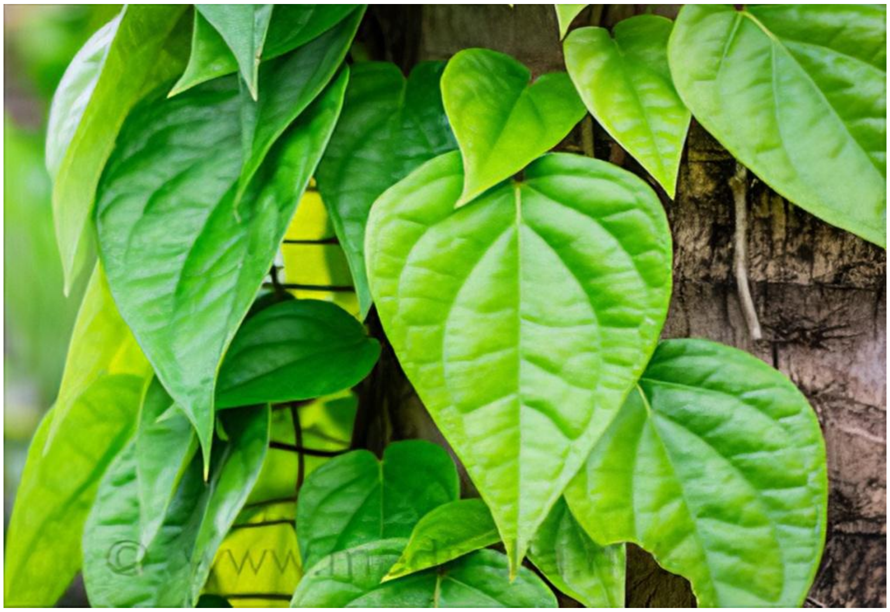
PM Formalization of

Micro Food Processing Enterprises (PMFME) Scheme

HANDBOOK

OF

BETEL VINE



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CHAPTER 1

INTRODUCTION

1.1 Background

Betel vine (*Piper betle L)* is known by its many names across the country and abroad. In Indian subcontinent it is known as pan in Hindi, Tambula in Sanskrit, Villayadela in Kannada, Vettilakkoti in Malyalam, Vettilai in Tamil, Tamalapaku in Telugu, Videch-pan in Marathi, Nagarbel in Gujrati and pan in Bangala. In foreign languages it is known as Tanbol in Arabic and Burg-e-Tanbol in Persian. It belongs to *piperaceae* family and is a perennial climber cultivated for its leaf. It is a shed loving plant and originated from Malaysia according to De Cando. Historically, the word pan in Hindi and other Indian languages is probably a derivative of the Sanskrit word 'pan' meaning leaf. It has been very intimately connected with the ancient Indian history, religion and culture as is evident by many references in the early Sanskrit literature (3000 BC), like Vedas, Ramayana, Mahabharata, Mahavansha, etc. Marcopolo (1295 AD) took notice of the pan chewing habit of the people in south India. Over the centuries, pan chewing had become so prevalent that serving and chewing of pan had been raised to the level of a fine art at the Mughal Darbar, particularly during the Akbar's regime. In course of time, offering the 'bida' of betel vine has become a symbol of offering and acceptance of mutual love and friendship.

Betel vine has been under cultivation in India for centuries. In fact, no Hindu religious ceremony is complete without pan. It is also offered after lunch and dinner and also during other social get together.

The medicinal properties of pan was recognized during 600 A D when Ayurvedic system of medicine came into practice. Betel leaves are beneficial to the throat and remove viscidity in human beings. Leaves help in digestion and tend to remove the bad smell of the mouth. The juice of betel leaves is used as an adjunct to pills administered in the Ayurvedic medicines. The fresh crushed leaves are used as antiseptic for cuts and wounds. It is also good for the respiratory system and is used in treatment of bronchitis, cough and cold (Chopra et al, 1958). The leaves of the pan plant have been traditionally used for chewing. Pan chewing is considered as a good and cheap source of dietary calcium. It increases digestive capacity when used with lime. Besides, it neutralizes the acidity and acts as blood purifier. Main constituents of betel leaves are vitamin B and C, carotene, and other elements. The oldest authentic Ayurvedic therapy books describe betel vine, honey and Tulsi as nectar (Amrit). In short, betel leaf is one of the grandmother's remedies, prescribed as traditional medicine, by experienced, older members of the family.

The harmful effects of pan as described in the Ayurvedic texts are that it weakens teeth, impairs health and deadens the taste buds of the tongue. In the Indian subcontinent, where chewing tobacco with pan is a common habit, cancer of the mouth is very common. But the educated Indians are of the opinion that moderate use of betel leaf is not merely innocuous but that it may even be conducive to good health. Pan is grown in moist tropical region in the world. It has been grown under two conditions i.e., natural conditions and controlled conditions. In natural condition in the tropical forest region on the tree it can grow as tall as the tree (Western regions
& north eastern regions). Cultivation under controlled conditions (bareja) is in practice in the sub-tropics. The south region where humidity and temperature do not fluctuate abnormally and high humidity with moderate sunshine prevails throughout the year, the natural condition of betel vine growing is practiced.

The cultivation under controlled condition is practiced where there is relative humidity is often low and temperature remains high (above 40°C) in summer and low (below10°C) in winter. The microclimate plays an important role in the production of good quality betel leaves. This ideal condition is provided by artificial means, popularly known as Bareja. The exact period of beginning of the prevailing system of pan cultivation is not known. However, as per literature available in charak, this practice is mentioned as older than 600-400 BC.

The first record of any structure, which may be called as greenhouse, is not known. However, it is believed that the first glasshouse/greenhouse dates back four to five hundred years. The glasshouses are useful in colder climates (winter) when thermal properties of glass conserve heat and maintain temperature to the extent suitable for plant growth. Such structure loses its utility during summers when higher temperature inside the glass house is detrimental to the plant. This limitation was overcome once refrigeration technology was developed in 1920. This technology is highly sophisticated and its running costs are high. The cultivation of betel vine under control conditions is also a case of creating an indigenous system of 'environmental chamber' with the material available in nature. As consequence of advancement in greenhouse/glasshouse construction technology, now it is quite easy to shift plants from their natural habitat and grow them under controlled condition throughout the year in subtropical region with significantly low cost.

The plant betel vine thrives best under shade, which provides low light intensity, mild temperature (10°C to 30°C), high humidity with 1450-1700 mm rainfall and frequent irrigation throughout the year. Hot wind burns the tender leaves and causes wilting while cold wave cause yellowing of leaves. The land suitable for cultivation of this crop is upland having well drained with loamy to clay loamy soil. Soil with good water holding capacity and slight acidic to neutral soil are considered to be ideal for its cultivation.

Betel (*Piper betle Linn.)* leaf is used as a masticatory along with arecanut, lime and catechu. The probable places of origin of betel vine are India, Sri Lanka, Malaysia and Indonesia. In India it is an important commercial crop of Andhra Pradesh, occupying about 3,600 hectares. The vine is a dioecious (male and female plants are different), shade loving perennial root climber.

SCIENTIFIC CLASSIFICATION

Kingdom:	Plantae
Class:	Angiospermae
Subclass:	Magnoliidae
Order:	Piperales
Family:	Piperaceae
Genus:	*Piper*
Species:	***P. betle***

Botany

- Woody climber with adventitious roots at swollen nodes.

- Leaf simple, alternate, cordate, 8-12 cm wide, 12-16 cm long, with Description odor and spicy taste.
- Inflorescence in axillary spike; flowers unisexual, white.
- Fruit globose berry.

1.2 Climate and Soil

Betel vine requires a tropical climate with high atmospheric humidity. It can be cultivated in the uplands as well as in wetlands. In Kerala, it is mainly cultivated in arecanut and coconut gardens as an intercrop. The crop grows best on well-drained fertile soils. Waterlogged, saline and alkali soils are unsuitable for its cultivation. The crop also comes up very well in lateritic soils. Proper shade and irrigation are essential for successful cultivation of this crop. An annual rainfall ranging from 200 to 450 cm is ideal. The crop tolerates a minimum temperature of 10ºC and a maximum of 40ºC. Extremely low atmospheric temperature leads to leaf fall. Hot dry winds are harmful.

