

## PM Formalization of Micro Food Processing Enterprises (PMFME) Scheme

### HANDBOOK FOR BAMBOO SHOOTS



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Deemed to be University (De-novo Category) under Section 3 of the UGC Act, 1956

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**ABBREVIATIONS**

1	PET	Polyethylene terephthalate
2	LDPE	Low-density polyethylene
3	HDPE	High-density polyethylene
4	BIS	Bureau of Indian Standards
5	FSSAI	Food Safety and Standards Authority of India

## CHAPTER-1

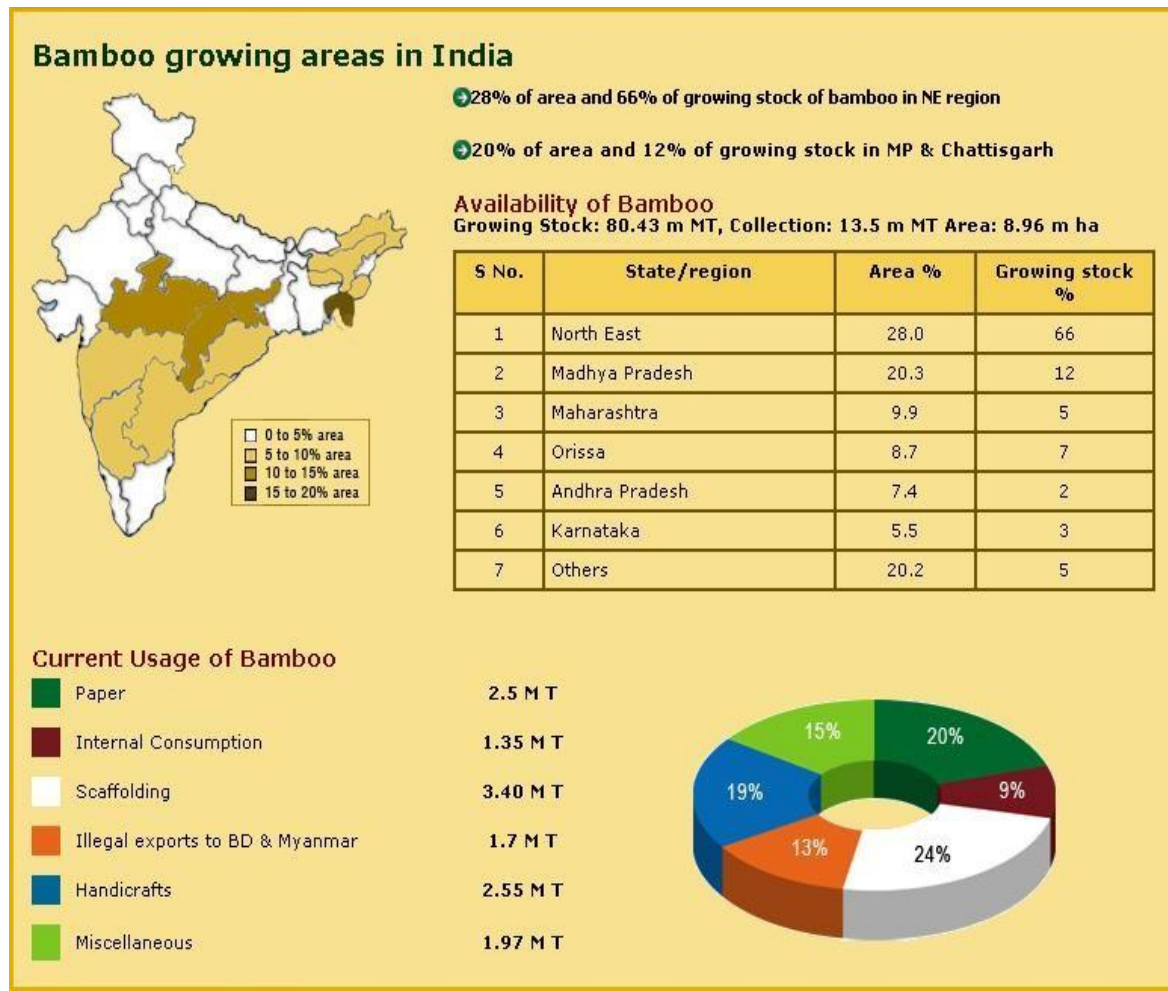
### 1.1. INTRODUCTION

Bamboo plant is considered as a giant grass. Bamboo shoot is the new tender growth of young culm from the rhizome apex having compressed internodes which are protected by numerous leathery sheaths. So, it is the young emerging culm of the bamboo plant.



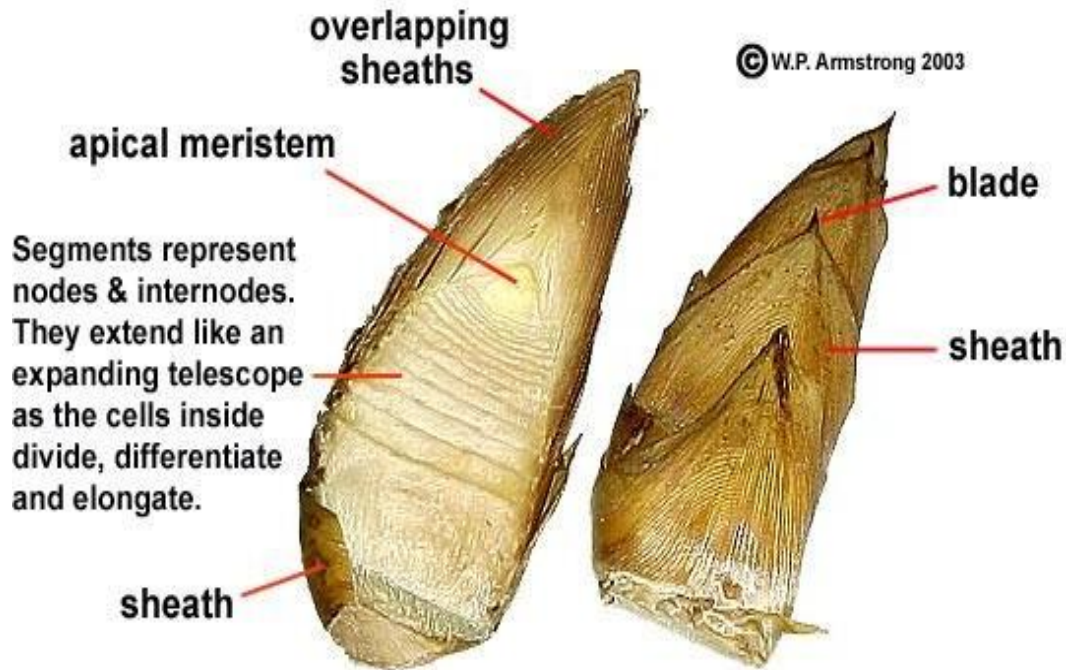
The scientific classification of the bamboo is as follows:

<b>Kingdom</b>	: Plantae
<b>Order</b>	: Poales
<b>Family</b>	: Poaceae
<b>Subfamily</b>	: Bambusoideae



The natural distribution of bamboo encompasses mainly the tropical, subtropical and mild temperate zones of worldwide and the tropical belt have the maximum number (320 species) of bamboo species. There are more than 1,250 species which belong to 75 genera worldwide, indeed India has more than 125 species belonging to 23 genera. India is third largest country in the world, that is, next to China (300 species) and Japan (237 species) as far as diversity of the bamboo species is concerned. The shooting period of bamboo varies species to species. Generally, it is known that runners are the temperate climate bamboos which shoot in the spring and clumpers which shoot in the late summer and fall which belong to tropical and subtropical regions. *Bambusa balcooa*, *B. tulda*, *Dendrocalamus hamiltonii*, *D. giganteus* and *Malocanna bacciferra* etc. are some of the examples of bamboo species which are available in North Eastern region of India.





**A Bamboo Shoot Sectioned Lengthwise**

The edible part consists of meristematic cell tissue with regions of rapid cell division and differentiation, which is enveloped in protective, non-edible leaf sheaths. The whole bamboo shoot consists of three parts, sheath, tender bamboo shoot (tip), and basal bamboo shoot. Bamboo shoots are highly nutritious and a great source of dietary fibers, carbohydrates, antioxidants, amino acids, minerals, vitamins, protein, low in calorie and fat content, but rich in essential fatty acids<sup>2-4</sup> with health beneficial properties. The health beneficial properties bamboo shoot possesses are anti-inflammatory, anticancer, antibacterial, antifungal, and antiviral properties etc. Some anti-nutrients are also present in bamboo shoots. Above all, it is traditional delicacy of different north eastern states of India. Bamboo shoots are used to make pickle, fermented products, biscuits and canned products etc.

