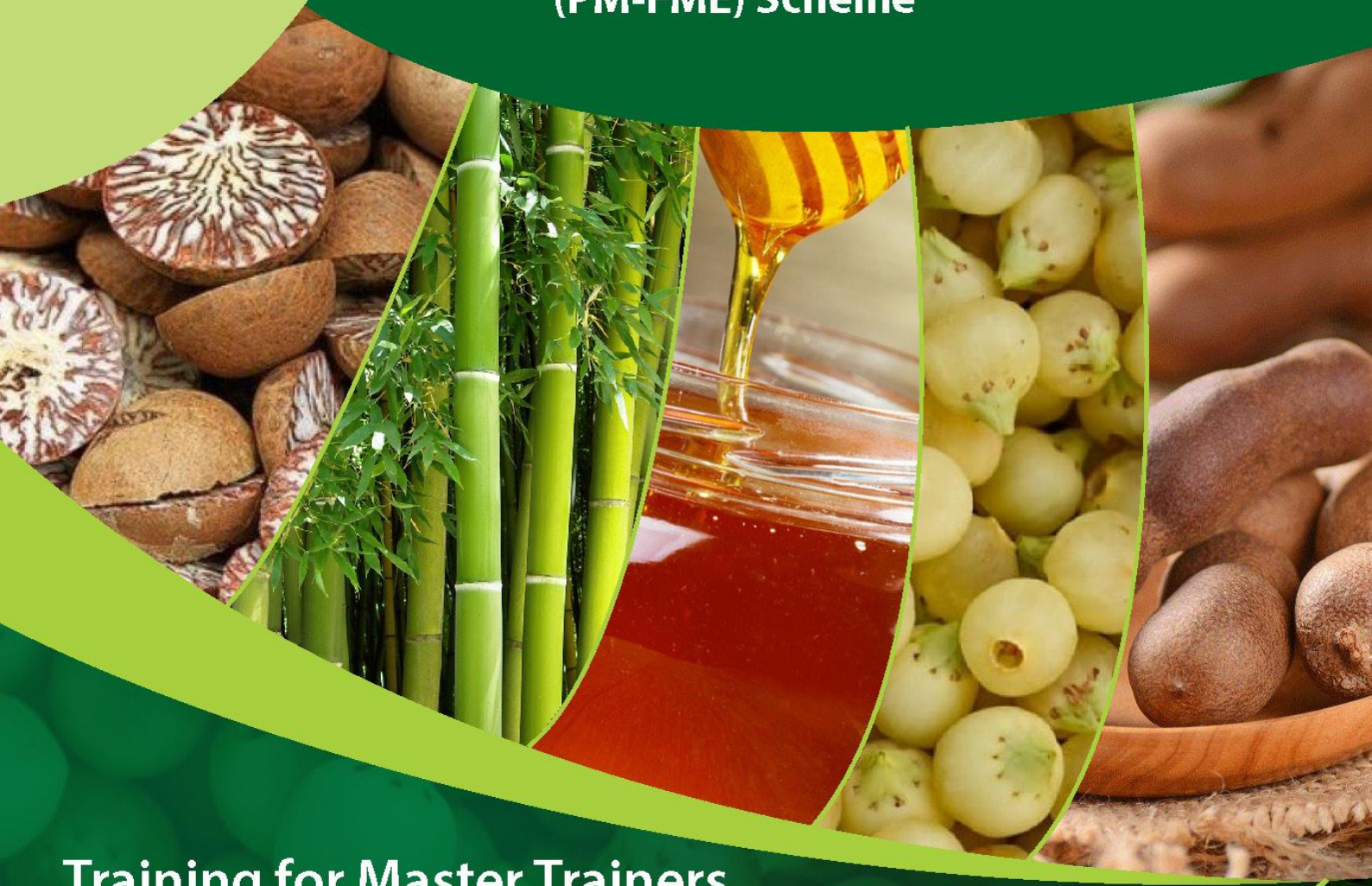
सत्यमेव जयते
MOFPI

PM Formalisation of
Micro Food Processing Enterprises
(PM-FME) Scheme

IIFPT



Training for Master Trainers

Handbook of
Minor Forest Produce Processing

AATMANIRBHAR BHARAT

Organized by

Indian Institute of Food Processing Technology (IIFPT)
Ministry of Food Processing Industries, Government of India
Pudukkottai Road, Thanjavur
Tamil Nadu Ministry of Food Processing Industries
Government of India

INDEX

Chapter 1

Overview of PMFME scheme

Er. Doll Chutani, Dr. Pratibha Singh
Indian Institute of Food Processing Technology-Liaison Office, Bathinda (Punjab)

1.1 Background

In India, the food sector has emerged as a high-growth and high-profit sector due to its immense potential for value addition, particularly within the food processing industry. The Indian food and grocery market is the world's sixth largest, with retail contributing 70 per cent of the sales. The Indian food processing industry accounts for 32 per cent of the country's total food market, one of the largest industries in India and is ranked fifth in terms of production, consumption, export and expected growth.

The food processing industry fosters a startling number of small and medium enterprises. Currently, there are an estimated 42.50 million small and medium-size businesses flourishing in India, comprising of both registered and unregistered ones, making up a staggering 95% of the country's overall industrial units. In this sector, the unorganized food processing segment comprises nearly 25 lakh units which contribute to 74 percent of employment. Nearly 66 percent of these units are located in rural areas. Food processing industry plays a vital role in these enterprises.

In order to provide financial, technical and business support for upgradation of existing micro food processing enterprises, Ministry of Food Processing Industries (MoFPI) has launched a Centrally sponsored scheme, 'PM Formalization of Micro Food Processing Enterprises' (PM-FME). The scheme would generate total investment of Rs 35,000 crore and generate nine lakh skilled and semi-skilled employment and benefit 8 lakh units through access to information, training, better exposure and formalization. This sector faces a number of challenges which include lack of access to modern technology and equipment, training, access institutional credit, lack of basic awareness on quality control of products, lack of branding and marketing skills which limit their performance and their growth. The food industry has always been a great source of employment with reference to the MSMEs. The small and medium enterprises are hugely benefited from the growth of the overall sector.

1.2 About the PMFME Scheme

Ministry of Food Processing Industries (MoFPI), in partnership with the States, has launched an all India centrally sponsored "PM Formalisation of Micro Food Processing Enterprises Scheme (PM FME Scheme)" for providing financial, technical and business support for upgradation of existing micro food processing enterprises.