1.3 Varieties

There are about 100 varieties of betel vine in the world, of which about 40 are found in India and 30 in West Bengal. There are mainly five cultivars of betelvine *viz.* Desawari, Bangla, Kapoori, Meetha and Sanchi. While Kapoori and Sanchi are the principal cultivars in the peninsular India, Bangla and Deswari are common in North India. Cv. Meetha is grown on commercial scale in West Bengal only. Betelvine is cultivated over an area of 40,000 ha in the country. It is a capital and labour intensive cash crop.

The important types grown in Tamil Nadu are Thulasi, Venmani, Arikodi, Kalkodi, Karilanchi, Karpuram, Chelanthikarpuram, Koottakkodinandan, Perumkodi, Amaravila and Pramuttan, Kallarkodi, Revesi, Karpuri, SGM 1, Vellaikodi, Pachaikodi, Sirugamani 1, Anthiyur kodi, Kanyur kodi.

Betelvine varieties Source: Betelvine Research Station, Diwthana, Akola	 kot Kapuri	 Assam Kapuri

		
Karapaku Kapuri	Maghai	Ghanagate Bangla

Season

November - December and January – February are optimum for cultivation.

1.4 Preparation of field

The field is prepared to a fine tilth and beds of 2 m wide are formed to a convenient length. Provide drainage trenches of 0.5 m width by 0.5 m depth in between two adjoining beds. Plant the seeds of the live supports i.e. Agathi (*Sesbania grandiflora*) in long rows. About 750 banana suckers are planted at the edges of the beds, which are used, for tying the vines on the live support and for packing the betel leaf. When the Agathi plants reach 4 m height, they are topped off for maintaining the height. The crop is planted in two rows in beds of 180 cm width on Agathi plants with a spacing of 45 cm between plants in the row.

Irrigation

Irrigate the field immediately after planting and afterwards once in a week.

<u>After Cultivation</u>

Training of the live standards

Before the establishment of vines, the side branches of Agathi trees up to a height of 2 m are removed for early creeping of the vines.

Trailing of the vines

The cuttings sprout and creep in about a month. At this time, they must be trailed on the standards. Training is done by fixing the vine at intervals of 15 to 20 cm along the live standards loosely with the help of banana fibre. Training is done at every 15 - 20 days interval depending upon the growth of vines.

Instead of live standards sometimes bamboo standards are erected at intervals and linked by tying at heights of 30 cm and 150 cm using coir rope. In the initial stages trailing is done on coir tied for the purpose. Trailing is done further by tying the vines, at intervals of 15-20 cm along the standards loosely with the help of banana fibre.

When vines come in contact with standards, they produce adventitious roots using which they cling to support. Trailing is done every 15-20 days depending on the growth of vines.

Bamboo standard

Live standard

Lowering of vines

Under normal cultivation, the vines grow to height of 3 m in one year period. When they reach this height their vigour to produce normal size leaf are reduced and they need rejuvenation by lowering during March - April. After the vine is lowered, the tillers spring up from the nodes at the bends of the coiled vines at the ground level and produce many primary vines. Irrigation should be given after each lowering.

Manuring

Apply 150 kg N/ha/year through Neem cake (75 kg N) and Urea (75 kg N) and 100 kg P2O5 through Super phosphate and 30 kg Muriate of potash in three split doses first at 15 days after lifting the vines and second and third dose at 40 - 45 days intervals. Apply on beds shade dried neem leaf or C*alotropis* leaves at 2 t/ha and cover it with mud (2 t in 2 split doses).

Time of application	**Nutrients (kg/ha)**		
	N	**P**	**K**
Basal dressing	37.5	100	50
Top dressing @ 3 split doses	112.5	0	0

Pests

Scale insects

Select scale-free seed vines. Spray Chlorpyriphos 20 EC 2 ml/lit when one or two scales are noticed on the basal portion of the stem/leaves. Direct the spray solution to the basal portion of the vines. Spray NSKE 5 % or Malathion 50 EC 1 ml/lit.

Mites

Mites can be controlled by spraying Wettable sulphur 50 WP @ 1 g/lit or Dicofol 18.5 EC 0.5 ml/lit.

Sooty mould (Aphids)

To control aphids spray Chlorpyriphos at 2 ml/lit on Agathi leaves. Clip off excess Agathi leaves.

Mealy bugs

Mealy bugs can be controlled by spraying Chlorpyriphos 20 EC at 2 ml/lit or Dimethoate 30 EC 2ml/lit. Concentrate the spray towards the collar region.

Nematode

Application of Neem cake at 1 t/ha or shade dried *Calotropis* leaves @ 2.5 t/ha can be applied to soil for controlling the nematode populations.

Diseases

***Phytophthora* Wilt**

Integrated disease management of *Phytophthora* wilt

- Select well matured (more than 1 year old) seed vines free from pest and diseases.
- Soak the seed vines for about 30 minutes in Streptocylin 500 ppm or Bordeaux mixture 0.5 %.
- Apply 150 kg N/ha/year through Neem cake (75 kg N) and Urea (75 kg N) and 100 kg P2O5 through Super phosphate and 30 kg Muriate of potash in 3 split doses first at 15 days after lifting the vines and second and third dose at 40 - 45 days intervals. Apply on beds, shade dried neem leaf or *Calotropis* leaves at 2 t/ha and cover it with mud (2 t in 2 split doses).
- Drench Bordeaux mixture 0.25% in basins formed around the vine at monthly intervals starting from October – January, three times soil drench and six times spray from June - July.
- During winter season avoid frequent irrigation.
- Remove the affected vines away from the garden and burn them.
- Application of *Trichoderma viride* @ 5 g/vine.

Bacterial leaf spot, blight and bacterial stem rot

Spray Streptocyclin @ 400 ppm + Bordeaux mixture @ 0.25% at the time of first disease symptoms appear. Continue spraying at 20 days intervals. Always spray the chemical after plucking the leaves.

Anthracnose

Spray 0.5% Bordeaux mixture after plucking the leaves after the first appearance of the symptom. The variety Karpoori is susceptible to the disease.

Powdery mildew

Powdery mildew can be controlled by spraying 0.2% Wettable sulphur after plucking the leaves.

Harvest

In about 3-6 months time, vines grow to a height 150-180 cm. At this stage branching is noticed in the vines. Leaves are removed along with the petiole with the right thumb. Once harvesting is commenced, it is continued almost every day or week. The interval of harvesting varies from 15 days to about a month till the next lowering of vines. After each harvest, manuring has to be done.

Yield

About 75 to 100 lakh leaves/ha/year can be obtained.

Various Cost Components of Betel vine Cultivation in the Sampled Villages.

(Rs. Per ha)

SN	Particulars of Cost Heads	All Average of the Villages (74)
A.	**Operational or Variable Cost**	
1.	Construction Cost of Bareja	21230.06
2.	Land Preparation and Vine transplanting	4436.50
3.	Fertilizer Application	5148.37
4.	Pesticides Application	2939.79
5.	Irrigation Charge	7719.63
6.	Inter-culturing Operations	15431.55
7.	Harvesting of the Crop	14716.79
8.	Packing, Marketing and Maintenance	5319.86
9.	Annual repair cost of Bareja	2044.13
10.	All Variable Cost (Sub Total)	78986.68
B.	**Fixed Cost**	
11.	Rental Value of Land	1000.00
12	Interest on Working Capital @ 10 %	7898.67
13.	Risk on Working Capital @ 10 %	7898.67
14.	Land Revenue	26.50
15.	Depreciation	853.62
16.	Total Fixed Cost Sub-Total	17677.46
17.	Sum of Cost A + B	96664.14

i. Gross Income and Net Return

The gross income is the value of total output and net income is the value of differences between total revenue minus total cost. The calculated data has been presented under table –

Estimated Gross Income and Net Return per hectare.

(In Rupees)

SN	Villag	Gross Income	Total	Net
5.	Average of all	151945.55	96664.14	55281.41

vi. Economic Efficiency of Betel vine Production

In this part of analysis, a number of profit measures have been dealt in. These profit measures are net income, farm business income, and farm investment income, return on working capital, etc. has been worked out and presented into sub-heads.