## CHAPTER-2

### 2. Selection of raw materials/ cultivar/variety

#### 2.1. Selection of raw materials

Shooting period of sympodial bamboos is May to October with most production is in July to August. Bamboo shoot should be selected for consumption before it is becoming tough and free from diseases, insect damage or any mechanical damage before and after harvest. Bamboo shoots can be selected for harvesting at any age base on processing different products and generally it is harvested at the time of June and July when the shoots are of 30 cm in height. Eg: for preparing fermented dry bamboo shoot product around 1.3-1.5 m in height bamboo shoot is selected. Generally for processing bamboo shoot high of 30 cm is selected for harvesting. Different species shows variation of nutritional composition based on harvesting age. For example: according to some research, after emergence from the ground the optimum harvesting age for shoots of *D. asper*, *D. strictus* and *B. tulda* was on 10 to 14 days, 6 to 10 days and 10 to 16 days respectively. The edible part of bamboo shoot is consisted by meristematic cell tissue with regions of rapid cell division and differentiation. The bamboo shoot is enveloped in protective and non-edible leafy sheaths.

#### 2.2. Cultivar/Variety

The temperate climate bamboo species are known as runners, which shoot in the spring season and the tropical and subtropical bamboo shoot species are called as clumpers, which shoot in the late summer and fall. For cultivation fresh bamboo seed is not easily available. So mostly bamboo are propagated vegetatively by cutting culm into one or two nodes along with culm buds and place them upright horizontally at an angle based on species in warm moist condition.

Though there are varieties of bamboo shoot species available worldwide, but not all bamboo shoot species are edible. Some edible bamboo shoot species are *Dendrocalamus strictus*, *Bambusa bambos*, *Bambusa nutans*, *Bambusa tulda*, *Dendrocalamus giganteus* and

*Dendrocalamus hamiltonii*, *Dendrocalamus asper*, *Phyllostachys pubescens*; *Phyllostachys. praecox*; *Phyllostachys praecox f. perversalis*; *Phyllostachys propinqua*; *Phyllostachys. dulcis*; *Phyllostachys irridenscens*; *Phyllostachys prominens*; *Phyllostachys flexuosa*; *Phyllostachys Bambusoides*, *Dendrocalamus latiflorus*; *Dendrocalamopsis vario-striata*; *Dendrocalamus beecheyana*; *Dendrocalamus beecheyanavar. pubescens*; *Dendrocalamus. validus*; etc. Commonly edible species in India are *Bambusa pallid*, *Bambusatulda*, *Bambus apolymorpha*, *Bambusa balcooa*, *Dendrocalamu shamiltonii*, *Dendrocalamus giganteus*, *Dendrocalamus asper*, *Melocanna bambusoides*, *Phyllostachys pubescens* etc.



## CHAPTER-3

### 3. Processing of Bamboo Shoots

#### 3.1. Harvesting

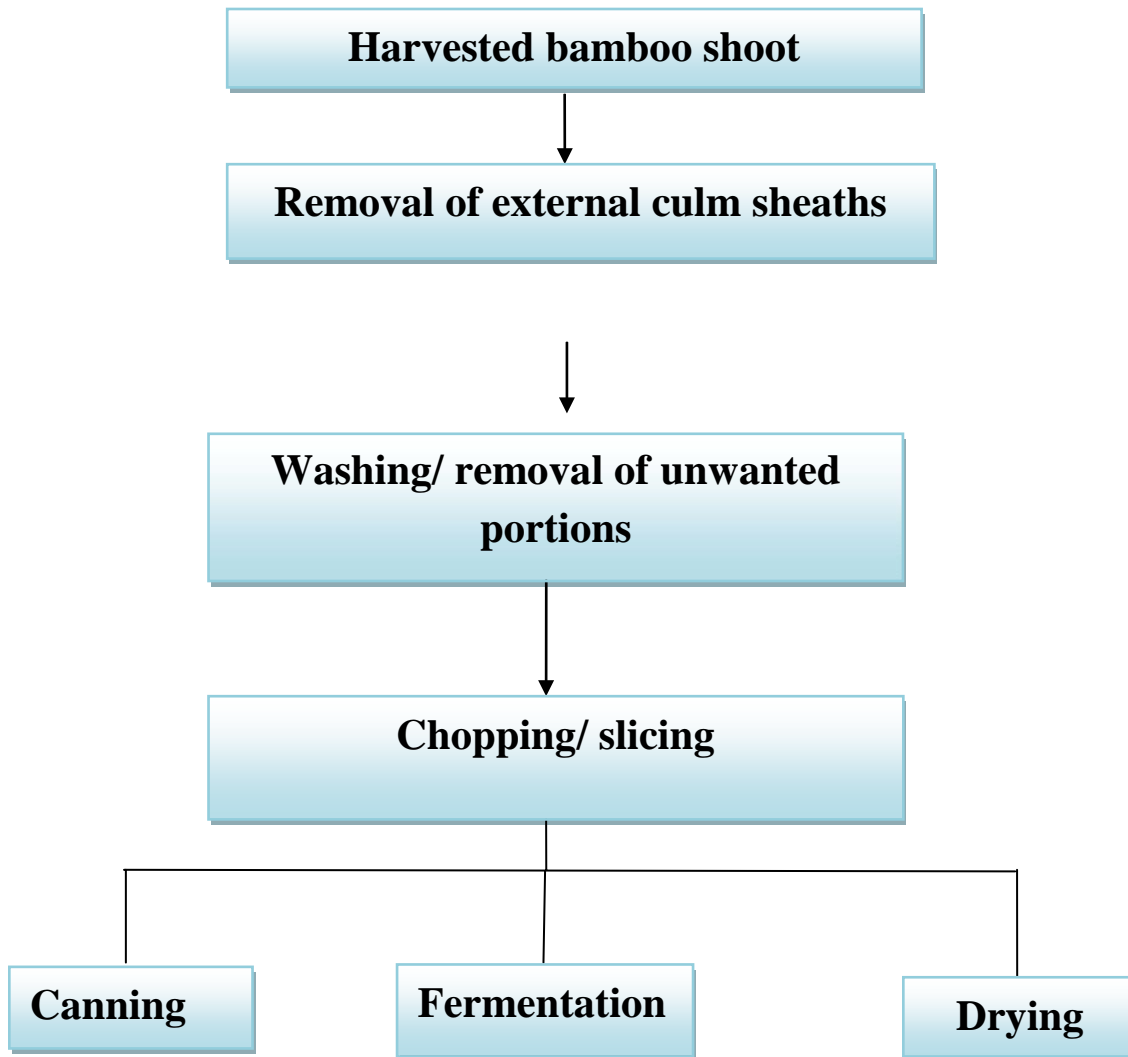
It was suggested that bamboo shoot should be harvested from mature clumps as immature clumps may not have sufficient biomass and edible content. Depending on species and processing product we can harvest tender young bamboo shoot when it is 15-30 cm long from the ground. While harvesting the selected bamboo shoot can be cut off from ground level or also can be dug around the young shoot and cut just above the rhizome.

Harvesting at morning hours helps to reduce the water loss due to transpiration and evaporation. So, generally early morning and late evening are best for harvesting bamboo shoots. While harvesting, first it is better to dig around the base of the shoot and after harvesting need to cover the dug area with soil. Comparatively, bamboo shoots in middle of shooting period are healthier than the extreme period of shooting. After harvest it is better to optimize processing methods within 24 hours from harvesting.

#### 3.2. Post-harvest processes of bamboo shoot

After harvesting, bamboo shoot can be degraded very rapidly due to different chemical changes, enzymatic degradation; microbial spoilage etc. bamboo shoot itself contains antinutrients (cyanide), which is necessary to remove before consumption. So to protect its quality there is need for processing. There is a need for some pretreatments for removal of bitterness/ cyanide from bamboo shoot before proceeding in any particular consumption process.

Post-harvest management is very necessary for bamboo shoot. Because, different internal and external factors such as enzymes and moisture of bamboo shoot, storage condition such as temperature, moisture, microorganisms, and the means of storage can impact on the nutritional contents as well as shelf life of bamboo shoot. As a general practice we can keep the raw bamboo shoot in refrigerator (relative air humidity at about 85%), also to inhibit enzyme action we can add salt, to control microbial activity we can keep bamboo shoots under oxygen insulated conditions. In cooked bamboo shoots chemical preservatives are also added for preservation.



**Fig.1: General primary processes of bamboo shoot**



**Fig.2: Bamboo shoot slicer**

The processing methods of bamboo shoots are discussed briefly below:

### **3.2.1. Cleaning, peeling and cutting**

After harvesting, cleaning of bamboo shoot is done to remove soil and other dirt. For further processing there need to peel out the other outer scaly layers until we get close to the soft edible core. The soft inner-core of the bamboo shoot can be cut longitudinally or perpendicular based on our requirements. In other words, it is chopped and sliced.