1.3 Objectives of the scheme

i. Capacity building of entrepreneurs through technical knowledge, skill training and hand holding support services;
ii. Increased access to credit to existing micro food processing entrepreneurs for technology upgradation;
iii. Support to Farmer Producer Organizations (FPOs), Self Help Groups (SHGs), Producers Cooperatives & Cooperative Societies along their entire value chain to enable microenterprises to avail common services;

iv. Support for transition of existing enterprises into formal framework for registration under regulatory framework and compliance;
v. Integration with organized supply chain by strengthening branding & marketing.

1.4 One District One Product

The Scheme will adopt a One District One Product (ODOP) approach to reap benefit of scale in terms of procurement of inputs, availing common services and marketing of products. One District One Product approach would provide framework for value chain development and alignment of support infrastructure. There may be more than one cluster for one product in one district. A cluster may also extend beyond one district. The States would identify food product for a district, keeping in perspective the focus of the scheme on perishables. The ODOP could be a perishable agri-produce, cereal based product or a food product widely produced in a district and their allied sectors. Illustrative list of such products includes mango, potato, litchi, tomato, tapioca, kinnu, bhujia, petha, papad, pickle, millet based products, fisheries, poultry, meat as well as animal feed among others. With respect to support to existing individual micro units, preference would be given to those producing under ODOP approach. However, units producing other products would also be supported. In case of groups, predominately, those involved in products under ODOP approach would be supported. Support to groups processing other products in such districts would only be for those already processing those products and with adequate technical, financial and entrepreneurial strength. Support for common infrastructure and marketing & branding would only be for products under ODOP approach. In case of support for marketing & branding at State or regional level, same product of districts not having that product as ODOP could also be included.

The scheme would also support strengthening of backward and forward linkages, provision of common facilities, incubation centres, training, R&D, marketing & branding, provision of which would primarily be for ODOP products. Further, this approach would also complement and benefit from the existing promotional efforts of the Government such as development of Agriculture Crop Clusters under the Agriculture Export Policy, the cluster approaches of the Ministry of Agriculture and the Ministry of Rural Development through the National Rurban Mission.

1.5 Support to Food Processing Units

Support to food processing units would be provided for the following:

i. Credit linked grant at 35% of the project cost with maximum grant up to Rs 10.0 lakh to existing unorganised food processing units for upgradation;
ii. Credit linked grant at 35% of the project cost to SHGs/FPOs/cooperatives for capital expenditure with maximum limit as prescribed;
iii. Seed capital @ Rs. 40,000/- per member to those engaged in food processing as a working capital;
iv. Credit linked grant at 35% of the project cost for common infrastructure with maximum limit as prescribed;
v. Support for marketing & branding up to 50% of the expenditure with maximum limit as prescribed.

1.6 Upgradation of Processing Units

Individual Category: Individual micro food processing units would be extended credit-linked capital subsidy @35% of the eligible project cost for expansion/ technology upgradation with a maximum ceiling of Rs.10 lakhs per unit. The beneficiary contribution should be minimum 10% and the balance should be loan from a Bank.

Eligibility criteria:

a. Individual / Partnership Firm with ownership right of the enterprise;
b. Existing micro food processing units in the survey or verified by the Resource Person;

c. The applicant should be above 18 years of age and should possess at least VIII standard pass educational qualification;
d. Only one person from one family is eligible for obtaining financial assistance. The "family" for this purpose would include self, spouse and children.

Procedure for applying for upgradation:

Applications would be invited at the district level on an ongoing basis for units interested in availing the benefits under the Scheme. Existing food processing units desiring to seek assistance under the scheme should apply on the FME portal. Loan proposals would be recommended to the Banks after scrutiny. States would decide the appropriate level for short listing of the applications to be recommended to the Banks.

Procedure with Banks for Grant:

At the national level, a Nodal bank would be appointed for disbursement of subsidy to the banks and liaison with the banks extending loan to the beneficiaries. The bank sanctioning the loan would open a mirror account in the name of the beneficiary. Grant by the Central and State Government in 60:40 ratios would be deposited in this account of beneficiary in the lending bank branch by the State and Central Government. If after a period of three years from the disbursement of last tranche of the loan, the beneficiary account is still standard and the unit is operational, this amount would be adjusted in the bank account of beneficiary. Release of grant for groups and common infrastructure would also be done in their bank account following the same principle.

Group Category: The Scheme would provide support in clusters to groups such as FPOs/ SHGs/ producer cooperatives along their entire value chain. SHGs / FPOs / Producer Cooperatives would be provided the following support:-

a. Grant @35% with credit linkage for capital investment with maximum limit as prescribed;
b. Training support;
c. Support for marketing and branding for products under ODOP for developing common brand.

Eligibility criteria:

a. It should be engaged in processing of ODOP produce for at least three years;
b. In case of FPOs / cooperatives, they should have minimum turnover of Rs.1 crore and the cost of the project proposed should not be larger than the present turnover;
c. The SHG / cooperative / FPO should have sufficient internal resources to meet 10% of the project cost and margin money for working capital.

Seed Capital to SHG: The scheme envisages provision of Seed Capital @ Rs. 40,000/- per member of SHG engaged in food processing for working capital and purchase of small tools. Seed capital as grant would be provided at the federation level of SHGs which, in turn, will be extended to members as loan through SHG.

Eligibility criteria:

For Seed Capital, only SHG members who are presently engaged in food processing would be eligible. The SHG member has to commit to utilize this amount for working capital as well as purchase of small tools and give a commitment in this regard to the SHG and SHG federation.

1.7 Creation of Common Infrastructure

FPOs/ SHGs/ Producer Cooperatives /State agencies or private enterprises would be supported for creation of common infrastructure including for common processing facility, incubation center, laboratory, warehouse, cold storage, etc. Eligibility of a project under this category would be decided based on benefit to farmers and

industry at large, viability gap, absence of private investment, criticality to value chain, etc. Credit linked grant would be available @ 35% with maximum limit as prescribed.

1.8 Branding and Marketing Support

Marketing and branding support will be provided to FPOs/SHGs/Cooperatives or an SPV of micro food processing enterprises under the scheme following the cluster approach for developing common packaging & branding with provision for quality control, standardization and adhering to food safety parameters for consumer retail sale.