Marketing

As per the information collected from the sample growers it was identified that growers were using three important channels through which they used to dispose off their produce. These channels are:

1. *Grower/Producer Local Trader Wholesaler Retailer Consumer*
2. *Grower/Producer Wholesaler Retailer Consumer*
3. *Grower/Producer Retailer Consumer*

Observation during the course of survey related to marketing aspect revealed that systematic marketing of betel vine did not prevail in the area. So the growers had to exercise much for the sale of their produce. It will be rather appropriate to say that they are being dictated by the terms and conditions of commission agents. Thus, they are forced to face exploitation in the form of non-remunerative prices. Besides, its competitive products like Gutkha, Pan parag, etc, adversely affect the marketing of this crop. Yet another serious matter of concern is that no effective institutional efforts have been undertaken for the promotion of the crop.

CHAPTER 2

2.1 HARVESTING AND POST HARVEST MANAGEMENT

As vines reach to a certain height, leaves are harvested from the lower portion of the stem. Harvesting is done during March–April in Uttar Pradesh, Madhya Pradesh and Bihar, during May–June in Andhra Pradesh; during January– February or April–May in Tamil Nadu

Mature leaves are plucked along with a portion of petiole. They are plucked by hand. In Karnataka and Tamil Nadu, leaves are plucked from side shoots. In south India, comparatively tender leaves are preferred in the market. After plucking, they are washed thoroughly and made into bundles according to the prevailing custom of the area. On an average, 60–80 lakh leaves are harvested annually from one hectare plantation.

Harvested leaves are washed, cleaned and graded according to their size and quality. Then they are packed after cutting a portion of the petiole and rejecting the damaged leaves. The picked leaves are sorted into different grades according to size, colour, texture and maturity. After that, they are arranged in numbers for packing. For packing mostly bamboo baskets are used and in many places straw, fresh or dried banana leaves, wet cloth etc. are used for inner lining.

Usually betel leaves are used for chewing as fresh unprocessed. But in certain areas, leaves are subjected to processing known as bleaching or curing. There is a good, demand for such leaves which fetch higher prices in the markets. Bleaching is done by successive heat treatments at 60°–70°C for 6–8hr.

2.2 MEDICINAL PROPERTIES

In India, betel is used from time immemorial to cure worms. According to traditional Ayurvedic medicine, chewing areca nut and betel leaf is a remedy for bad breath. They are also said to have aphrodisiac properties

In Malaysia they are used to treat headaches, arthritis and joint pain. In the Philippines, Thailand, Indonesia and China they are used to relieve toothache. In the Philippines, they are used specifically as a stimulant and was believed to strengthen the teeth and gums. In Indonesia they are drunk as an infusion and used as an antibiotic.

They are also used in an infusion to cure indigestion, as a topical cure for constipation, as a decongestant and as an aid to lactation. In Indonesia, betel is also used to cure nosebleeds. Many Indonesian women use the leaves in bath water after giving birth to shrink vaginal canal. It also counters unpleasant smells.

2.3 COMPOUNDS OF BETEL OIL

The active ingredients of betel oil, which is obtained from the leaves, are primarily a class of allylbenzene particular emphasis has been placed on chavibetol (betel- phenol; 3-hydroxy-4-methoxyallylbenzene), it also contains chavicol (p-allyl-phenol; 4-allyl-phenol), estragole (p-allyl- anisole; 4-methoxy-allylbenzene), eugenol (allylguaiacol; 4- hydroxy-3-methoxy-allylbenzene; 2-methoxy-4-allyl-phenol), methyl eugenol (eugenol methyl ether; 3,4-dimethoxy- allylbenzene), and hydroxycatechol (2,4-dihydroxy- allylbenzene).Several terpenes and terpenoids are present in the betel oil as well. There are two monoterpenes, p-cymene and terpinene, and two monoterpenoids, eucalyptol and carvacrol. Additionally, there are two sesquiterpenes, cadinene and caryophyllene.

2.4 METHODS FOR MINIMIZING POST-HARVEST LOSSES OF BETEL LEAVES

1. Depetiolation

Depetiolation is removal of the petioles from the leaves. It reduces about 10-25% weight of leaves due to 10-40% reduction in length of leaves. It helps in delaying senescence (Mishra and Gaur, 1972). Depetiolated condition was always better than petiolated condition for enhancing storage life (Imam and Pariari; 2012). They reported that Chlorophyll degradation was found minimum in petiolated condition either in packing with banana leaves or in treatment with Benzylaminopurine (BA) @ 30 ppm compared to depetiolated condition. Ascorbic acid content was more in sterilized paddy straw packing and in hessian cloth lined with mustard seed and ice pieces compared to other treatments. Winter season (December-January) was the best for longer storage of betel leaves in any form. Among method of storage, zero energy coolchamber was the best for longest period of storage followed by packing with banana leaves in bamboo basket

2. Dehydration

It is an essential method of processing of betel leaf that can avoid spoilage and facilitate preservation. Dehydration means removal of moisture from any substance. Drying is preservation process of any product by reducing the amount of moisture content in the materials (Drouzas and Schubert, 1996). Drying may be of different types (i) solar drying, (ii) shade drying, (iii) mechanical drying and (iv) microwave drying or hot air drying.

Shade drying of betel leaves in dark rooms is a time consuming process, resulting into a product with inferior quality. Sun drying is widely practiced, but prolonged direct exposure to solar radiation leads to adverse changes in colour, texture and flavor, contamination with sand, soil and foreign matter. Because of this reason, using hot air dryers seems inevitable for drying to improve the quality of the final product .Solar drying produced better results as compared to shade drying, mechanical drying and microwave drying. Hence, modern drying (microwave drying) should be promoted for beneficiary outcomes because in this method, there was substantial losses of volatile oil which is responsible for improving organoleptic qualities of the leaves.

3. Bleaching and curing

Generally bleaching and curing procedure of leaves is done in a bhatti or closed room. It can be made up of mud, cement, brick or any other locally available suitable material. The curing process for betel leaves was probably first invented at Varanasi, India where the techniques were traditionally used for making *Banarasi paan* (Das *et al;* 2017). Betelvine Research Centre, Islampur under Bihar Agricultural University, Bhagalpur, Bihar (India) took initiation from the year 2013 in the studied of curing of betelvine and constructed two *paan bhati* at the centre (Kumar and Pandey, 2014). The basic principle in curing process of betel leaf is that the green leaves are treated with smoke, high temperature and pressure in a bhatti or closed room with little or no ventilation so as to regulate the temperature inside the room for improving organoleptic qualities and ultimately the green leaves are converted to white or yellowish white colour leaves. Actually it is alternate heating of 6 hours at 50-60 °C and cooling of 12 hours, two to three times followed by aeration of leaves by turning and stored under dark condition. It took 15-20 days for making complete white or yellowish from green betel leaves. In this process, the shelf life of betel leaves is extended up to one month and the superior quality bleached leaves being very soft and coloured a uniform green yellow (Burkhill, 1935 and Pandey *et al*.2016). This process heightens flavour, which is due to the presence of volatile oils. The chief of these is eugenol, an unsaturated aromatic phenol, usually very pale yellow in colour, which has a strong pungent odour reminiscent of cloves, and a pungent spicy taste. This substance has antiseptic and local anaesthetic properties. Chewing a betel leaf for five minutes leaves the mouth rather numb. Terpenes are also present, these are pungent, and unpleasant if present to excess. Unusually large amounts of potassium nitrate, and small quantities of sugar, starch and tannin have been found (Mann and Patwardhan, 1916). Changes in the chemical composition of leaves after curing leads to earn more money (Rs. 0.50 per leaf in the local marketof Bihar) for the farmers. After completion of the process, the leaves are graded , spoiled leaves are discarded, bleached leaves are taken out and the unbleached green leaves are cured again for 8-24 hrs depending upon the colour of the leaves.

Generally bleached Betelvine leaves of these bhattis are prepared with lesser quality green leaves and the leaves are sent to north India like Varanasi, Allahabad and Delhi. The better quality green leaves of the areas are sent as such to Bombay where they are bleached by stacking of Betelvine baskets one on the other. The finished goods are of good quality and are exported to different countries from there.