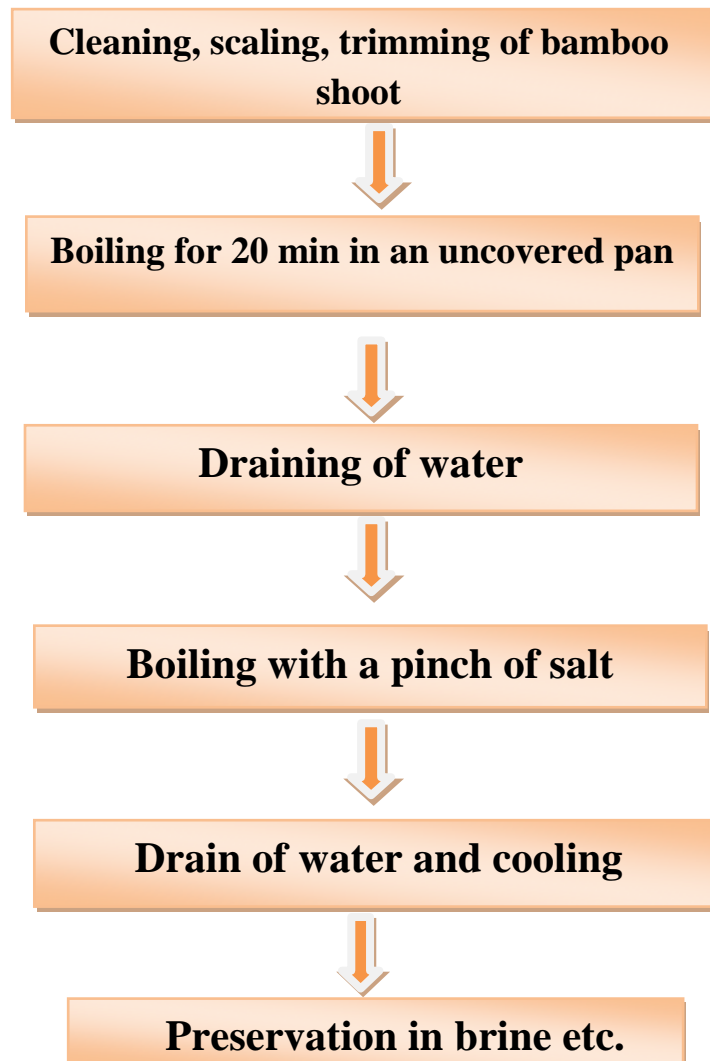
### **3.2.2. Pretreatment**

Pretreatments are important before consumption of bamboo shoot as it contains some antinutritional properties such as Cyanoglycosides (Taxiphyllin). Indeed, boiling, steaming and soaking in water etc. can be adapted for removal of antinutrients. These pretreatment can affect the sensory attributes and also bioavailability of nutrients of bamboo shoots. The lethal dose of cyanide for a healthy adult was reported as 0.5–3 mg/kg body weight. Due to consumption of cyanide general sickness, diarrhea, goiter, muscle weakness and other respiratory, nervous and gastrointestinal problems can occur.

Boiling can be done using hot water for generally about 10 minutes and repetition of boiling is required by changing the boiling water each time of repetition. This will remove bitterness and unwanted foreign matters. The amount of water used for boiling has impact on the reduction of cyanogenic glycoside. Sometimes different concentrations of salt solution (5%, 10% etc.) can be taken for boiling the bamboo shoots. After boiling the bamboo shoot pieces, finally water is drained off and is cooled for further process. Soaking is done by dipping the bamboo shoot pieces in water generally for few hours or overnight. This overnight soaking helps to eliminate the acrid taste and smell from the shoots. In case of steaming, bamboo shoot pieces are placed on a steamer and pressure cooked for different time.

Also, blanching is done to ward off the microbial attack and enzymatic browning. Blanching is a unit operation and a method of preservation used widely in the agro-food sector. It softens the vegetable tissues to facilitate filling into containers and removes intracellular air which increases the density of food and prevents the oxidation of canned food. In this method, bamboo shoots are put into hot water at specific temperature and time, after that bamboo shoot

pieces are then dipped in cold water immediately. A general method for removal of cyanide is shown below:



**Fig.3: Flowchart of removal of hydrogen cyanide from bamboo shoot**

People of Arunachal Pradesh, uses banana leaves to semi-ferment the bamboo shoot and pressed by stones by keeping it near water stream for 3-4 months. This removes bitterness from bamboo shoots. In Odisha, the bamboo shoot pieces are dipped in water for a day for fermentation to remove the bitterness. Sometimes pieces of bamboo shoot pounded in mortar and pastel and sun dried before further processing.

### 3.3.3. Preservation processes

People generally consume bamboo shoots in the form of fermented slices, crushed fermented moist, crushed fermented dry, fermented whole shoot, roasted whole shoot, boiled whole shoot, liquor etc. Different processing methods for bamboo shoots are fermentation, roasting, boiling, blanching, pickling, canning etc. In other words, preservation methods of bamboo shoot are storing in brine solution (e.g.5% salt and 1% citric acid in 100 ml), drying, fermentation, canning, pickling, freezing, or heating etc. These processes are basically adopted to preserve the bamboo shoots so that they could be used for a longer time.

Drying decreases water content which plays important role towards the microbial attack and enhance shelf life. Some general drying methods generally which are generally used are sun drying, oven, freeze and superheated steam, hot air drying, vacuum freeze drying (FD) etc. In some researches some optimized advanced drying such as drying in a cabinet dryer (at 60 °C for 7 to 8 h), two-stage hybrid method of drying: hot airflow drying followed by vacuum freeze drying (AFD), reverse of the process i.e. vacuum freeze drying followed by hot airflow drying (FAD) was adopted.

In case of refrigeration, bamboo shoots can be stored up to 2 weeks. Here, it is better to keep them whole and unpeeled in refrigerator. Alternatively, it is also recommended to put the bamboo shoots in a jar with water and keep in refrigerator by changing the water daily. Sometimes Osmotic dehydration can also be adapted to remove the water from bamboo shoots by using hypertonic solution of sugar, salt or any other osmotic agent. Also water storage is one of the methods practiced in Manipur. Here, boiled bamboo shoots are stored in water or by addition of some salt in an air tight container.

#### 3.3.3.1 Canning

After harvesting the bamboo shoot is cut from head and tail and also removes the outer unwanted layers. After that the tender bamboo shoot is cleaned with water and then chopped or sliced and grading is done. The bamboo shoot pieces are boiled (brining) and drained and then canned. In this can salt solutions are added and allowed to evaporate. Finally, the cans are sealed and processed (retort, 100-120 °C). After cooling the cans it is labeled and packed. Canning and retort input output ratio could be 100:85 and is around 2 days of process time.

