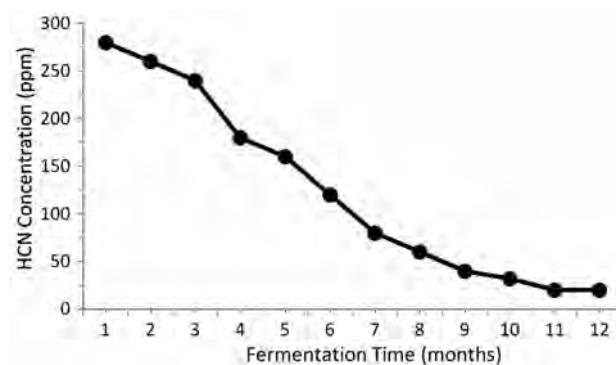


Fig. 3—Cyanogen content (ppm) of bamboo shoot during the course of fermentation (in months)

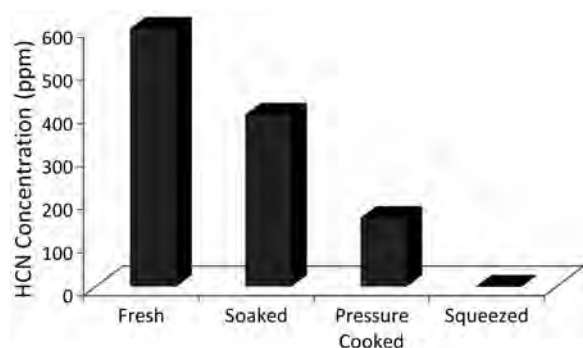


Fig. 4—Cyanogen content (ppm) of bamboo shoot during the different stages of bamboo shoot salad preparation

Fig. 4 shows the cyanide content during the course of traditional bamboo shoot salad preparation. Results show that the concentration of hydrogen cyanide is decreased during the preparation of bamboo *salad* and is completely removed at the final step of preparation. The cyanide content in fresh bamboo shoot was found to be 600 mg/kg. After soaking for some time in water (approx 1 hr), the cyanide content was found to reduced to 400 mg/kg. However, after pressure cooking, the level of cyanide drastically reduced to 160 mg/kg. After squeezing of the cooked bamboo shoot, the cyanide content of the food could not be detected. The stepwise process of removal of cyanide during a special bamboo shoot salad of Manipur locally known as *Ushoi Kangsu* has been reported²¹.

In an age dominated by scientific and technological marvels, the *meiteis* of Manipur still conserve the traditional process of food preparations, which have been developed by their fore-fathers. Even though there were no scientific studies during the times of our ancestors' maybe they had knowledge about the toxicity of fresh bamboo shoots and hence had invented simple procedures for the removal of toxic compounds. It is a taboo for the *meitei* community to eat raw bamboo shoot without soaking or boiling/cooking. Some food preparations, like chutney or salad are fiery in nature, these are garnished with nutritive and digestive herbs to combat the fiery flavor. The wisdom of using food processing methods by our forefathers are unique and scientifically advanced way ahead of their times to ensure the good health of the community for which the present population is highly indebt to them.

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