Types of bhatti or closed room for curing of betel leaves

(i). Natural without external energy source which takes 3-10 days for bleaching in summer and 7-15 days during winter.

(ii). With outer source of Heat (Coal & Charcoal in a ration of 2:½ kg) that takes 24 hours for bleaching and gives better result, it depends upon the expertise & experience of the technician or mistri to manage the temperature inside the bhatti. The temperature of the closed curing room is maintained at 60-70 °C.

(iii). Bleaching process can also taken place in a chamber made of galvanized iron sheet. Mature leaves are selected and filled in the chamber and covered with moist gunny bags. The leaves are to be examined every alternate day to see the progress of bleaching which is involved in the lightening of the leaf colour. After attaining the desired colour bleaching process should be stopped. Normally it completes in about 8-15 days in summer and 15-25 days in winter.

4. Chemical treatments

Attempts are also being made to reduce wastage by controlling senescence (Mishra and Gaur, 1972) through chemical treatments, manipulation of storage temperature, adopting better packaging materials and methods (Guha, 2004; Rao and Narasimham, 1997) besides curing and bleaching of the leaves (Dastane, 1958; Sengupta, 1996).

The storage of the betel leaves could be extended by including a mixture of sodium bicarbonate and tartaric acid in the packaging. Before packaging, the packing material could be disinfected with sodium hypochlorite as it reduces the spore load and development of yellow colour. Ventilation was found to be most important as no aeration leads to moist discolouration and fermentation and too much aeration leads to dry discolouration. For prolonged storage and distant transport, the betel leaves treated with benzyl adenine (BA) had less chlorophyll destruction with greater build up of carotenoids and yellowing was delayed about 3 days. Betel leaves packed in traditional packaging subjected to heat treatment for 1hour at 45 0C had as extended storage life. Storage life of betel leaves was extended by 5 days with acceptable qualities by keeping in cold chamber; Storing betel leaves for 10 days at 20 ^{0C} under modified atmosphere packing had better retention of chlorophyll which could be an alternative for retail handling and storage which is at present done by ice boxes and gunny bags. Post-harvest dipping of betel vine leaves for 6 hours in solutions of 25 ppm benzyladenine (BA) and 50 ppm kinetin and packed in vented polythene bags stored under refrigerated conditions prolonged the shelf life of the leaves. Leaves packed in baskets and stored at room temperature could keep up to 40 days.

5. Combined treatment of de-petiolation, de-midribbing and chemicals

A combined treatment of de-petiolation, de- midribbing and dipping in 25 ppm of BA for

6 h resulted in the further increase of shelf life by about 10 days. In these treatments, spoilage due to yellowing was negligible. From a commercial point of view, matured harvested leaves, after de-petiolation, treated with 5 mg/ l of BA for 6 hours and stored in conventional packing was observed to be best suited to prolong the shelf life of betelvine leaves (Bhuvaneswari and Narayana, 2014). Thus, de-petiolation and de-midribbing increased the shelf life of leave

6. Extraction of essential oil

Despite the knowledge of traditional and modern preservation methods, India is still facing the serious issue of post-harvest losses. Surplus leaves which remain unsold in the market can be utilized through extraction of essential oil. The constituents present in the oil may vary with the variety, soil and agro-climatic conditions followed to raise the crop like any other essential oil yielding crop (Sankar *et al.,* 1996; Sharma *et al*., 1981)

Two bioactive phytochemicals that found in betel leaves are hydroxychavicol (HC) and eugenol (EU) contribute to the beneficial bioactivity of betel leaves (Rathee *et al*.2006; Mazura *et al.,* 2007; Nalina and Rahim, 2007). The industrial use of such range indicates promising future for betel leaves. IIT, Kharagpur design and develop an apparatus for extraction of essential oil from betel leaves that recovered essential oil 16.2 % more as compared to Clevenger Apparatus. The essential oil extracted with this apparatus clearly revealed that the Meetha, Bangala and Sanch varieties of betel leaves contained about 2.0%, 1.7% and 0.8% essential oil respectively, on dry weight basis. Essential oil of Bangala variety contained a mixture of about twenty- one different compounds of which eugenol (29.5%) was chief ingredients (Guha, 2014). Betel leaf has many unique properties including those of its essential oil besides medicinal ones which can be utilized for development of Novel food and non-food products. Accordingly at IIT, Kharakpur a few novel food product like cup cake, suji halwa, Ice cream, Chocolate and Biscuit have been developed with using essential oil of betel leaves ranging from 0.01 to 0.5% (Guha, 2014). One other hand, as far as non- edible products are concerned, developed an herbal Shampoo with very low concentration of essential oil of betel leaf which was found to be beneficial against Dandruff with very pleasant smell and smooth feeling in hair without addition of hair conditioner or oil. As a raw material, it can be used for the manufacturing of tooth- pastes, skin emollients, tooth-powders, paan masala, de-odorants, mouth fresheners, facial creams, antiseptic lotions, cold-drinks, chocolates, appetizers, carminative mixtures, digestive agents, tonics, medicines etc (Guha, 2000). Therefore, for exploitation of the unique qualities of the crop, there is a tremendous requirement for research on developing new products from betel leaves and essential oil. This would definitely be helpful for minimizing the menace of post-harvest losses of the leaves.

Hence concluded, in view of the commercial potentiality of betel leaf in India, Post- harvest losses of betel leaves can be prevented if proper preservation techniques are followed. Right from the ancient techniques of solar drying and depetiolation to the modern methods of preservation including modern drying technologies, bleaching and curing, chemical treatments, advanced packaging technologies, etc., can prove to be beneficial in reducing post- harvest losses of betel leaves that might be helps to generate employment opportunities and enhance national economy.

2.5 Different products manufactured from betel leaves.

Products manufactured from betel leaves on industrial scale	
Tooth -pastes	Cold Drink
Skin emollients	Chocolates
Tooth Powder	Appetizers
Pan Masala	Digestive Agents
Deodorants	Tonics and medicines
Mouth freshness	Beauty and Cosmeties
Facial Creams	Beatal leaf essential oil
Anti-septic lotions	Ice-cream

Processed betel leaves (cured betel leaf) have potential to earn more money

The curing process for betel leaves was probably first invented at Varanasi, India where the techniques were traditionally used for making Banarasi paan (cured betel leaf). The green leaves are treated with smoke, high temperature and pressure for improving organoleptic qualities and ultimately the green leaves are converted to white or yellowish white colour leaves. Although, there is no standard method been reported for curing process of betel leaves, Betelvine Research Centre, Islampur under Bihar Agricultural University, Bhagalpur, Bihar (India) took initiation from the year 2013 in the studied of curing of betelvine and constructed two paan bhati at the centre (Kumar and Pandey, 14). It also facilitates the training to betel growers coming from different parts of the state. The method of curing the betel leaves are alternate heating of 6 hours at 50-60°C and cooling of 12 hours, two to three time following aeration of leaves by turning and stored under dark condition. It took 15-20 days for making complete white or yellowish from green betel leaves. In this process, the shelf life of betel leaves is extended up to one month and curing imparts softness and sweet taste in betel leaves (Pandey *et al.*, 16). After completion of the curing process, the leaves are graded, spoiled leaves are discarded, cured leaves are taken out and the uncured green leaves are cured again for 8-24 hrs depending upon the colour of the leaves. Changes occurred in sweetness of leaves after curing leads to earn more money (` 0.50 per leaf in the local market) by the farmers. The processed leaf also imparts a sweet taste, making it a favourite among connoisseurs due to its high quality

New possibilities of agricultural diversification

Replacement of rainfed upland rice with low water requiring high value cash crop like betelvine may be one of the best option to increase the production,well-prepared betel quid is still regarded as an excellent mouth freshener and mild vitalizer, routinely served on the social, cultural and religious occasions like marriage, *Puja* (religious festivals), *Sraddha* ceremony (religious function performed after cremation) etc. It is also used as a special item offered to the guests in order to show respect in the Indian society. This clearly showed that this crop has a tremendous potentiality in earning the money from social, cultural, religious occasions and even day-to-day life (Guha, 9) which will strengthen the rural people economically at local level.