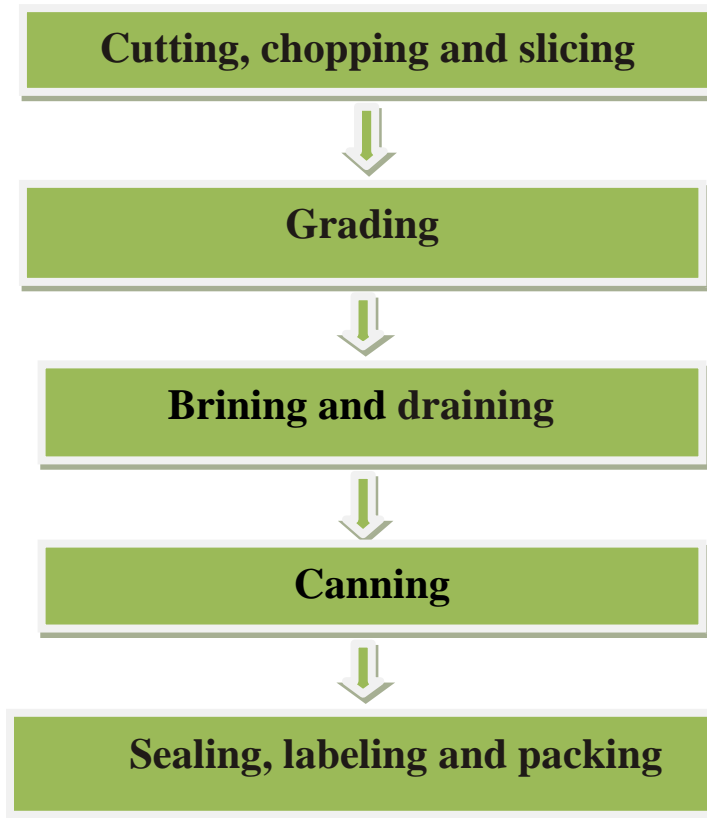


Fig.4: Flowchart of Canning of bamboo shoot



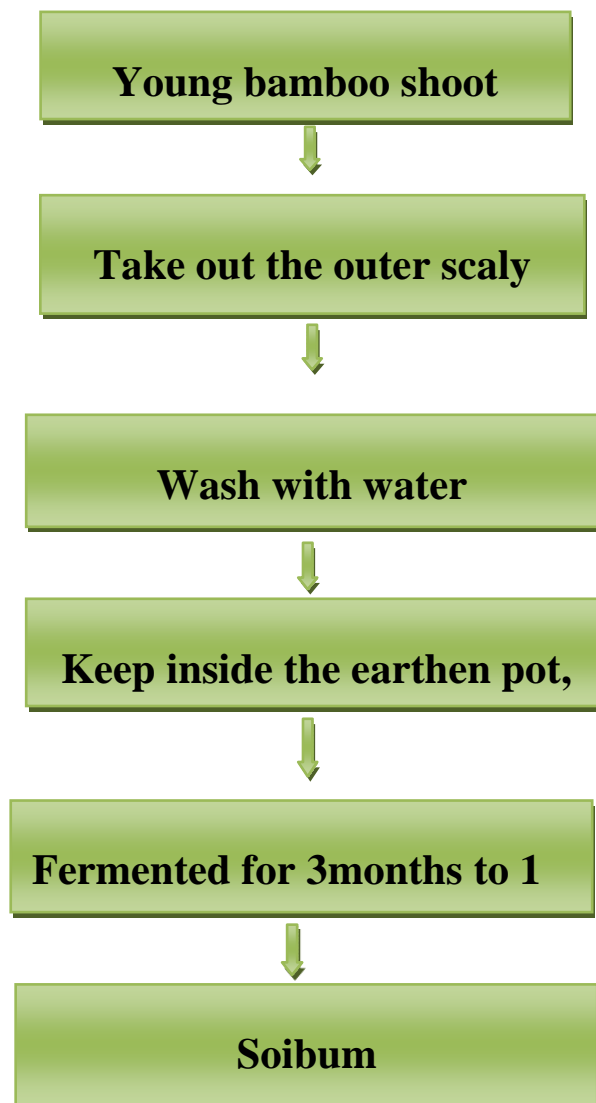
Fig.5: canned bamboo shoot



### 3.3.3.2 Fermentation

Fermentation is one of the popular methods for preservation of bamboo shoot. Different communities of India ferment the bamboo shoot in different ways. In Manipur the fermented bamboo shoot is known as Soidon, Soibum and Soijim.

**SOIBUM:** Soibum is a popular fermented product of bamboo shoot. It can be prepared in 2 ways such as Khongkhang/ Kwatha type and Andro type.

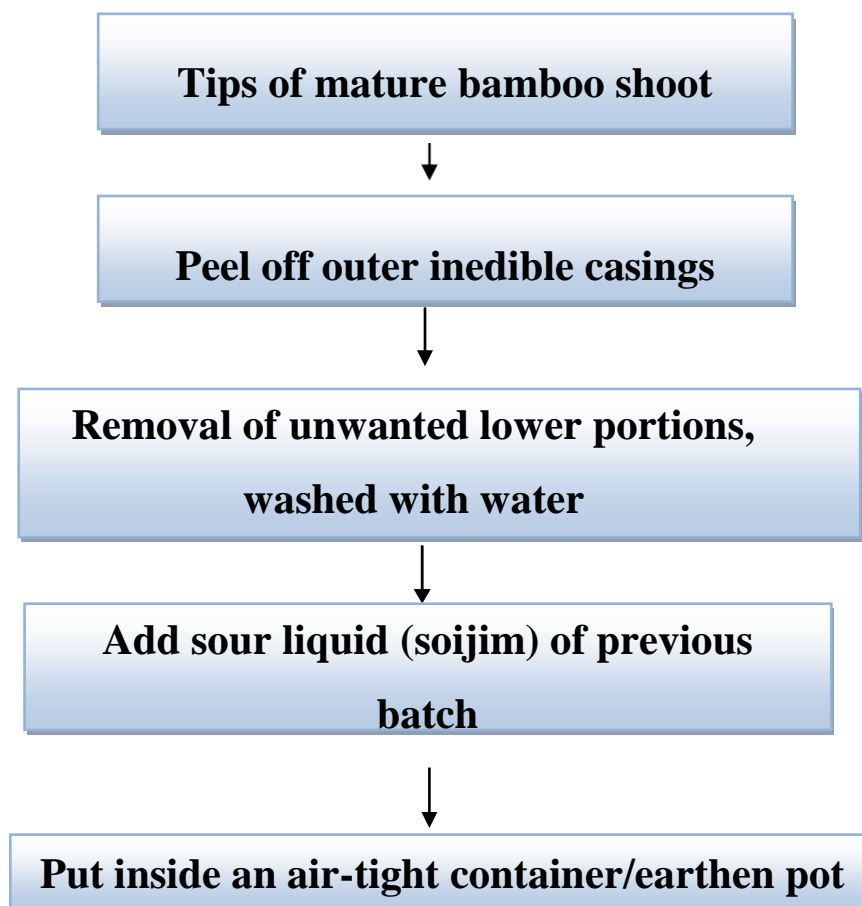


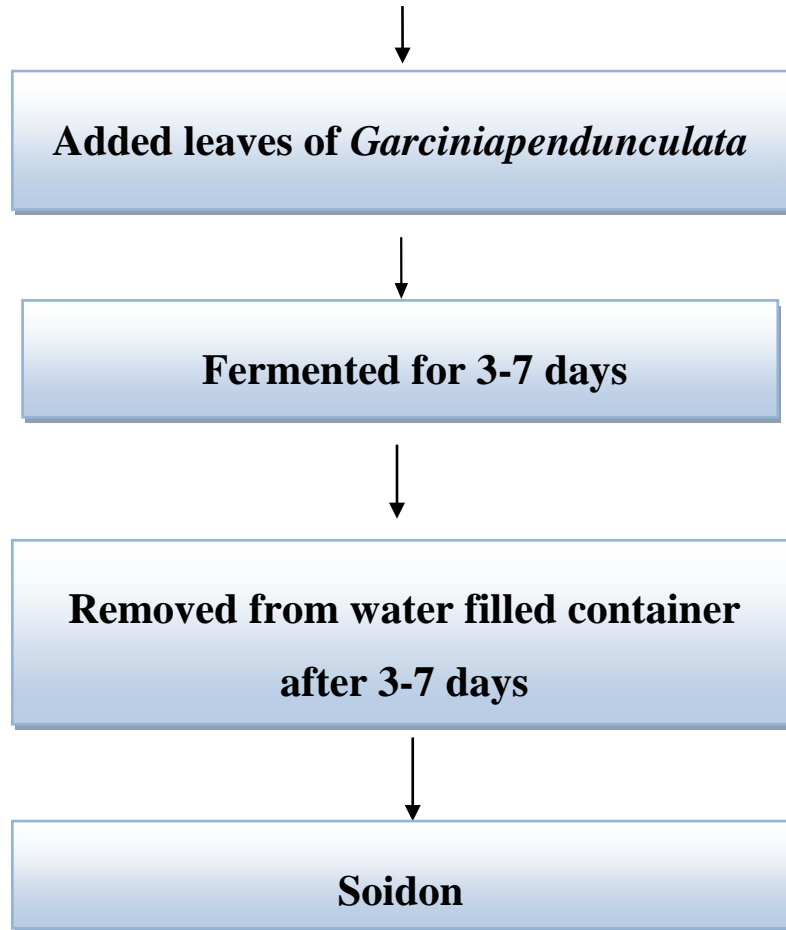
**Fig.6: Soibum preparation in Manipur**

The andro type soibum has faint aroma and faint taste. In this process initially the outer unwanted sheaths of selected bamboo is removed and the soft tender bamboo shoot cut into slices and washed. After that the slices of bamboo shoot is put into earthen pot and cover it nicely. This is left for fermentation for 3 months to 1 year. Soibum can be prepared from one single species of bamboo shoot or mixed species of bamboo shoot. Generally *D. hamiltonii* and, *B. manipureana* are used for preparation of soibum.

In Khongkhang/ Kwatha method, after peeling outer layers and washing the bamboo shoots are sliced. A large bamboo basket lined by banana leaves and plastics sheet is taken. Here, the slices of bamboo shoot is put and sealed with plastic sheets along with some extra weight is given from the top of the basked by any heavy object such as stone etc. for a perfect fermentation. The exudates produced during the fermentation is arranged to go out from the bottom of the basket and it is kept for 6-12 months for fermentation.

**SOIDON:**





**Fig.7: Soidon preparation in Manipur**

Soidon is prepared from tip of the matured bamboo shoot. The outer layers and lower portions are removed after collecting the tip of mature bamboo shoot. After in a container or earthen pot water is taken and the tips which are cut into transversely and longitudinally for 4- 5cm are dipped in that water pot, along with the addition of sour liquid (soijim) from previous batch. It is now covered and let it ferment for 3-7 days at room temperature. To enhance its flavor additionally leaves of *Garcinia pendunculata* can be added in the pot. After the fermentation period the soidon is removed from the pot and can keep it in different air tight container for a year at room temperature. There are several methods for fermentation of bamboo shoot in India.