Support for Marketing and Branding requires a minimum volume which can be generated through active involvement of FPO/ SHG/ Cooperatives to bring large number of producers together. These organisations would be supported based on DPR prepared by them indicating essential details of the project. Support up to Rs.5 lakh would be available from State Nodal Agency for preparing DPR for proposals for branding & marketing.

Support for branding and marketing would be limited to 50% of the total expenditure with maximum limit as prescribed. Proposal from states or national level institutions or organizations or partner institutions for branding & marketing will be supported for vertical products at the national level. No support would be provided for opening retail outlets under the scheme.

Procedure for Applying for Support

In case of SHGs/FPOs/cooperatives or SPV interested in applying for support for branding and marketing under the Scheme, DPR should be prepared and submitted to State Nodal Agency (SNA). SNA would appraise the proposal and with recommendation from the State Level Approval Committee (SLAC) seek approval from MOFPI. Thereafter, the proposal would be recommended to a Bank for sanction of loan. Same procedure should be followed for applying for support for creation of common infrastructure as well.

1.9 Capacity Building & Research

***"Capacity building is the process through which individuals, groups, organizations and societies deploy, adapt, strengthen and maintain the capabilities to define, plan and achieve their own development objectives on an inclusive, participatory and sustainable basis.*"**

Need for capacity building

Capacity building is set of activities that expand the scale, reach, efficiency, or effectiveness of programs and organizations. Capacity building activities expand services, enhance skills and generate additional resources for programs and/or organizations. It is a planned and systematic sequence of instruction under supervision, designed to impart skills, knowledge, information and attitudes of the trainees. Globalization and increased competition have intensified the need for highly skilled workforce in the economy to meet global standards of quality. A combination of demographic, economic and social factors makes skill development a major priority.

The challenge is immense. 54% of India's population is below 25 years of age and above 62% of population is in the working age group. Yet, only 4.69% of the Indian population has undergone formal skills training. The food processing industry demands different skill sets on the basis of their relevance to various segments. The basic functional distribution of human resource in the industry is involved in operations stage with 10 percent of the workforce dedicated towards supply chain. Several skill gaps exist in various stages of the food processing value chain that need to be addressed. This includes the food processing sector as well as ancillary industries, such as bottling, packaging, labelling, quality standards, etc.

Capacity building under the PM-FME scheme

Capacity building is an important component of PMFME Scheme. Under the Scheme, it is envisaged to provide training to food processing entrepreneurs, various groups, such as, SHGs/ FPOs/ Cooperatives, workers and other stake holders connected with the implementation of the scheme such as government officials, project officials etc. The training for the following categories of persons would be provided under capacity building component of the scheme: - i. Individual micro-food processing entrepreneurs availing credit linked grant under the Scheme ii. Individual existing micro-food processing enterprises those are not taking grant under the Scheme iii. Workers of micro-food processing enterprises iv. Members of SHGs/ FPOs/ Cooperatives engaged in food processing activities v. Government officials and other resources person engaged in implementation of PMFME Scheme vi. Resource persons and officials of other Departments collaborating with the implementation of the Scheme, such as, Tribal Development Department, Scheduled Caste Development Department, SRLM, Cooperative Development, etc. at the State level.

Capacity Building Framework

Capacity building Component of PM FME scheme essentially geared towards strengthening entrepreneurial capability of existing micro food processors and upgradation of the skill of the workers working in those units in critical areas like food handling, safety, hygiene and their own safety at plant level. These objectives are sought to be achieved through creation and strengthening of a structure by mobilising existing institutions such as NIFTEM, IIFPT, FICSI, ICAR/ CSIR institutes, training/ extension departments of SAU, RSETI, RUDSETI, State Level Training Institutions and NGO/ VO for imparting training to the intended beneficiaries. The training at the district level to the entrepreneurs will be imparted through transfer of entrepreneurial and technical knowledge from apex level institutions through intermediation of Master Trainers and the Trainers.

Major component of capacity building relevant to the target beneficiaries are EDP training and Product training. PM FME Scheme conceptually based on ODOP theme focused on promoting the perishable produce of which fruits and vegetables form the major segment. Therefore, Master trainers will be trained by the two National Institutes viz. NIFTEM and IIFPT in these two components who in turn will train the Trainers. These Trainers will impart training to the intended beneficiaries at the district level. For products other than those based on fruits and vegetables, the ICAR/ CSIR research institute will meet the training needs of entrepreneurs through Trainers trained by the respective institutions. Ministry of Food Processing at the GOI level and the State Nodal department will enlist support of all the stakeholders in organising the training. Institutions preparing training Modules and participating in other training activities will be financially supported as per the norms prescribed under the guidelines. There will be a system of assessment of the quality of training and learning through third party assessment.

In brief, NIFTEM and IIFPT would finalise syllabus and course content of trainings in consultation with FICSI. A Committee consisting of representatives of NIFTEM, IIFPT, CFTRI, FICSI and other experts in relevant fields would supervise technical aspects of training including approval of syllabus, course content, course material including trainers' manual, reading material and video tutorials. NIFTEM would be responsible for EDP training and IIFPT for food sector training. Training of Master Trainers would take place for EDP at NIFTEM and for fruits & vegetables at IIFPT. As number of trainers for other food sub-sectors in each state would be quite small, Master Trainers would be trained only for EDP and F&V. Master Trainers for EDP and F&V would in turn train Trainers in each State at SLTI. For other food sub-sectors and Minor Forest Produce (MFP), training of Trainers would take place online by National Level Research Institutions identified by IIFPT. Trainers could also be District Resource Persons or other Trainers identified by SNAs.

Training to beneficiaries at the District level for EDP and ODOP for that District would be imparted by the Trainers in the class room. For beneficiaries other than ODOP, EDP training would take place at the District level in the same format while product specific training would take place online by National Level Research Institutions identified by IIFPT. These National Level Research Institutions would conduct training for 7 food

sub-sectors and for Minor Forest Products (MFP) each month for one week. Schedule for this online training would be announced by IIFPT. FICSI would arrange for assessment and certification for various trainees at the conclusion of their training through third parties. The Salient Features of Training under PM FME Scheme are given in the following paragraphs.

The standard Entrepreneurship Development Program as imparted under other MSME schemes will be customized to include heath, hygiene, standards, quality aspect of food processing. Some of the important features of such ED Program (EDP+) are as under:

a. To impart knowledge on identification of business opportunities and preparation of business plan
b. Familiarization on procedure and formalities of setting of an enterprise including Registration
c. Develop skills on management of a unit including their finance, regulatory & statuary requirements
d. Hygiene, FSSAI standards, Weights & Measures Regulation and Registration etc. issues specific to food processing sector.