CHAPTER 3

PACKAGING OF BETEL VINE PRODUCE

3.1 INTRODUCTION

Indian Food Industry is in the thrones of a major revolution, thanks to the economic liberalization. Demand for fresh produce is increasing in internal market as well as other countries due to globalization. India is one of the largest producer of horticulture produces both in terms of number of varieties and quantities. Nearly 20-25% of total production islost every year due to poor handling, storage and transportation methods. The main purpose of packaging is to provide produce with the attributes necessary to survive a number of different hazards which can be expected during storage, transportation and distribution. In recent days, entrepreneurs in India are showing greater interest for the internal marketing as well as export of fresh produce. The trade is attractive but is not an easy enterprise; a high degree of organisation and professionalism is necessary to export fresh produce successfully, especially to the sophisticated markets of Europe. It can make good use of indigenous horticultural skills. The combined requirements of fresh produce and of its transport environment often impose unusually severe conditions on the packaging employed. As a result, higher package quantity is usually needed for fresh fruits and vegetables for manufactured goods of the same weight. For designing of a package for a specific product and particular target market a clear picture of distribution system should be drawn up, as hazards involved in transportation are different for different modes (i.e. packaging requirements for ship transportation are total different than that by air transportation). The models may be used depending upon the characteristics of the produceand the market. Fresh produces are lining tissue, high in 'water content and diverse in terms of morphology, composition and physiology. So package design should be based on requirement of the product in terms of mechanical fragility, susceptibility to or benefits at high or low relative humidity, limitations or benefits at high or low temperatures and optimum atmospheric composition.

Some of the commodities with high sensitivity to ethylene gas, hence the need to avoid gas build up in transit, which allow for effective external air ventilation (e.g. avocados and package may protect from moisture loss). Certain commodities have special treatments e.g. sulphur dioxide treatment of grapes. The package assist in protection of commodity against damage, the appropriate design of package and fittings should reduce the chance of bruising.

3.2 SYSTEMS APPROACH

A systems approach to modern fresh produce processing and distribution organisations includes all the information required for packaging it reproduce, whereby the produce and the package become together the produce sold in the market. This may be grouped into the following :

I. Protection requirement and constraints of the product:

1. Mechanical fragility of the product; ability to sustain prolonged compression shocksand vibration in transit.
2. Susceptibility to or benefits at high or low relative humidity.
3. Tolerance or benefits at high and low temperatures; contaminant hazards.
4. Atmospheric composition conducive to better preserving the quality, or its damage potential.

II. Marketing requirements of the product:

1. Number of products and number of product (types/grades) in the same container.
2. Weight of the container (gross and net).
3. Means of handling, storage and transportation environment (chain from productionto consumption).
4. Modes and types of wholesale and retail outlets.
5. Modes of quantizing (by weight, by count, by volume, etc.).
6. Modes of coding and labeling (prices, dates, health hazard warnings, utilization instructions, etc.).

III. Requirements and constraints of the package:

1. Types of packaging materials, types and construction of containers, standardisation requirements and types of closures. Modes of package manufacturing (in-plant versus contacting suppliers).
2. Modes of empty container storage (in knocked down form?)
3. Feeding containers into the packaging line.

IV. The processing and packaging line in the packaging house:

1. Type and sequence of processing and packaging stages (mechanized, semi-mechanized, manual), number of workers and their skills at each station, etc.
2. Unitizing methods, master containers, bundling, strapping, palletizing, shrinkwrapping or

stretch wrapping of pallets, airline or maritime containerization, etc.

V. Quality criteria of alternative packaging systems available:

1. Total packaging cost per unit product.
2. Containment and protective qualities, marketability and salability.
3. Disposal or recycling possibilities of the package.

3.3 PACKAGING HOUSE OPERATION:

The packaging line begins with unloading harvested produce. Bulk bins of 200-500kg capacity are used for big packaging houses but in India reusable plastic crates are used. Freshly harvested produce stacked up for interim storage. Interim storage may serve severalpurposes, depending on the type of produce. Latest damage, sustained during harvesting, will appear as visual defects several hours later and can be detected. Storing field-warm produce for few hours in a cool place, such as cold storage corridors, whereby produce temperature is reduced by several degrees before processing will help reducing subsequent spoilage and damage in the packaging line.

The most important process in fresh produce is respiration, a biochemical oxidation of all living cells. Respiration rate is proportional to temperature, approximately doubling for every 10°C. Due to high respiration, heat build up will be more, which in turn increases the temperature and respiration of produce. This reduces shelf-life of the produce. The heat produced may be calculated by

1 mg CC>2/kg hr. = 61.2 k.cal/metric ton. day = 220 BTU/ton.day.

The term precooling refers to several practices whereby the temperature of the freshly harvested produce is quickly lowered to shorten the period of initial high respiration rates as well as to reduce the loads on the long-term cold storage facilities. Success of efficient precooling depends upon fast removal of field heat from all fruits, preferably within 2 to 3 hours. Regular cold storage room with about 150 air changes per hour gives best result, but with danger of excess moisture loss.

Hydrocooling consist of drenching field-warm produce with stream of cold water taking care of chilling injury suitable for leafy vegetables. There are three types of hydrocoolers. Immersion, flooding and spraying. Another precooling method suitable for lettuce is vacuum cooling. This system uses hermetically sealed vacuum chambers whereby the pressure is reduced until the vaporising temperature of water is near O°C (4.6 mm Hg), removes moisture uniformly from all tissues, not just from the surfaces. The produce are subjected to a cleaning process, which begin with soaking tank, where dirt clods and pesticide residues are softened and diluted by warm or cold solution of water detergents and disinfectants. The fruit is thoroughly washed by piece of cloth or soft brushes withwater spray. The produce is then treated with fungicide treatment if any. Before processing further, produce is dried by air steams from overhead fans. In the next stage the undersizedproduce called as culls, is eliminated can be sent for converting, called as presizer stage.

The grading process next follows to segregate the produce into quality groups, such as ripe fruits which must be marketed immediately, grade A,B,C, export grade or culls. Before or after grading, high quality fresh produce processing may be included a waxing, operation, especially when long shelf-life is desired. Most produce has a natural wax layer on its rind orskin which protects it from excessive moisture loss while allowing free metabolic gas exchange. This wax is largely removed by the cleaning operation. By applying an artificial wax, the keeping quality of produce is reinstalled or even bettered, which includes chemical additives to inhibit spoilage or to add gloss to colour for sales appeal. Sizing is an additional sorting operation whereby sorting attribute is size. Now uniformly sized and graded produce is ready to be packaged. Depending upon produce type and grade, distance to markets, costand availability of packaging materials, the produce may be packed in a large variety of shipping containers.

The packaging operation usually includes set up of container, before quantitizing of produce, filling and container closure. Quantitizing may be by count or by weight or a combination of the two. Accurate sizing provides proportional link between count and weightwhereby only 'check-weighing' is required after filling by count. Container fill may be randomor pattern packed. Pattern packed increases protection of produce, by minimising contact pressure by increasing number of contact points until its maximum of 12, is emphasized andmaximising volume utilisation. Sometimes the produce is pre-packed in packaging house in consumers pack, mostly different types of plastic bags or overwrapped trays. The final packaging operation is container closures which may be performed by gluing, stapling, strapping. Unitization and palletization may be done according to the container requirement and market need.

3.4 Specific Applications

The particular type of package used depends upon the shape and perishability of the product. There are five main classifications soft, fruit, hard fruit; stem products; root vegetables; and green vegetables. Soft fruits are highly perishable and easily subject to anaerobic spoilage. They bruise and squash easily which leads to rotting. They are packagedin semi-rigid containers with a cover of cellophane, cellulose acetate, polystyrene or other suitable film cover. Adequate ventilation is a must to avoid fogging. Handling must becareful and avoided as much as possible. Shelf-life is limited due to individual damage and decay. Some berries under ideal conditions only remain top quality for 2 or 3 days. Typical soft fruits are cherries, grapes, blueberries, strawberries, raspberries, plum,etc.

Types of packaging: Packaging can be classified in number of ways; the most importantone is by stages of distribution system for which it is primarily intended.