**Table 1: Fermented bamboo shoot products in NE states of India**

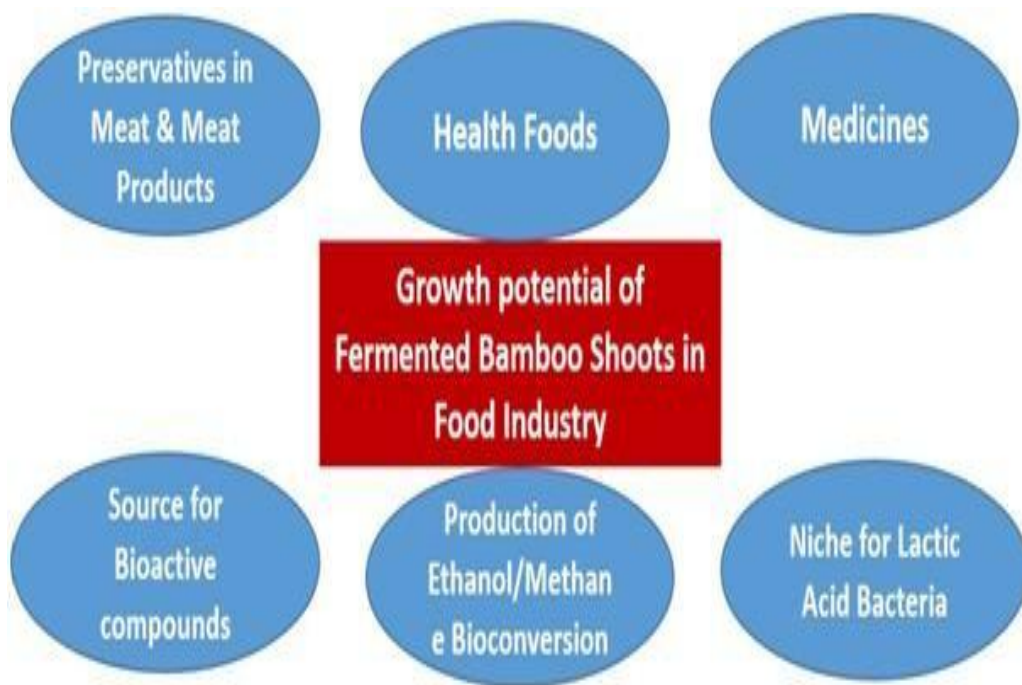
<b>Fermented bamboo shoot</b>	<b>Nature of product</b>	<b>Uses</b>	<b>Community</b>	<b>NE States of India</b>
<i>Mesu</i>	Solid, acidic, sour taste	Use as pickle	Gorkha	Sikkim
<i>Soibum</i>	Wet, solid, sour taste	Use in the preparation of special local dish called Iromba or cooked with fish and meat	Meetei	Manipur
<i>Soidon</i>	Wet, solid, sour taste	Use in making of Iromba or consumed as vegetable with fish or meat	Meetei	Manipur
<i>Soijim</i>	Liquid, acidic, sour taste	Use as condiment and flavouring agent	Meetei	Manipur
<i>Batangapani</i>	Liquid, acidic, sour taste	Use as condiment and flavouring agent	Nagas	Nagaland
<i>Ekhung</i>	Solid, sour and acidic	Use in the preparation of local dishes, curry or soups	Adi tribe	Arunachal Pradesh
<i>Hirring</i>	Solid, Sour, acidic taste	Preparation of local dishes	Nishi tribe	Arunachal Pradesh
<i>Eup</i>	Solid, sour, acidic	Preparation of ethnic dishes	Nishi	Arunachal Pradesh
<i>Tuaitar</i>	Wet, solid and sour taste	Use as pickle or in the making of traditional curry	Baite, Hmar	Mizoram, Manipur
<i>Lung-SieJ</i>	Wet, sour, acidic	Used in the preparation of traditional curry	Khasi	Meghalaya

## Chapter 4

### 4. Value addition and by products processing

#### 4.1. Value addition

In value addition process raw bamboo shoots are changed its form to produce a high quality end product, which means longer shelf-life and better organoleptic qualities. Value added products from bamboo shoot are pickled condiments, stir fries, soups and beverages, nuggets, papad, pickle, soup mixture, cookies etc. is available in worldwide. In NE of India bamboo shoot pickle, dry bamboo shoot etc. are highly popular. Different fermented bamboo shoots products are ushoi, soidon, soibum, soijim, iromba, ekung, eup, hiring lung-siej and syrwa. Bamboo shoots can be dried, marinated and sautéed. Bamboo juice can be produced by pressure-cooking, which is generally practiced in China.



**Fig.8: Growth potential of fermented bamboo shoots in food industry**

Some bamboo shoot based food products are shown in below:



Bamboo shoot powder incorporated cookies



Bamboo shoot pickle



Dry bamboo shoot



soibum



Fermented bamboo shoot water



#### 4.2. By products processing

It was estimated that 70% of the harvested bamboo shoots is being discarded as waste biomass such by products are outer sheath and basal section of the bamboo shoot, and wastewater etc. as it is mentioned above that bamboo shoots are full of nutrients, vitamins, minerals, bioactive compounds etc, so there is a chance of presence of these health beneficial compounds in bamboo shoot processing residue (BSPR). BSPR consists of outer leafy sheaths of bamboo shoot and the basal portion (tough woody fiber) of the bamboo shoot. Along with these, water used for boiling, soaking, and chilling, is also comes under list of byproduct of commercial bamboo shoot processing. It was found that like the tender bamboo shoot the byproducts such as outer sheaths and hard basal portion of bamboo shoot also comprise these antioxidant activity and bioactive compounds and also cyanide. So, there is a potential to use these BSPR for extracting bioactive compounds. But there need further research to conduct on innovative ways to eliminate the toxiccyanogenic material without disturbing the nutrients and bioactive compounds present in the BSPR f, so that there can be surety of safety of using BSPR extract.

Some researchers used bamboo shoot shells as a potential source of dietary fiber. Disposal of untreated BSPR can give a way of emission of unpleasant odors, breeding of mosquitoes, and leachate outflow. So generally way to discard BSPR is through incineration or by direct dumping into the environment.

In China, different items such as handicrafts and toys, flooring materials, door curtains, footwear and soles, hats, furniture, and disposable tableware etc. Bamboo shoot outer leafy layers have antimicrobial properties. So, it is used as effective packaging materials for rice balls and meat in Japan. Also, in China it is used traditionally as a container to maintain the taste of tea. The nutritional value of BSPR is higher than common straw, so sometimes it can be used as animal feed.

## Chapter-5

### 5.1.Quality

Bamboo shoots could be considered as an ideal vegetable as it has high nutritional properties. It is a good source of high dietary fiber such as NDF, ADF, uginin, hemicelluloses and cellulose; and low in fat content. Bamboo shoots are also low in cholesterol content and has high amount of potassium which is a heart-healthy mineral. It is rich in many vitamins like tocopherol, vitamin C, Vitamin B6, thiamin, riboflavin and niacin. Bamboo shoots are rich in many minerals and have 17 different types of amino acids, and out of them, 8 are essential and they are serine, methionine, isoleucine, leucine, phenylalanine, lysine, and histidine.1,4 and aspartate, glutamine, glycine, alanine, and tyrosine are found to be non-essential. Minerals present in bamboo shoot are phosphorus, calcium, copper, iron, manganese and magnesium. Bioactive compounds such as saponins, flavonids, alkanoids, terpenoids, quinons, tannins and phenols are present in bamboo shoot. Bamboo shoots are rich in both phenols and phytosterols. The predominant sterols found in bamboo shoots are  $\beta$ -sitosterol, campesterol and stigmasterol bamboo shoots are low in fat but also some fatty acids are found here are palmitic acid, linoleic and linolenic acid and flavouring compounds are flavouring compounds like diacetyl (0.86 mg/100g), acetoin. Shoots are rich in lignans and also which have anti-inflammatory, anticancer, antibacterial, antimicrobial, antifungal, and antiviral properties. It is very effective in reducing the risk of cancer and also prevents any injury to blood vessels. As bamboo shoots being locally available, could be a good source of nutrition for the poor people.