Product Specific Skilling

a. Profile of products under the group, procurement and quality standards complementary products, by-products and their use
b. Profile of processing technology, overview of machinery, their costing and sourcing
c. Different types of packaging, scientific storage, shelf life and food handling
d. Product quality & safety requirements as per the national & international standards
e. Appreciation of the importance of quality of products in value addition, branding and marketing

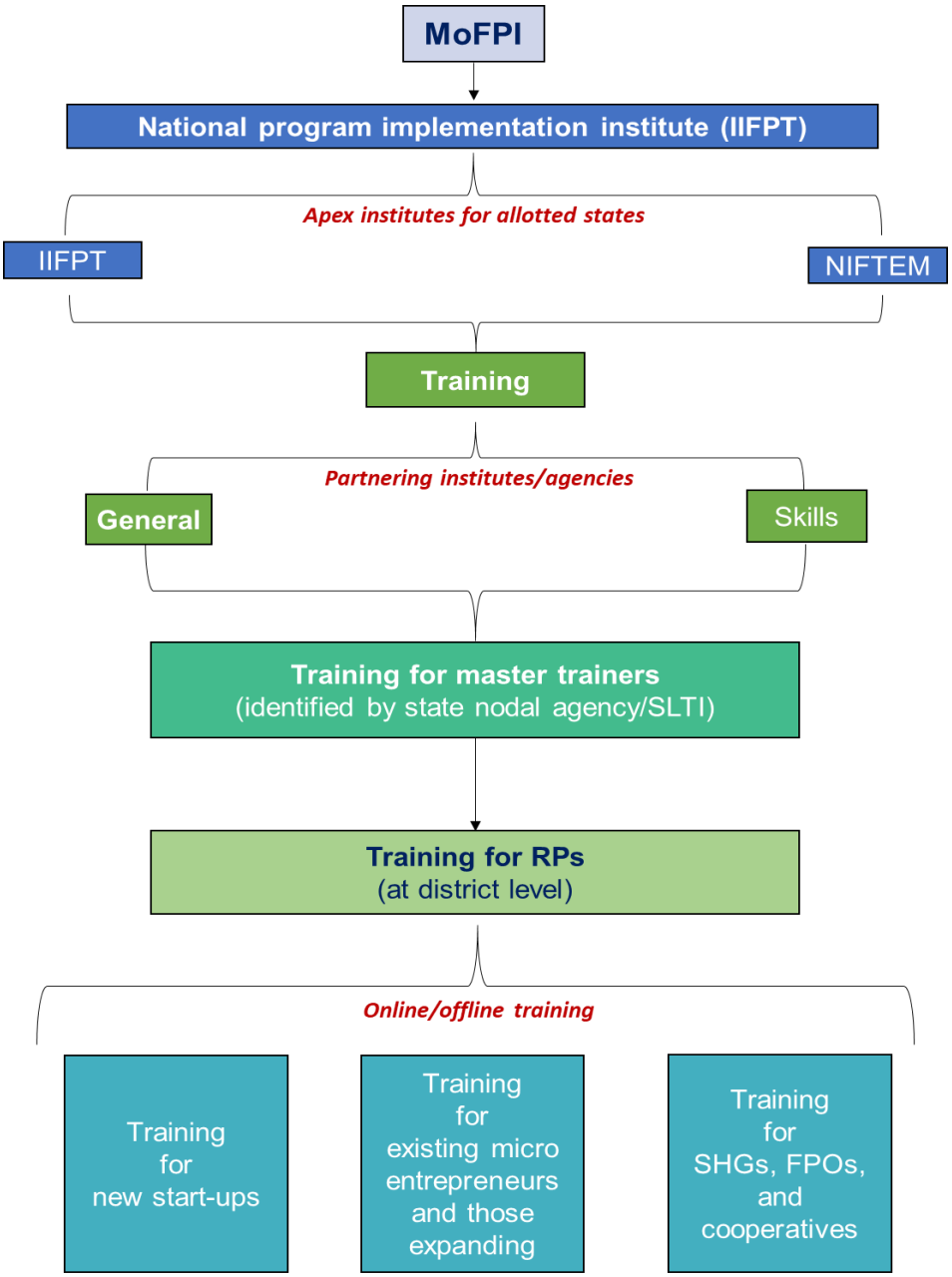
Domain Skills & Platform Skills

Domain Skills refers to the sector-specific skills, technical knowledge, and know-how to perform a specific job accurately. **Platform Skills** refers to presentation behaviors that a trainer uses to transmit content effectively. Trainers must demonstrate excellent platform skills to get their messages across. Both Masters Trainer and DLTs would be trained for two core skills being Domain skills and Platform Skills.

Modes of Delivery

The training would be delivered by following modes

a. Classroom Lecture & Demonstration
b. Live Classes (online)
c. Self-Paced Online Learning Material
d. Training on Machines



1.10 Guidelines & Contact

Detailed guidelines of the scheme may be viewed at Ministry's website *mofpi.nic.in* Individual entrepreneurs and other stake holders may contact the State Nodal Agencies of their respective State / UT regarding the roll out of scheme and contact points at the district level.

References:

Opening gates for growth of Micro Enterprises in Food Industry, PMFME Scheme, Ministry of Food Processing Industries, Govt. of India.

Revised Guidelines for Capacity Building Component under PMFME Scheme, Ministry of Food Processing Industries, Gov. of India.

Chapter 2

Status and Scope of Minor Forest Produce

Er. Doll Chutani, Dr. Pratibha Singh
Indian Institute of Food Processing Technology-Liaison Office, Bathinda (Punjab)

Traditionally Minor Forest Produce (MFP) or Non Timber Forest Products (NTFPs) refer to all biological materials other than timber extracted from natural forests for human and animal use and have both consumptive and exchange value. Globally NTFP / MFP are defined as "forest products consisting of goods of biological origin other than wood, derived from forest, other wood land and trees outside forests". An estimated 100 million people derive their source of livelihood directly from the collection and marketing of MFPs (Report of the National Committee on Forest Rights Act, 2011). According to a World Bank estimate, the MFP economy is fragile but supports close to 275 million people in rural India (quoted in 'Down To Earth' Report, November 1-15 2010) - a significant part of which comprises the tribal population, the most disadvantaged section of society, who live in forest fringe areas. According to an estimate the MFP sector alone is able to create about 10 million workdays annually in the country.