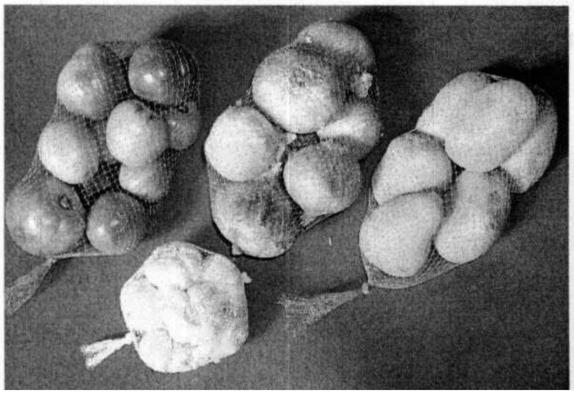
- Consumer or unit packaging,
- Transport packaging;
- Unit load packaging.

Consumer packaging

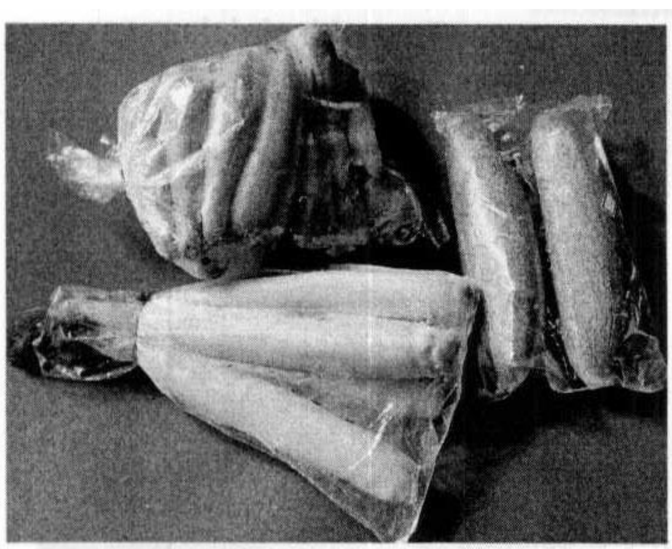
The package in which consumer receives the produce is called consumer packaging. The term prepackaging of produce in consumer units prior to its presentation to the final consumer. Prepackaging may be undertaken at any stage throughout the distribution chain from the field to the retailers premises, depending upon, need of produce for protection, expected transport and storage time, required shelf-life, packaging material costs and costs of packaging and sorting at different points, transport and storage cost and latest knowledge of the market requirements.Types of consumer package:

Bags :

Bags are most common and favoured retail packs because of its low material and packaging cost. In terms of cost to strength ratio 25 - 40 micron low density polyethylene or 12.5 micron high density polyethylene bags are most suited. Net bags are used to provide desired ventilation and allow free air moment for the produce such as citrus fruits, onions potatoes etc. The bags can be made of paper, perforated polyethylene or polypropylene film, plasticor cotton nets.




Net bags Perforated bags



Tray:

Tray packs made of foamed polystyrene or PVC or PP are overwapped with heat shrinkable or stretch films. A tight wrap immobilizes the fruits and keep them apart. Trays of moulded pulp, card board, thermoformed plastic or expanded polystyrene are used.

Sleeve packs:

Combine the low cost of bags and protective qualities and sales appeal of tray packs. Wraps of plastic film such as polyethylene or PVC, in the form of shrink-wrap, stretch film or cling film. Regular net stocking or expanded plastic netting can also be used. The traditional fruits and vegetable retail trade packs the produce in the presence of consumers and in the qualities and quantities required by them. The package normally used is a simple wrap of paper or a paper or polyethylene bag. Sleeve packs can be fabricated to contain from one toas many as ten fruits. The main advantage in sleeve packs is that they immobilize the produce at a fraction of cost of tray packs and produce can be observed from all sides without damage to the fruit.

Transport packaging:

The transport packaging for fresh produce may be divided into two size groups:

i) The predominant size group, suitable for carrying by man, is in the range of 15 to 25 kg.

ii) The other group, recently becoming increasingly popular is in 200-500 kg range suitablefor fork lift handling refers to as pallet container.

Wooden boxes:

Includes natural wood and industrially manufactured wood-based sheet materials. Timber used must be inexpensive and easily worked. All wood that is used for the production of the packaging should be well dried in order to prevent cracks and mould growth later. Manufactured wood based sheet materials include ply wood, hard board and particle board. Plywood is usually made from birch. It is rigid and strong, though perhaps somewhat less resistant to splintering than poplar, but is smoother and flatten so suitable for direct printing. Hard board is dark in colour but its appearance can be improved with decorative printing, but deforms after long storage in high relative humidity. Particle board is thicker and rigid but relatively brittle.

Corrugated fibreboard boxes:

Corrugated fibreboard boxes are the most commonly used shipping containers wherecartons, glass, cans and pouches are the unit containers. The popularity of CFB as a container in food industry as well as in other industrial packaging is for the followingreasons:

1. Low cost to strength and weight ratio.
2. Smooth, no abrasive surface.
3. Good cushioning characteristics.
4. Excellent printability.
5. Easy to set up and collapsible for storage, and
6. Reusable and recyclable market.

Corrugated fibreboard boxes

The most commonly used material for plastic corrugated box is polypropylene and HOPE. Itsadvantage over CFB is low weight to strength ratio and its reusability. The printability is also excellent when compared to CFB boxes. But CFB has edge over plastic fibreboard boxes when cushioning properties are taken into consideration. The disadvantages are ultraviolet degradation and temperature resistant.

Plastic crates

Plastic crates are usually made up of HOPE or Polypropylene by injection moulding has beenreplacing wooden and wire crates. These crates must have good resistant properties to ultraviolet degradation and shock damages.

Sacks:

These are flexible shipping containers which are generally used in food industries to bring to raw materials viz. fruits and vegetables from the field. If the weight of content is more than 10 kg then it is called sack otherwise bags. The commonly used materials for sacks are cotton, jute, flan, plastics (HOPE, Polypropylene). These sacks are advantageous to use as itcost less, high strength, reusability and requires small space for the empties. Disadvantageof plastic woven sack is poor stackability due to low coefficient of friction.

Palletization:

Pallets have been standardised keeping in view of the standard package sizes and sea containers. The size of the pallet take on a strategic importance since they correspond directly to the sizes of the various types of containers, ship cargo compartments, trucks, forktrucks, etc. Most commonly used pallet sizes are 120x80 cm (Euro pallet) and 120x100 cm (Sea pallet). Sea pallets are most commonly used outside the Europe.

Palletized loads are used in order to reduce handling costs by allowing the substitution ofmechanical handling for manual methods.

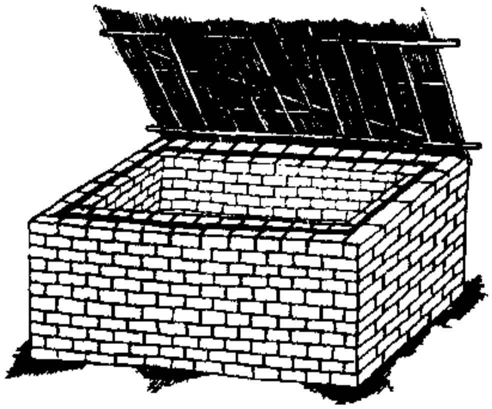
- A decrease in sorting.
- Redraw labelling requirement.
- Better utilization of storage space.
- A reduction in mechanical strains and damages.
- A reduction of the total distribution time.
- A better maintenance of product quality.

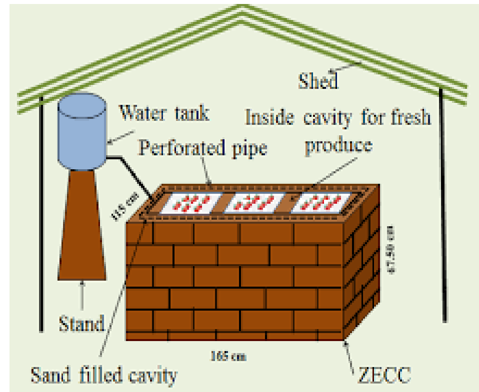
Two principles are used in the assembly of pallet loads.

1. The modular principle, in which all package are oriented in the same direction.
2. The two-way principle, in which the packages in each tier form a pattern such thatsome packages are oriented lengthwise and other cross wise on the pallet.