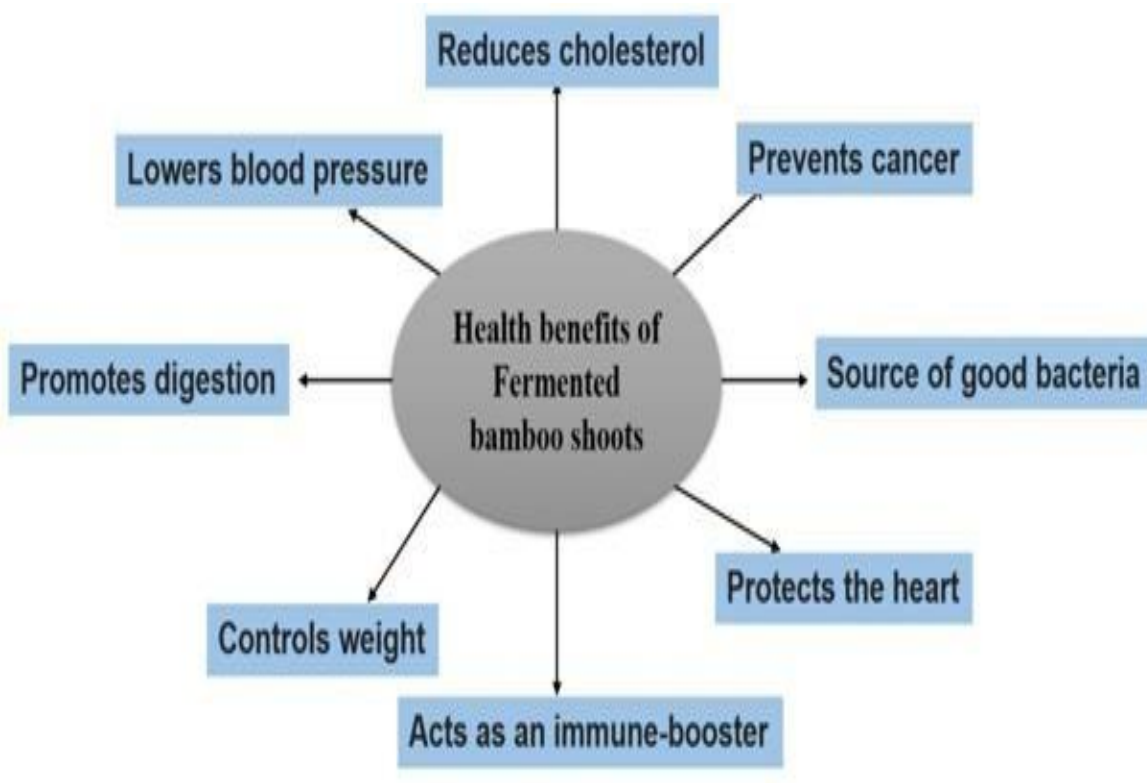
The cyanogenic glycoside present in the bamboo shoot is taxiphyllini.e., 2-(b-D glucopyroanosyloxy)-2-(4-hydroxyphenyl) acetonitrile which is present in the young emerging succulent bamboo shoots and is hydrolyzed and decomposed to hydroxyl benzaldehyde and hydrogen cyanide (cyanogen). The taxiphyllin present in bamboo shoot is a phydroxylatedmandelo-nitrile triglochinin and is highly unstable.

The nutritional potential of various species of bamboo shoots are given in the table below-

Table 2: nutritional potential of various species of bamboo shoots

Parameter	<i>Bambusa balcooa</i>	<i>Bambusa polymorpha</i>	<i>Bambusa bambusa oides</i>	<i>D.strictus</i>	<i>D.hamiltonii</i>	<i>D. giganteus</i>	<i>B.pallidata</i>
<b>Moisture%</b>	91.65	91.65	91.22	85.9	92.37	91.19	92.2
<b>Ether Extract %</b>	0.817	0.44	0.518	0.82	0.314	0.502	0.34
<b>Minerals (as total ash)%</b>	0.99	0.91	0.98	1.14	1.01	0.89	1.12
<b>Phosphorus mg/100g</b>	30.99	15.06	14.28	58.1	27.76	12.57	32.2
<b>Calcium mg/100g</b>	24.01	180.69	47.58	139.	44.16	26.93	21.1
<b>Iron mg/100g</b>	1.02	1.53	0.879	2.91	1.65	1.06	1.11
<b>Hydrocyanic acid %</b>	0.071	0.032	0.056	0.13	0.070	0.044	0.10
<b>Protein%</b>	2.74	2.10	3.29	1.98	2.60	2.59	2.31
<b>Niacin mg/100g</b>	1.40	2.60	6.70	2.10	2.60	6.40	1.40

<b>Carbohydrates %</b>	3.90	4.86	3.93	9.94	4.00	4.78	3.83
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**Fig.9: Overall health benefits of fermented bamboo shoots.**

Bamboo shoots deliver various health beneficial properties such as balance cholesterol level, lower blood pressure, strengthen immune system, healthy bowel movements, anti-inflammatory properties, combat respiratory disorders, anti-venomous properties, uterotonic properties, stomach disorder, wound cleaning, anti-cancer etc.

## Chapter-6

### 6.1.Packaging

Packaging is an important part of any product because it protect the food, promote the food product and inform the consumer. In other words, food is packaged to preserve its quality and freshness, add appeal to consumers and to facilitate storage and distribution. Packaging Institute International defined packaging as the enclosure of products, items or packages in a wrapped pouch, bag, box, cup, tray, can, tube, bottle or other container form to perform one or more of the following functions: containment, protection, preservation, communication, utility and performance. If the device or container performed one or more of these functions, it was considered a package.

### 6.2. Functions of packaging

**Containment:** Containment wards off the product loss and wide spread of pollution. Because of this property of packaging protects the environment from countless of products, which are transported from one place to another every day. Faulty packaging can give the outcome of product loss and environment pollution.

**Protection:** It is generally regarded as a primary function of the package. Packaging protects its contents from outside environmental influences such as water, water vapor, gases, odors, microorganisms, dust, shocks, vibrations and compressive forces etc. In some points it's also an essential part of the preservation process.

**Convenience:** Packaging plays an important role in meeting the demands of consumers for convenience. Products designed around principles of convenience includes foods which foos which are pre-prepared and can be cooked or reheated in a very short time, preferably without removing the primary package and sauces, dressings and condiments that can be applied simply through aerosol or pump-action packages which minimize mess. Also, apportioned function of packaging is an important part of containment.

**Communication:** “A package must protect what it sells and sell what it protects”. The ability of consumers to instantly recognize products through distinctive branding and labeling enables

supermarket to function on a self-service basis. Packaging can communicate by the information on it such as nutritional information, quantity information, labeling, ingredients information, manufacturer, product name, terms and uses, date of manufacturing, best before date etc.

Packaging has to perform its functions in three different environments such as physical, ambient, human environment. Failure to consider all these 3 environments during package development will result in poorly designed packages, increased costs, consumer complaints and even avoidance or rejection of the product by the consumer.

### **6.3. Types of Packaging**

#### **Primary packaging**

In primary packaging the food product is in direct contact with the packaging. It is also referred to as consumer unit, such as a plastic pouch holding whole-grain cereal or the cardboard box containing the pouch of cereal etc. Its main purpose is to contain, protect and/or preserve the finished product, particularly against contamination. Examples: Metal cans, tea bag, paperboard cartons, glass bottles and plastic pouches etc.

#### **Secondary packaging**

It surrounds or contains the primary package. It can be made up of various components such as box, padding, separators, reinforcements, bags, paper, etc. Examples: Corrugated case, Boxes etc.

#### **Tertiary package**

It contains groups of secondary packaging. Transportation of large or heavy loads can be safely and securely transferred by this tertiary packaging. Examples: stretch-wrapped pallet.

#### **Quaternary package**

It generally handles quaternary packages such as metal container which can be transferred to or from ships, trains.



#### 6.4. Packaging of bamboo shoot

After harvesting, raw bamboo shoot can be under gone discoloration and browning. So proper packaging is highly needed for enhancing shelf life of bamboo shoot. Different external factors such as temperature, humidity, microorganisms, and storage conditions impact on its shelf life, which can limit the marketability of bamboo shoots. Losses of water can decrease the fresh outlook and the quality of bamboo shoots. As a result enzyme activity and saccharine content is enhanced and that makes bamboo shoot prone to hydrolysis and rotting etc. Low temperature and proper packaging can reduce transpiration of bamboo shoot and can protect from other external damages also.

In old days bamboo shoots were packaged by using natural packaging material such as leaves, barks and animal skin. Gradually, due to consumers' demands towards quality and safe and hygienic food with an enhanced shelf-life, various trends in the packing systems were developed. The plastic-based packaging manufactured mainly with polyethylene, polypropylene and polyvinyl chloride. Also, glass bottle, high-density polyethylene bottle, low-density polyethylene bag, polyvinyl chloride, vacuum packaging, modified atmospheric packing and edible films and coating based on different storage durations are available for various bamboo shoot species.

##### 6.3.1 Packaging material for bamboo shoot

Low density polyethylene (LDPE) is the largest volume single polymer used in food packaging in both the film and blow-molded form. It is a tough, slightly translucent material which can be blow extruded into tubular film or extruded through a slit die and chill -roll cast, the latter process giving a clearer film. It has good tensile strength, burst strength, impact resistance and tear strength, retaining its strength down to  $-60^{\circ}\text{C}$ . while it is an excellent barrier to water and water vapor, it is not a good barrier to gases. It has excellent chemical resistance, particularly to acids, alkalis and inorganic solutions, but is sensitive to hydrocarbons, halogenated hydrocarbons, oils and greases.