Historically, the MFP sector was neglected for many decades from mainstream forestry, and they were considered as 'minor', despite the fact that monopoly rights over several such NTFPs/MFPs fetched a good income for the Forest Department. After the ban on green felling, the income from MFP in the total income of the Department became the major one with that from timber marginalized, in many states. Export of MFP and its products contributes 68% of the total export from forestry sector.

MFP have a tremendous potential to involve local collectors for establishing micro-, small- and medium enterprises through clear tenured rights, better collection methods, financial support, capacity development, infrastructure and institutional support in near future. With these efforts there is a potential to create large scale employment opportunity thereby, helping in reducing poverty and increasing empowerment of particularly women, tribal and poor people of the poorest and backward districts of the country.

2.1 Importance of Minor Forest Produces (MFPs)

MFPs provide essential nutrition to people living in forested areas, and are used for household purposes, thus forming an important part of their non-cash income. For many tribal communities who practice agriculture, MFPs are also a source of cash income, especially during slack seasons. The economic dependence of tribal communities on MFPs can be understood from the following Table.

Table 2.1. Economically Important MFPs

Seasons	MFPs collected	Economy
January- March	Lac (resin), mahuwa, flower and tamarind	Over 75 per cent of tribal households in Orissa, Madhya Pradesh and Andhra Pradesh collect mahuwa flower and earn Rs.5000 a year. 3 million people are involved in lac production
April-June	Tendu leaves, sal seeds and chironji	30 million forest dwellers depend on seeds, leaves and resins from sal trees; tendu leaf collection provides about 90 days of employment to 7.5 million people, a further 3 million people are employed in bidi processing

July-September	Chironji, mango, mahuwa fruits, silk cocoons and bamboo	10 million people depend on bamboo for livelihood; 1,26,000 households are involved in tussar silk cultivation only
October-November	Lac, kullu gum, resins used in incense sticks	3 lakh person days of employment from collection of gums.

Source: Trifed

MFPs are especially important for the poorest households living in forested areas, especially women. A research study (The Livelihood School, BASIX, 2010) shows that in Chhattisgarh, the involvement of women in the MFP economy is very high, tribal households depend on the MFP economy more than non-tribal households and poorer households more than comparatively better-off ones. The MFP economy is a critical one for the most vulnerable sections of society. Further, a list of the important MFPs, in terms of their collection potential besides importance for livelihood:

Table 2.2. A list of the important MFPs, in terms of their collection potential besides importance for livelihood

S.No.	Commodity	Estimated Production Potential		Estimated Collection Potential	
		Qty in Lakh MTs	Value in Rs Crores	Qty in Lakh MTs	Value in Rs Crores
1.	Tamarind	2.00	240.00	2.00	240.00
2.	Mahuwa Flower	1.50	122.00	1.00	81.00
3.	Mahuwa Seed	1.00	110.00	0.50	55.00
4.	Sal Seed	1.60	160.00	1.00	100.00
5.	Tendu	80 (In standard bags)	1040.00	40 (In standard bags)	520.00
6.	Bamboo	48.00	12.00	12.00	300.00
7.	Karanjaaa Seed	0.40	40.00	0.25	25.00
8.	Myrobalan	1.30	78.00	0.75	45.00
9.	Chironjee	0.10	230.00	0.05	110.00
10.	Lac (Stick Lac)	0.25	150.00	0.20	120.00
11.	Gum Karaya	0.05	62.00	0.03	37.00
12.	Wild Honey	0.30	270.00	0.25	230.00
13.	Puwad Seed	0.50	50.00	0.20	20.00
14.	Neem Seed	0.25	25.00	0.25	25.00
			3777.00		**1908.00**

Source: Trifed

Status and scope of this natural resource is described in following manner:

- It is one of India's largest unorganized sectors having a dependent population of about 275 million, and with a business turnover of more than Rs.6000 crores per annum, the NTFP sector has however and unfortunately been neglected since the pre-independence period.
- Although MFP accounts for about 68% of the export in the forestry sector, conventional approaches of forest management focused largely on timber with but secondary attention to MFP development, and Working Plans remained confined at best to elaborate prescriptions for bamboo along with few tit bits on other MFP.
- NTFP contributes to about 20% to 40% of the annual income of forest dwellers who are mostly disadvantageous and landless communities with a dominant population of tribals.
- It provides them critical subsistence during the lean seasons, particularly for primitive tribal groups such as hunter gatherers, and the landless.
- Most of the MFPs are collected and used/sold by women, so it has a strong linkage to women's financial empowerment in the forest-fringe areas.
- MFPs have a tremendous potential to create large scale employment opportunity thereby helping in reducing poverty and increasing empowerment of particularly tribal and poor people of the poorest and backward districts of the country.
- Fortunately, for natural reasons, India still remains no.1 in case of few items like lac because it is only here that the best quality lac is produced that too in substantial quantities.
- According to a study the Indian share of global medicinal plants trade is increasing at an annual growth rate of 23%, and India stood 3rd among the biggest exporters of medicinal plants after China and Canada respectively.
- Herbal raw materials from MFP source contribute to 90% of the supply for the industry, which are practically sourced from natural forests. Of the 7000 plants used in Indian System of Medicine, 960 have been recorded in trade and 178 are traded in high volumes in quantities exceeding 100 MT per year.

2.2 Estimates of selected Non-Timber Forest Products

The utilization of NTFP by local communities for various purposes has also not been properly studied and documented. The availability of data on NTFP is only of how much is harvested or collected. Though there are more than 800 types of NTFPs harvested in India but annual harvest data of only a few are available to be compiled at the national level and presented in this report (Table 2.3). Data on NTFP is difficult to obtain as not all the NTFPs are nationalized and are collected by tribal and dwellers of forest fringes villages, who do not keep records of collections. Further, most of the times the states also report the revenue earned through sale/collection of NTFPs in royalty figures which is much less than the market value. This underestimates the total value of NTFPs, and consequently, their role in providing livelihood to the poor masses.

Crude resin is a thick, sticky fluid material obtained by tapping living pine tree. Resin is the source for producing rosin and turpentine which have wide utility in making soap, paper, paint, varnish, pharmaceuticals etc. A small quantity of resin is also produced from Pinus wallichiana which grows at higher elevations in these states. The production of the resin harvested in India during 2009-10 was about 28,000 tons having market value Rs 108 crore.