Zero Energy Cool Chamber for Pan storage

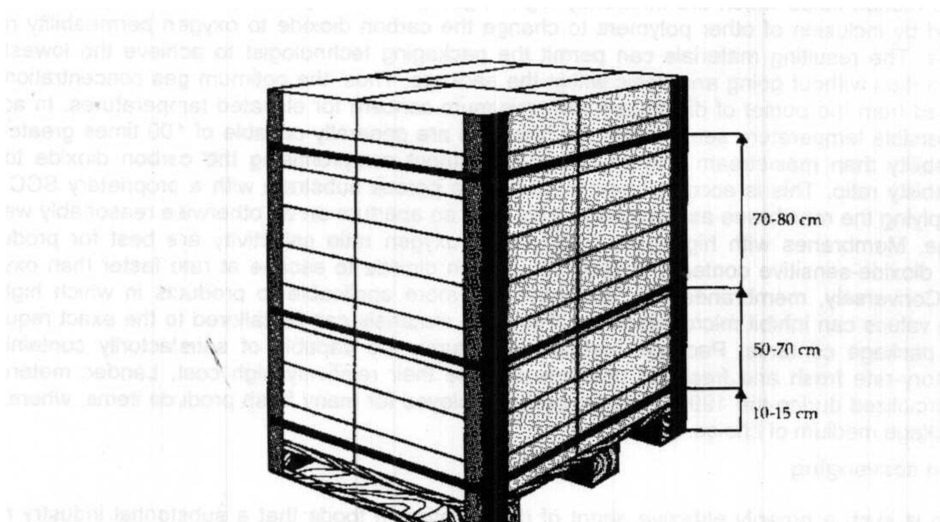
The betel leaves could be stored in zero energy cool chamber with acceptable qualities 2 to 5 days more than the leaves stored under ambient conditions, depending on packaging system. Among various packaging systems, the traditional package gave best results under ambient conditions, where as much difference could not be noticed among packages stored in the zero energy cool chamber.





Unitization :

Corner posts made with plastic or wood or Moulded paper boards is generally used as columns for unitization. The boxes are held together by means of strapping around theboxes as shown in below.



Correct placement of corners and straps

Modified Atmosphere Packaging (MAP)

A modified atmosphere is the initial alteration of the gaseous environment in the immediate vicinity of the product, permitting the packaged product interactions to naturally vary their immediate gaseous environment.

A controlled atmosphere is a process by which the gaseous environment is modified to a desired level and controlled at this level, with strict limits, throughout storage and is usually applied to bulk storage.Normal composition of air 20% O_2, 79% N_2, 0.03% CO_2.

Smart packaging

To be able to control the package structure to deliver controlled atmosphere within packages is a major accomplishment that truly deserves the name "smart packaging." The term "smart" packaging was coined about fifteen years ago to describe package structures that allegedly sensed changes in the internal or surrounding environment and altered some of their relevant properties in response. Simultaneously, academics and true researchers, concerned that the term was too juvenile, invented the term "interactive" packaging to describe the same entities and later shortened it to "active" packaging, the nomenclature employed today. The problem with too much active packaging today is that it is not very intelligent, i.e., it does not really change with environment but rather functions in a less passive fashion than "ordinary" "barrier" packaging.

Intellipac™ polymeric package materials, manufactured by Landec Corp., Menlo Park, Calif., are side-chain-crystallizable (SCC) polymers with the ability to effectively and reversibly meltas the temperature increases and thus foster increased gas transmission through them. SCC polymers are acrylics with side-chains independently of the main chain. By varying the side- chain length, the melting point can be altered. By making the appropriate copolymers, it is possible to produce any melting point from 0 to 68 0 C., well within the extreme distribution temperature range of minimally processed foods. SCC polymers are unique because of their sharp melting transition and the ease with which it is possible to produce melting points in a specific temperature range. When elevated to the switch temperature, SCC polymers become molten fluids which are inherently high in gas permeability. The permeation properties may be modified by inclusion of other polymers to change the carbon dioxide to oxygen permeability ratios, for example. The resulting materials can permit the packaging technologist to achieve the lowest oxygen concentration without going anaerobic within the

package. Thus, the optimum gas concentration may be employed from the outset of distribution with minimum concern for elevated temperatures. In addition to the reversible temperature sensitivities, the materials are generally capable of 100 times greater oxygen permeability than mainstream polyethylene films without compromising the carbon dioxide to oxygen permeability ratio. This is accomplished by coating a porous substrate with a proprietary SCC polymer and applying the membrane as a package label over an aperture on an otherwise reasonably well sealed package. Membranes with high carbon dioxide to oxygen ratio selectivity are best for products with carbon dioxide-sensitive contents to allow the carbon dioxide to escape at rate faster than oxygen can enter. Conversely, membranes with low ratios are more applicable to products in which high carbon dioxide values can inhibit microorganisms. Thus, the materials can be tailored to the exact requirements of the package contents. Package materials structures are capable of satisfactorily containing high- respiratory-rate fresh and fresh-cut produce. Despite their relatively high cost, Landec materials were commercialized during the 1990s and are being employed for many fresh produce items, where they are the package medium of choice.

Oxygen scavenging

Oxygen is such a broadly effective agent of deterioration in foods that a substantial industry has been established to provide a wide range of alternative means of oxygen removal from package headspaces to reduce chemical deterioration. Such deterioration processes include discolouration of meats or rancidity development due to lipid oxidation.

The choice of method of oxygen removal depends upon both economic factors and upon the properties of the particular food. In practice the application of a short inert-gas flush coupled with use of a scavenger is likely to be an attractive combination.

The performance of oxygen scavenging sachets depends strongly on the equilibrium relative humidity of the food and the range of sachets available. The inclusion of iron-based scavenging compositions in sachets has been improved by development of adhesive scavenging labels for the inner wall of packages.

Technologies for thin films typically used in MAP systems need an additional feature to prevent premature reaction if they are to provide maximum scavenging capacity. The transition-metal-catalyzed (optionally light-activated) process patented by W.R. Grace, Inc. approaches this by pre-planned activation involving generation of full capacity by consumption of antioxidants. Amoco Chemicals have reported some performance data for their Amosorb®, water-activated, masterbatch for blending into a variety of plastics. No

compositional detail is yet provided but the masterbatch and plastics incorporating it are stable at relative humidities below 40%.

Co2-scavengers and emitters

Co2 is formed in some foods due to deterioration and respiration reactions. The produced Co2 has to be removed from the package to avoid food deterioration and/or package destruction. Co2-absorbers might therefore be useful. The 02 -and Co2 -scavenging sachet FreshLock® or Ageless® E is used in coffee to delay oxidative favour changes and absorb the occluded 602 which if not removed would cause the package to burst . The active compound Ca(OH)2 of FreshLock® reacts at suffciently high humidity with the Co2 to produce CaCoa. Multiform Desiccants patented a Co2 -absorbent sachet including a porous envelope containing CaO and a hydrating agent such as silica gel on which water isadsorbed.

In some cases, however, high 602 -levels (10-80%) are desirable for foods such as meat and poultry because these high levels inhibit surface microbial growth and thereby extend shelf-life . Fresh meat, poultry, fish and cheese can benefit from packaging in a high Co2 - atmosphere. Removal of 02 from a package by use of 02 -absorbers creates a partial vacuum which may result in a collapse of flexible packagings. Also, when a package is flushed with a mixture of gases including €02, the Co2 dissolves partly in the product and creates a partial vacuum. In such cases, the simultaneous release of Co2from inserted sachets which consume 02 is desirable. Such systems are based on either ferrous carbonate or a mixture of ascorbic acid and sodium bicarbonate. The 02 -absorbers/Co2 -generators are mainly used in products where package volume and package appearance are critical.

Antimicrobial packaging

Substantial recent research has been directed at determining how the surfaces of plasticscan be made not only sterile but also capable of having an antimicrobial effect on the packaged food or beverage.

This type of effect has already been achieved in outer layers of laminates by use of modified printing presses.

Horseradish extract on a cyclodextrin carrier has been used in a drip sheet for fish or in a film wrap for lunches in Japan.