High density polyethylene (HDPE) is a non polar, linear thermoplastic that possesses a much more linear structure than LDPE. It has upto 90% crystallinity. HDPE film is stiffer and harder than LDPE and softening point is about  $121^{\circ}\text{C}$ . HDPE is blow-molded into bottles for a

variety of food packaging applications, although its uses in this area have tended to be taken up by PET bottles which generally have better barrier properties than HDPE.

Polypropylene (PP) is a linear polymer containing little or no unsaturation. PP has a lower density ( $900 \text{ kg m}^{-3}$ ) and a higher softening point (140 to 150 °C) than the polyethylenes, low water vapor transmission, medium gas permeability, good resistance to greases and chemicals, good abrasion resistance, high temperature stability, good gloss etc. PP can be blow molded and injection molded.

Polyvinyl chloride (PVC) is the second most widely used synthetic polymer after polyethylene and is referred to simply as “vinyl”. Unplasticized PVC has excellent resistance to oils, fats and greases and is also resistant to acids and alkalis. Thin, plasticized PVC film is widely used for the stretch rapping of trays containing fresh red meat and produce. The relatively high water vapor transmission rate of PVC prevents condensation on the inside of the film. Unplasticized PVC as a rigid sheet material is thermoformed to produce a wide range of inserts and barrier properties than those made of from HDPE. Some researchers found that PET and PVC were better than PE material in case of bamboo shoot packaging.

Glass bottles as a packaging material performs strong barrier to moisture and gases, ward off unwanted odors and microbial growth, inhibit reacting with food products, act as strong barrier to moisture and gases. It is transparent, rigid and allows stacking without container damage and reusable and recyclable. The disadvantages are glasses are fragile, heavy in weight for transportation and potentiality of serious hazards from glass splinters or fragments.

Modified atmosphere packaging (MAP) can increase the shelf life of food by possibly 50 to 400% and hence reduce economic losses due to longer shelf life. It delivers improved presentation-clear view of product and all-around visibility; little or no need for chemical preservatives; sealed packages are barriers against product recontamination and drip from package; odorless and convenient packages. The disadvantages are added cost for gases, packaging materials and machinery; temperature control is necessary; different gas formulations for each product type; potential growth of food-borne pathogens due to temperature abuse by retailers and consumers; loss of benefit once the pack is opened or leaks; increased pack volume adversely affects transport costs and retail display space etc.

Vacuum packaging has several benefits such as increased shelf life, reduced product loss, sealed barrier from external elements, seals in flavors, no chemical preservatives required, improved product presentation , quick and efficient packaging etc. disadvantages are loss of preservation once the package has been opened, proper gas levels and oxygen levels must be known to increase shelf life etc. Vacuum processing in nylon-based packages of bamboo shoot can allow preserving bamboo shoot for few months.

Under metal packaging can is used for bamboo shoot packaging. Advantages are increase shelf life, easy to handle, strong and rigid; it allows for extremely flexible packaging etc. disadvantages are corrosion, acid and metal reaction, content is not visible etc. The canned bamboo shoots can be stored for years. Canning effectively in retard rancidity and preventing the growth of micro-organisms in bamboo shoots.

## Chapter-7

### 7.1. BIS regulations for bamboo shoot in brine

#### **Some BIS regulations for bamboo shoot in brine stated briefly here:**

Bamboo shoot shall be prepared from selected, fresh, washed, clean and firm shoots of suitable variety. These shoots shall be practically free from blemishes and extraneous matter. As a pre treatment the bamboo shoot after removal of the outer sheath should be held in water for 12 to 15 h or boiled in water for a total period of 30 min with a change of water after every 10 min of boiling. This treatment is necessary to leach out the bitter components present in raw bamboo shoot. The bamboo shoot after the pretreatment should be washed thoroughly and should be packed in brine solution (5 percent) immediately within 12 h. The material shall be prepared and handled under strict hygienic conditions. The product shall be packed in food grade sanitized plastic containers (IS 10171) or glass containers or plastic poly pouches or any other packaging material conforming to the packing material standards. The product should be sealed as quickly as possible. The packaging container should be inert to the corrosive action of the brine solution. The product should be free from artificial coloring matter and flavoring agents. The product may, however, contain natural spices, spice oils, aromatic herbs and their natural extracts, natural aromas and seasoning. Only one type of bamboo shoot shape can be filled in one pack. The pieces of bamboo shoot may come in any styles sliced round thick, sliced round thin, shredded, slivers, cubes/dices, cones, and other optional style. Finally, while opening packed bamboo shoot product, the content should have uniform color, free from black spots or any other discoloration. Uneven distribution of pigments and changes in color normally associated with proper processing shall not be considered as defects. The product shall possess a good texture, which means that the product shall be just firm but not hard or unduly soft and shall be characteristic of bamboo shoot. Bamboo shoot shall be free from flavors and odors foreign to the product and their taste should be characteristic to the shoots used. The product shall be practically free from defects. The product should be virtually free from peel, transportation damage and any other foreign material adhering to or excluded in the product. Containers shall be filled as commercially as possible. The product shall be free from micro-organisms capable of development under normal conditions of storage, and shall not contain substances originating

from microorganisms that may represent a hazard to health. For marketing the labeling should be done according to the standard laid down in IS 7688 (Part 1), such as Name, type and style of the product with the brand name, if any; indication of the source of manufacture; Net content in g; month and year of manufacture; batch or code number, if any; list of ingredients in descending order; list of additives, if used; 'The words 'Best before ' (Month and year to be indicated); manufacturing license number etc.

The product shall also conform to the requirements, metallic contaminants in excess of the quantities specified in following tables

## **7.2. BIS regulations for canned bamboo shoot**

Some BIS regulations for canned bamboo shoot also stated briefly here:

The product shall be prepared and handled under strict hygienic conditions and shall be prepared from fresh, washed, clean, firm and ripe bamboo shoots of suitable variety. These shall be practically free from blemishes and extraneous matter. The product shall be free from artificial coloring matter and flavoring agents. The product may, however, contain natural spices, spice oils, aromatic herbs and their natural extracts, natural aromas and seasoning. The product may be presented in any one of these styles: sliced round thick, sliced round thin, shredded, slivers, cubes/dices, and conical. Types of pack: regular pack with brine solution, and regular pack with plain water. Canned bamboo shoot may be packed in any of these media: *Brine Solution* — A) the brine shall be clear and the salt (sodium chloride) used for preparation of brine shall conform to IS 7224 and water used shall conform to IS 10500. B) Plain water (conforming to IS 10500). Canned bamboo shoot on opening shall display these characteristics- The product should possess a healthy and practically uniform color, characteristic of well-matured fruit, practically free from black spots or any other discoloration due to oxidation processing and other causes. Uneven distribution of pigments and changes in color normally associated with proper processing shall not be considered as defects. The product shall possess a good texture which means that the product shall be just firm but not hard or unduly soft and shall be characteristic of bamboo shoots of proper stage of harvesting; the product shall be practically uniform in size and free from flavors and odor foreign to the product and their taste should be characteristic to the shoots used. The product shall be practically free from defects, free from peel, transportation

damage and any other foreign material adhering to or excluded in the product. Containers shall be filled as commercially as possible. The product shall be: (a) free from micro-organism capable of development under normal conditions of storage, and (b) not contain substances originating from micro-organisms in amounts which may represent a hazard to the health. The product shall be packed either in hermetically sealed open top sanitary cans made from tin plate [IS 9396 (Part 1 and Part 2)] and inside lacquered or in food grade sanitized plastic containers (IS 10171) or in any other food grade packing material as agreed to between the purchaser and the supplier. In case of marketing these requirements are necessary: Name, type and style of the product with the brand name, if any; indication of the source of manufacture; net content in grams; month and year of manufacture; batch or code number, if any; list of ingredients in descending order, the words 'Best before ..... (month and year to be indicated) etc.