The total production of tendu leaf varies between 3.3 lakh tons to 4.5 lakh tons per years with a market value of about Rs 1,000 crores per annum. The three States producing the bulk of the tendu leaf are Chhattisgarh, Madhya Pradesh and Odisha.

Bamboo is a versatile natural resource and extensively used in cottage industry for making lots of household products besides use in house construction. It has been an important source of income for millions of rural Indian for sustaining their livelihoods. The major quantity of bamboos is utilized as raw material by paper and pulp industries, for housing, rural and agricultural applications, and in packing industry, etc. Besides forests it

also grows in private lands in the homesteads. The total bamboo growing stock of green bamboo is about 169 million tonnes. About 28 percent of the total bamboo area with 66 percent (approx.) of growing stock is located in north-east India represented by 58 species belonging to 10 genera. The other areas rich in bamboos include the States of MP, Chhattisgarh, Maharashtra, Odisha, Andhra Pradesh, Karnataka, and the Union Territory of Andaman and Nicobar Islands.

Harvesting of bamboo is done on a 3-4 years felling cycle. A lot of bamboo is given to the local people / tribals under NISTAR rights either free or on nominal royalty cost to meet their domestic/ livelihood needs. Generally commercial bamboo meant for construction/ cottage industry is disposed in numbers whereas industrial bamboo (for paper mills) in tonnes.

It may be recalled that estimates of output for forestry and logging sub-sector depends on the latest data available in the ISFR. Between ISFR 2015 and ISFR 2017, growth has been observed in growing stock of the trees. The percentage share of value of output from NTFPs to total value of output of forestry sector is 16% in 2017-18 as compared to 18% in the year 2011-12.

Table 2.3. Output of NTFPs at constant (2011-12) prices

Year	Value (₹ '000 crore)
2011-12	26.4
2012-13	26.7
2013-14	27.1
2014-15	26.5
2015-16	26.9
2016-17	27.8
2017-18	29.6

Source: Ministry of Statistics and Programme Implementation Government of India

It can be concluded that minor forest produce is the proverbial manna from the heaven for the poorest of the poor or the most vulnerable groups of India e.g. the tribals, the landless labourers & the women folks among the forest dependent communities. Ayurveda, the world's oldest healthcare system & India's heritage completely depends upon forests as almost 85% of the raw herbs used in this system of medicine are sourced from this resource.

2.3 Types of Minor Forest Produce

Table 2.4. Types of minor forest produce under different categories

Edible products	Fruits, flowers, seeds, roots, roots, rhizomes, tubers, etc. of several forest species are edible. Fruits and seeds of *Anacardium occidentale, Tamarindus indica, Syzygium cumini, Emblica officinalis, Buchanania lanzan,* etc., flowers of *Madhuca indica,* green pods of *Moringa oleifera,* new shoots of bamboo, etc. are in great demand.
Grasses and grazing	Forests provide grazing facility to about 30 per cent of the total livestock population of the country. Grasses such as *Cenchrus, Lasiurus, Heteropogon, Bothriochloa, Andropogon, Eragrostis, Iseilema,* etc. are abundantly found in the forest as a ground cover. Some grasses like *Eulaliopsis binata* are also used for rope and papermaking.
Fodder trees and shrubs	Forests provide fodder from trees, shrubs and climbers. Leaf fodder of several tree species is almost as nutritious as that of agricultural fodder crops. Good fodder

	yielding tree species includes: *Ailanthus excelsa Moringa oleifera, Sesbania spp., Morus alba, Albizia lebbek, Leucaena leucocephala, Pongamia pinnata, Hardwickia binata, Quercus, Grewia, Bauhinia, Celtis*, etc. Several shrubs, herbs and climbers also yield good quality fodder leaves.
Bamboo and canes	India is very rich in bamboo resources. The bamboo is used for housing, for rural agricultural works, for paper pulp, for packaging and other uses.
Oil seeds	Many tree species produce oil-bearing seeds, which are commercially important. Some of these oils are fit for human consumption. Generally, these seeds are used in soap industry. Tribals use these oils for various purposes.
Essential oils	Essential oils are a good source of forest revenue. Many species in the Indian forest yield essential oils, which are used in making perfumes, soaps, cosmetics, etc.
Tans and dyes	A variety of vegetable tanning material are produced in the forest. Important ones include the myrobalan nuts and bark of wattle *(Acacia mearnsii, A. decurrens, A. nilotica and Cassia auriculata*, etc.) Other tanning materials include, leaves of *Emblica officinalis* and *Anogeissus latifolia*, bark of *Cleistanthus collinus*, fruits of *Ziziphus xylopyra*, bark of *Cassia fistula, Terminalia alata, T. arjuna*, etc.
Gums and resins	Gums and resins are exuded by trees as a result of incision or injury to the bark of wood. Gums are collected from several tree species. Resins find wide use in industries and in Indian pharmacy.
Fibres and flosses	A wide range of plants, yielding fibre occur in the forests of India. Fibres are obtained from tissues of different parts of certain woody plants, which are used for making cloth, rope and cordage.
Flavouring plants	A variety of plants including cumin (seeds of Carum carvi), cinnamon (bark of *Cinnamomum zeylanicum*), cardamom (dried capsule of *Elettaria cardamomum*), bay leaf (leaves of *Cinamomum tamala*), are obtained from forests used locally and throughout the world.
Animal products	Animal products include Lac, honey, silk, horns, fur, skins, tusks, musk, bones, fur and feathers, meat etc. Lac is a resinous secretion of the Lac insects, which feed on forest trees, particularly on Butea monosperma. Similarly, silk worm is reared on *Terminalia alata* and *Morus alba* plantations. Honey is another important product obtained from forests.
Leaves	Leaves of various forest tree species have been used for various purposes since ancient times and help earn forest revenue. Leaves of several trees and shrubs are widely used as food, fodder, medicine, etc. Other than these, leaves of some trees and shrubs are put to the following uses: • Making plates and cups; • Thatching; • Basket making; • Umbrella making; • 'Bidi' leaves for smoking.
Tendu and other leaves	Tendu leaves (*Diospyros melanoxylon*) are used to prepare 'Bidis' and therefore, these are also called 'bidi' leaves. Leaves of trees such as *Bauhinia* spp., *Shorea robusta, Pterospermum acerifolium*, etc. are used for making plates, 'dona', etc.