Approaches to antimicrobial packaging can be classified as either of two types. The first consists of binding an agent to the surface of packages and this would require a molecular structure large enough to retain activity on the microbial cell wall even though bound to the plastic. Such agents are likely to be limited to enzymes or other antimicrobial proteins. The second approach involves the release of agents into the food or beverage or localized removal of a food ingredient essential for microbial growth.

Major constraints in production and marketing of betelvine

According to Kaleeswari and Sridhar (12), the major problems in betel leaf farming were traditionally management operations, unskilled labour, pest and disease problem, non existence of regulated market, presence of too many middlemen and price fluctuation due to seasonality in production of betel leaves. However, Zn-deficient soil also act as limiting factor for sustainable production of betelvine in agro-climatic zone III B of Bihar (Das et al., 4)

3.5 CONCLUSION

The betel farming activities can generate employment opportunities for throughout the year. It is one of the most important cash crop and adequately justifies its nomenclature as the "green ATM for rural women" which is unlocking the lock of women entrepreneurship in Bihar. The central and state government should jointly take appropriate steps to improving pest management of betel farm activities, to establish a Research and Development Board; to enhance export oriented activities meeting global standards, to reduce intermediaries in marketing, to stabilize the betel prices, to increase farm cultivation and awareness among betel growers. Thus, government needs to recognise betel leaves important trading commodity and offer them support. If farmers have given a little support in terms of insurance or infrastructure then betel leaf trade will flourish to boost up the national economy and generate huge employment opportunities for the rural women.

CHAPTER 4

4.1 FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA (FSSAI)

- **The Food Safety & Standards Authority of India** is the **principal Government Authority** responsible for preparing specific regulations under the Act. **FSSAI** is an autonomous body established **under the Ministry of Health & Family Welfare, Government of India**
- **FSSAI** has been established under the **Food Safety and Standards Act, 2006**
- **Came in to action- August 2011**
- **FSSAI is responsible for protecting and promoting public health through the regulation and supervision of food safe.**
- Businesses having annual turnover above 20 crore can apply for FSSAI central license.
- 1. Rental Agreement of Business Premises.
- 2. ID Proof of the Concerned Person (Aadhaar Card / Driving License / Passport / Voter ID)
- 3. If any Government Registration Certificates (Company Incorporation Certificate / Firm Registration / Partnership Deed / Pan card / GST / Shop & Establishment / Trade License)
- 4. If the applicant is private limited company or partnership firm then they should provide MOA & AOA or Partnership deed copy.
- 5. IE Code (Import Export Code) Certificate (for the category of export and import IE code is compulsory)
- 6. Authority letter from the company letterhead to the concerned person stating that he is authorized to file FSSAI application.
- 7. List of food category desired to be manufactured (In case of manufacturers).

4.2 HACCP PROCEDUER

Appropriate to the nature and size of the operation and sufficient to assist the business to verify that the HACCP controls are in place and being maintained.

Documentation shall include (as a minimum) the following:

- HACCP team composition;
- Product description;
- Intended use;
- Flow chart;
- Hazard analysis;
- CCP determination;
- Critical limit determination;
- Validation process; and
- HACCP plan

The HACCP plan shall include the following information for each identified CCP:

- Food safety hazard(s) to be controlled at the CCP;
- Control measure(s);
- Critical limit(s);
- Monitoring procedure(s);
- Corrections and corrective action(s) to be taken if critical limits are exceeded;
- Responsibilities and authorities for monitoring, corrective action and verification;

  Record(s) of monitoring

Guidelines on Method of sampling for determination of Salmonella spp. for exports of Betel Leaves

Sampling and analysis of Betel Leaves shall be carried out in accordance with Article 4 C implementing Regulation (EC) No 2017/186 dated 2nd February 2017 laying down specific conditions applicable to the introduction into the Union of consignments from third countries due to microbiological contamination and amending Regulation (EC) No. 669/2009.

The authorized laboratories shall perform sampling in accordance with Chapter III „Sampling and analysis" in Title II of Regulation (EC) No. 882/2004. In particular, the sampling shall be performed in accordance with the relevant standards of the ISO (International Organisation for Standardization) and the guidelines of the Codex Alimentarius used as reference and the analysis for Salmonella spp. shall be performed according to the reference method EN/ISO 6579 (the latest updated version of the detection method) or a method validated against it in accordance with the protocol set out in EN/ISO 16140 and other internationally accepted similar protocols.

The sampling shall be carried out either at APEDA recognized pack-houses/establishments or at registered farms. A representative sample of produce shall be drawn from a lot traceable with unique identification code. Simplified guidelines of method of sampling referred at para 3.2 of these Procedures are given as follows:

Definition of lot and consignment

A quantity of material at one time and known, or presumed, by the sampling officer to have uniform characteristics such as origin, producer, variety, packer, type of packing, markings, consignor, etc.

Each lot shall have a unique identification code which shall be clearly mentioned on the outside (external part) of the corrugated box.

A consignment may consist of one or more lots. In case where a consignment is comprised of lots which can be identified as originating from different growers (following different practices), etc., each lot shall be sampled and analyzed separately. Similarly, one lot can also have more than one consignment. Even in such cases, there shall be one sampling and analysis for that lot.

To establish traceability of the produce, the sampling shall be done either from APEDA registered pack-houses or from the farm. In case, a consignment is created by mixing produce from more than one farm (following different practices) or different lots, then each individual farm produce or lot shall be given a unique identification code, sampled separately and analyzed individually. Thus, e.g. if a consignment contains produces from 20 different farms (following different practices) or lots, then the consignment shall carry 20x5 separate analysis. If any of the analysis indicates non- compliance to the microbial load of Salmonella spp. then that particular lot shall not be included in the consignment.In case the farm(s)/group of farm(s) are monitored by exporter(s) and the farm(s) following uniform production practices, the exporter may opt for sampling and analysis of produce either as mentioned above or consignment wise.

A consignment of Betel Leaves may comprise produce of optimum 20 farms, provided these farms have adopted uniform pre harvest practices and are maintaining same PHI so that the samples drawn for residue analysis are homogenous and representative of the supplying farms.

Materials required for sampling (sterilized)

- Large Polythene bags, hand gloves, hand sanitizer
- Knife, cutter, seizer, cleaning solution, tags seals

Paperwork

- Sample slip (as given in Annexure-2)
- Stand Operation Procedures (SOP) of Sampling procedures in local language or in English

Contamination and deterioration of samples must be prevented at all stages, because they may affect the analytical results. Each lot to be checked for compliance must be sampled separately.

Avoid sampling from wet boxes, if the weather is bad. Many contaminants are water soluble so rainwater could result in cross-contaminating other boxes.

The minimum of primary samples to be drawn from a lot is as given below:

Commodity classification	Nature of primary sample to be taken	Minimum size of each laboratory Sample
Betel Leaves		
(Units generally < 5g)	Whole units	400 g (around 10 g from 40 primary sampling locations)

The selected lot of Betel Leaves shall be divided into 40 primary sampling locations covering 2 locations of each farm‟s produce. Draw samples of 5 gram from each location as described in table given above. Irrespective of number of optimum supplying farms in one consignment, primary sampling shall be done from minimum 40 locations as described in the above table.

The laboratory sample shall be thoroughly mixed up by quartering technique and divided into 2 parts: (i) Sample for direct analysis by the laboratory (half quantity of produce)
(ii) Control sample for further analysis in future, (half quantity of produce). The authorized laboratories shall retain control sample(s) in controlled conditions in Cold Store at appropriate temperature for a period of 10 days from the date of issue of analysis certificate.

Packing and transport of sample

The samples should be packed separately in clean and virgin polythene bags designed for transport of Betel Leaves. Sample slip given at Annexure-2 should be kept in a polyethylene cover and the same should be inserted in the bags. The bags should be labeled from outside with the following information:

- Sample for Salmonella spp. analysis of Betel Leaves
- Sample slip number
- Date of sampling
- Time of sampling

- Unique identification code of the lot

- Farmer identification code

- Name of the authorized representative (sampler) of the laboratory with signature

Sealed samples shall reach the laboratory within 24 hours of sampling from the packhouse/ establishments/farms. Enough care should be taken to prevent any spoilage of the samples during transit.

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