### **7.3. BIS regulations of dry salted bamboo shoot**

Some BIS regulations for dry salted bamboo shoot briefly stated here:

The material shall be prepared and handled under strict hygienic conditions,. All workers should use clean, sterilized hand gloves for the purpose of mixing bamboo shoots with dry and crystalline salt. Bamboo shoot shall be prepared from selected, fresh, washed, clean and firm shoots of suitable variety. These shoots shall be practically free from blemishes and extraneous matter. The bamboo shoot after removal of the outer sheath should be held in water for 12 to 15 h or boiled in water for a total period of 30 min with a change of water after every 10 min of boiling. This treatment is necessary to leach out the bitter components present in raw bamboo shoot. The product shall be prepared from fresh, washed, clean, firm and ripe bamboo shoots of suitable variety. These shall be practically free from blemishes and extraneous matter. The product shall be free from artificial coloring matter and flavoring agents. The product may, however, contain natural spices, spice oils, aromatic herbs and their natural extracts, natural aromas and seasoning. The product may be presented in any one of these styles: Sliced round thin, shredded, slivers, and Other optional styles. Type of packaging is regular pack of dry salted bamboo shoot. Bamboo shoot should be packed in dry and crystalline salt conforming to IS 7224. Packed bamboo shoot on opening shall display these characteristics - the product should possess a healthy and practically uniform color, practically free from black spots or any other discoloration due to oxidation and other causes. Uneven distribution of pigments and changes in

color normally associated with proper processing shall not be considered as defects. The product shall possess a good texture, which means that the product shall be just firm but not hard or unduly soft and shall be characteristic of bamboo shoot. The product shall be practically uniform in size. Bamboo shoot shall be free from flavors and odors foreign to the product and their taste should be characteristic to the shoots used. However, due to the addition of the salt the product can have a salty flavor. The product shall be practically free from defects. The product should be virtually free from peel, transportation damage and any other foreign material adhering to or excluded in the product. The product shall be: (a) free from micro-organisms capable of development under normal conditions of storage, and (b) shall not contain substances originating from microorganisms that may represent a hazard to health. The bamboo shoot after being treated as described in 5 should be washed thoroughly and packed as soon as possible but not later than 12 h. The product shall be packed in food grade sanitized plastic containers (IS 10171) or glass containers or in any other food grade packing material as agreed to between the purchaser and the supplier. The product should be sealed as quickly as possible. The packaging container should be inert to the corrosive action of salt. Each pack shall be marked with these particulars: Name, type and style of the product with the brand name, if any; indication of the source of manufacture; net content in g; month and year of manufacture; batch or code number, if any; list of ingredients in descending order; list of additives, if used; the words 'Best before . . . . . ' (Month and year to be indicated); manufacturing license number etc.

#### **7.4. BIS regulations for dehydrated bamboo shoot**

##### **Some BIS regulations for dehydrated bamboo shoot briefly stated here:**

Dehydrated bamboo shoots shall be prepared from edible portions of suitable variety of bamboo shoots, free from insect or fungal infection, free from blemishes, harvested at appropriate maturity. Bamboo shoot after removal of outer sheath should be held in water for 12 to 15 h or boiled in water for a total period of 30 min with a change of water after every 10 min of boiling. This treatment is necessary to leach out the bitter components present in raw bamboo shoot. Dehydrated bamboo shoots shall be of a color, typical of the type and variety and shall have the characteristic odor of fresh bamboo shoots. It shall be free from any added coloring material. Dehydrated bamboo shoots shall be free from scorched, musty and other objectionable off-flavors and odors. The product shall be in the form of thin round slices or in the form of



dices but not in the form of a mixture of any two or more of the different types of dressing. The thickness of the different forms of bamboo shoots shall be uniform. The product shall be free from - any chemical preservative other than sulphur dioxide, artificial food colors, bleaching or flavoring agents. The product shall be free from dust, dirt, stones, and lumps of the earth or any other extraneous matter. The product shall be free from blemished units like black spots,-moulds, insect infection, rodent excreta and other foreign material. Dehydrated bamboo shoots shall reconstitute to a tender crisp product free from toughness or mushiness having a characteristic flavor, color and odor of cooked bamboo shoot. The product shall be prepared and handled under hygienic conditions ( IS 14135). The product shall be packed in clean, moisture proof food grade plastic material (IS 10171) or in clean tin-plate containers [ IS 9396 (Parts 1 and 2)] or in laminated foils or in any other food grade packing material as agreed to between the purchaser and the supplier which would prevent the uptake of moisture. For marketing purpose the product should be marked these : Name, type and style of the product with the brand name, if any; indication of the source of manufacture; net mass, in grams; Batch or code number, indicating the month and year of manufacture; list of ingredients in descending order; The words ‘Best before (month and year to be indicated) etc.

## **7.5. General food hygiene- general principles**

### **Some general food hygiene- general principles are briefly given below**

To reduce the likelihood of introducing a hazard which may adversely affect the safety of food or its suitability for consumption, at later stages of the food chain, primary production should be managed in a way which ensures that food is safe and suitable for its intended use. Where necessary, this should include: avoiding the use of areas where the environment poses a threat to the safety of food; controlling contaminants, pests and diseases of animals and plants in such a way as not to pose a threat to food safety; and adopting practices and measures to ensure food is produced under appropriately hygienic conditions.

Potential sources of contamination from the environment should be considered. In particular, primary food production should not be carried on in areas where the presence of potentially harmful substances would lead to an unacceptable level of such substances in food. The potential effects of primary production activities on the safety and suitability of food should be considered at all times. In particular, this includes identifying any specific points in such activities whereas

high probability of contamination may exist and taking specific measures to minimize that probability. The HACCP based approach (IS 15000) may assist in the taking of such measures.

On-farm programmes which achieve specific food safety goals are becoming an important part of primary production and should be encouraged. Care should be taken to prevent, as far as practicable, deterioration and spoilage through appropriate measures which may include controlling temperature, humidity and/or other controls.

Appropriate facilities and procedures should be in place to ensure that necessary cleaning and maintenance is carried out effectively and appropriate degree of personal hygiene is maintained. Attention to good hygienic design and construction, appropriate location, and the provision of adequate facilities are necessary to enable hazards to be effectively controlled. Depending on the nature of the operations and the risks associated with them, premises, equipment and facilities should be located, designed and constructed to ensure that - contamination is minimized; design and layout permit appropriate maintenance, cleaning and disinfections and minimize air-borne contamination; surfaces and materials, in particular those in contact with food are non-toxic in intended use and where necessary, suitably durable, and easy to maintain and clean; where appropriate, suitable facilities are available for temperature, humidity and other controls; and there is effective protection against pest access and harbourage.

To locate a food establishment, it should normally be located away from: environmentally polluted areas and industrial activities which pose a serious threat of contaminating food; areas subject to flooding unless sufficient safeguards are provided; areas prone to infestations of pests; and areas where wastes, either solid or liquid, cannot be removed effectively. Equipment should be located so that it: permits adequate maintenance and cleaning, functions in accordance with its intended use; and facilitates good hygiene practices, including monitoring.

Where appropriate, the internal design and layout of a food establishment should permit hygienic practices, including protection against cross-contamination between and during operations and storage. The surfaces of walls, partitions and floors should be made of impervious materials with no toxic effect in intended use, Walls and partitions should have a smooth surface up to a height appropriate to the operation; Floors should be constructed to allow adequate drainage and cleaning; ceilings and overhead fixtures should be constructed and finished to minimize the buildup of dirt and condensation, and the shedding of particles; windows should be

easy to clean, be constructed to minimize the buildup of dirt and where necessary, be fitted with removable and cleanable insect-proof screens. Where necessary, windows should be fixed; Doors should have smooth, non-absorbent surfaces, and be easy to clean and, where necessary, disinfect; and working surfaces that come into direct contact with food should be in sound condition, durable and easy to clean, maintain and disinfect. They should be made of smooth, non-absorbent materials, which are inert to the food, detergents and disinfectants, under normal operating conditions.

Equipment and containers (other than once-only use containers and packaging) coming into contact with food, should be designed and constructed to ensure that, where necessary, they can be adequately cleaned, disinfected and maintained to avoid the contamination of food. Equipment and containers should be made of materials with no toxic effect in intended use. Where necessary, equipment should be durable and movable or capable of being disassembled to allow for maintenance, cleaning, disinfection, monitoring and inspection. Equipment used to cook, heat treat, cool, store or freeze food should be designed to achieve the required food temperatures as rapidly as necessary in the interests of food safety and suitability, and maintain them effectively. Such equipment should also be designed to allow temperatures to be monitored and controlled. Where necessary, such equipment should have effective means of controlling and monitoring humidity, air flow and any other characteristic likely to have a detrimental effect on the safety or suitability of food.

Facilities such as adequate water supply, drainage and waste disposal, cleaning, personnel hygiene facilities and toilets, lighting, temperature control and ventilation systems, storage should be available.

Food business operators should control food hazards through the use of systems, such as HACCP(IS 15000). They should identify any steps in their operations which are critical to the safety of food; implement effective control procedures at those steps; monitor control procedures to ensure their continuing effectiveness; and review control procedures periodically, and whenever the operations change. These systems should be applied throughout the food chain to control food hygiene throughout the shelf life of the product through proper product and process design.

In this way there so many areas of food where is HACCAP is maintained for safety of food.

## Chapter-8

### 8.1. Opportunities for micro/ unorganized enterprises

Bamboo shoot has a great potential for economic growth through cultivation, processing, packaging and commercialization. There are limited standard processes or technologies for bamboo shoot and mostly the products of bamboo shoot are traditional, local, unorganized and based on the taste of the local people which is following generation wise. There is a great scope for development of standard processes or technologies for bamboo shoot based products or preservation of raw bamboo shoots into various food items in an organized manner.