Source: Forest Research Institute, Dehradun

2.4 Areca Nut

Arecanut, botanically known as Areca catechu, is a tropical plant found all over South East Asia. This tree belongs to the palm tree species and is from the Arecaceae family. The fruit (nut) of this tree is popularly known as the betel nut or supari in India. This is an important commercial crop of the region and also forms part of ritual offerings in Hindu religion. Areca is taken up from the Malayan language which means 'cluster of nuts'.

Globally it is primarily grown in India, Bangladesh, China, Indonesia and Myanmar. India leads the production followed by China and Bangladesh. In India it is grown in Karnataka, Kerala, Assam, Maharashtra, West Bengal and parts of Tripura.

Status of Production of Areca Nut in India (2017-18)

In India, Karnataka is the leading producer of areca nut, followed by Kerala, Assam, Meghalaya, and West Bengal along with other southern and north-eastern parts of India.

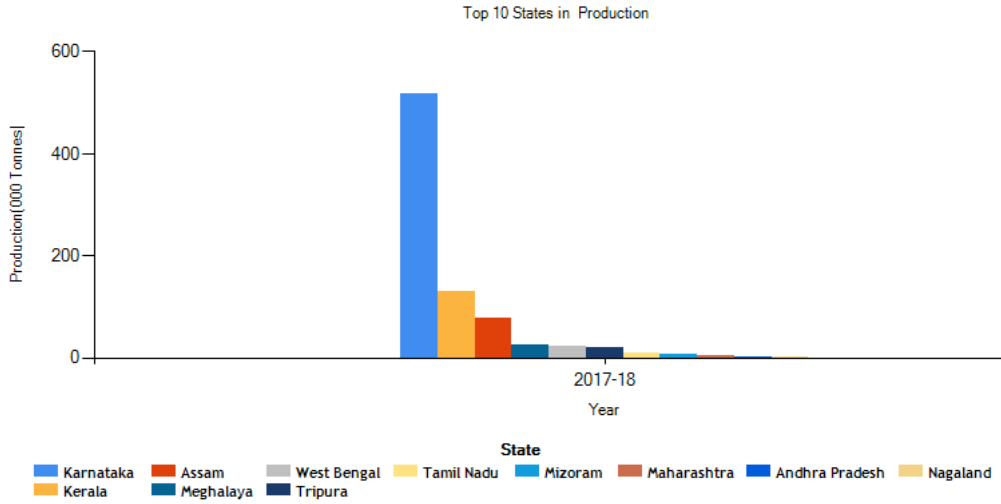


Fig.1 State-wise Production of Areca Nut in India (2017-18)

India is the highest producer of arecanut in the world with a production of around 3.3 lakh tonnes and a total acreage under cultivation of 2.64 lakh hectares, with Karnataka and Kerala accounting for nearly 72 per cent of the total production.

Table 2.5. Details of production of Areca Nut in India (top 11 states) for 2017-18

Sr. No.	State	Production (000 tonnes)	Share (%)
1	Karnataka	517.35	63.16
2	Kerala	130.10	15.88
3	Assam	77.90	9.51
4	Meghalaya	24.99	3.05
5	West Bengal	22.85	2.79
6	Tripura	20.41	2.49
7	Tamil Nadu	10.14	1.24
8	Mizoram	7.27	0.89
9	Maharashtra	3.41	0.42
10	Andhra Pradesh	2.37	0.29
11	Nagaland	2.30	0.28

Source: National Horticulture Board (NHB)

Over six million people are engaged in arecanut cultivation, processing and trade. More than 85 per cent of the area under cultivation is made up of small and marginal holdings.

Among the two varieties white nuts have a share of 60 per cent. India is also the largest consumer with around 3.2 lakh tonnes.

The following factors influence the areca nut market:

- Weather conditions
- Government policies over the pricing of betel nut
- Carryover stocks
- Growth of the consumer industries
- Government policies over the consumer industries

Multi-State cooperative such as CAMPCO (Central Arecanut and Cocoa Marketing and Processing Co-operative), a joint venture of the States of Karnataka and Kerala, has been established in 1973 for procurement of areca nut.

2.5 Honey

Honey and beekeeping have a long history in India. Honey was the first sweet food tasted by the ancient Indian inhabiting rock shelters and forests. The raw materials for the beekeeping industry are mainly pollen and nectar that come from flowering plants. Both the natural and cultivated vegetation in India constitute an immense potential for development of beekeeping. About 500 flowering plant species, both wild and cultivated, are useful as major or minor sources of nectar and pollen. There are at least four species of true honey bees and three species of the stingless bees. Several sub-species and races of these are known to exist. In recent years the exotic honey bee has been introduced. Together these represent a wide variety of bee fauna that can be utilized for the development of honey industry in the country. There are several types of indigenous and traditional hives including logs, clay pots, wall niches, baskets and boxes of different sizes and shapes.

Varieties: Rapeseed / Mustard Honey, Eucalyptus Honey, Lychee Honey, Sunflower Honey, Karanj / Pongamea Honey, Multi-flora Himalayan Honey, Acacia Honey, Wild Flora Honey, Multi and Mono floral. Honey are some of the major varieties of Natural Honey.

Areas of Production: North East Region of India and Maharashtra are the key areas for natural honey production.

The country has exported 59,536.75 MT of Natural Honey to the world for the worth of Rs. 633.82 Crore/ 88.65 USD Millions during the year of 2019-20.

Table 2.6. Year-wise details of Honey Production for the period 2012-13 to 2017-18

S.No.	Year	Production in thousand MTs
1	2012-13	72.30
2	2013-14	76.15
3	2014-15	80.53
4	2015-16	88.90
5	2016-17	94.50
6	2017-18	105.00 (estimates)

Source: National Bee Board

Punjab is the leading state in beekeeping in the country, with about 35,000 beekeepers producing about 15,000 metric tonnes of honey. This accounts for more than 39 per cent of the country's apiary honey production. The honey market in India was worth Rs. 15,579 Million in 2018, registering a Compound Annual Growth Rate (CAGR) of 10.9% during 2012-2018.

2.6 Tamarind

Tamarind or imli is a well-known commodity of Indian cuisine, and has medicinal and industrial uses. The fruit of the tamarind tree or 'Assam tree' is known as 'imli' or 'Indian date'. The sticky acidic pulp of tamarind fruit has been used as a food ingredient and medicine for many years. The edible fruits, and especially the pulp, can be eaten raw or used as sherbet or as an ingredient in curries, pickles, etc.

India is the world's largest producer of tamarind products. Tamarind is abundantly available in the Indian states of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Orissa and Kerala. Figures available for the production of tamarind in India for the years 2007-8 and 2008-9 indicated yields of 188 278 tonnes and 193 873 tonnes from 55 682 ha and 54 222 ha, respectively (Spice Board, 2011a). India exports processed tamarind pulp to western countries, mainly the European and Arab countries and, more recently, the USA. During the year 2009–10 India exported 12200 tonnes of different tamarind products valued at Rs 4705.50, lakhs (Spice Buded, 2011b).

In India, practically all parts of the tamarind tree are used for various purposes (Fig. 3). Earlier, in South India the natives used the pulp as a constant ingredient in all their curries and sherbet. At present, the pulp of ripe fruits is widely used mostly for culinary purposes in a number of preparations like sambar, rasam, curries, and chutneys.

The leaves are also cooked as vegetable or mixed in curry to make it sour. In South India the nectar obtained from tamarind flowers is rated very high; it is golden yellow and slightly acidic in fl avor. Flowers are sour and sweet, tasty, appetizing and are cooked as vegetable. The flowers are also used to prepare chutney.

Tamarind based products

Tamarind Pulp

Tamarind is used in India mainly in the form of pulp. The fruit pulp is the chief agent for souring curries, sauces, chutneys and certain beverages throughout the greater part of India. Tamarind fruit is also reported to be used as a raw material for the preparation of wine-like beverages (Giridhari et al., 1958; Sanchez, 1985; Latino and Vega, 1986; Benk, 1987; Grollier et al., 1998).

Tamarind Toffees

The pulp after removing the fibers, is mixed with sugar, wrapped in paper and sold as toffees. The pulp is also used to make sweetmeats mixed with sugar called "tamarind balls".

Tamarind Juice Concentrate

Tamarind juice concentrate is a convenient product, prepared by extracting cleaned pulp with boiling water. It is very rich in tartaric acid (13%) and invert sugars (50%)

Tamarind Pulp Powder

Tamarind Pulp Powder (TPP) is one of the convenience food product prepared by concentrating, drying and milling the pulp into a powder form.

Tamarind Pickle

The pickles are commonly used in Asia as an accompaniment to curries or other main meals. pickles are hot, spicy, and of salty-sour taste and can be preserved for several months. Tamarind pickle is available in the urban markets of Bangladesh, India and Sri Lanka and is rated as a popular product of tamarind.

Tamarind Jam

Tamarind pulp is boiled with an equal amount of sugar and it turns out as Jam. A syrup can also be made.

Similarly, other products can be Tamarind Candy, Champoy, Sous (a drink of Jordan) and Ade along with utizing by-products into Kernal Powder, Tamarind Seeds and leaves.

2.7 Mushrooms

Mushrooms are considered as a potential substitute of muscle protein on account of their high digestibility. In addition to protein, mushroom is an excellent source of Vitamin-D which is not available in other food supplements. Mushrooms are low in calories, fat free, cholesterol free, gluten free and very low in sodium. Minerals such as potassium, iron, copper, zinc and manganese are high in fruit bodies. Specific bioactive compounds in mushrooms are responsible for improving human health in many ways. These bioactive compounds include lentinan in shiitake, lovastatin in oyster, lectins in white button mushrooms, ganoderic acid β-glucans in reishi mushrooms, acidic polysaccharides in wood ear mushrooms, ergothionine in winter mushroom, cordycepin in Cordyceps and many more. All these compounds have immunomodulating properties and promote the immune function of the human body against the cancer risk and tumor growth.

Status of mushroom production in India

Mushroom industry in India is overwhelmingly focused on white button mushroom which is a highly sophisticated and capital-intensive activity. There are two main types of mushroom growers in India, those who are growing white button mushroom round the year under controlled conditions and seasonal growers who are growing button mushrooms during the winter seasons in north western part of India. The total white button mushroom produced in India from both seasonal and high tech cultivation units is estimated at 94676 metric tons. Out of this, approximately 8500 metric tons of button mushroom was produced from the seasonal growing units located in Haryana and Punjab which accounted for 9% of total button mushroom production. By effectively utilizing the seasonal variations, the farmers of Punjab and Haryana region have revolutionized the seasonal cultivation process with very less inputs.

Table 2.7. Mushroom production in India during 2016

(Production in metric tonnes)

States	Button mushroom	Oyster mushroom	Milky mushroom	Other mushrooms	Total
Andhra Pradesh	3000	500	15	0	3515
Arunachal Pradesh	20	5	0	1	26
Assam	20	100	5	0	125
Bihar	950	1500	150	0	2600
Chhattisgarh	20	200	35	89	344
Delhi	3000	50	20	0	3070
Goa	4200	20	0	0	4220
Gujarat	10000	1200	0	0	11200
Haryana	15000	50	50	0	15100
Himachal Pradesh	9000	110	30	10	9150
Jammu and Kashmir	565	15	50	0	630
Jharkhand	200	20	0	0	220
Karnataka	700	320	160	0	1180
Kerala	0	500	300	0	800

States	Button mushroom	Oyster mushroom	Milky mushroom	Other mushrooms	Total
Maharashtra	10000	2000	50	0	12050
Madhya Pradesh	10	5	0	0	15
Manipur	0	10	0	50	60
Meghalaya	25	2	0	0	27
Mizoram	0	50	0	0	50
Nagaland	0	75	0	250	325
Odisha	126	6310	0	9550	15986
Punjab	16000	2000	0	0	18000
Rajasthan	100	1000	0	200	1300
Sikkim	1	2	0	0	3
Tamil Nadu	6500	2000	1500	0	10000
Tripura	0	100	0	0	100
Uttarakhand	8189	1228	819	0	10236
Uttar Pradesh	7000	100	0	0	7100
West Bengal	50	1500	0	500	2050
Andaman & Nicobar	0	300	0	0	300
Total	**94676**	**21272**	**3184**	**10650**	**129782**

Source: ICAR-DMR, Solan official data

At present, highest production of button mushroom is registered from the Punjab followed by Haryana and Maharashtra (Fig. 2). These three states producing 43% of total white button mushroom produced in India. Some of the big mushroom units viz., M/s Agro Dutch Industries Ltd., (6000 tons per annum) M/s Tirupathi Balaji Agro Products Pvt Ltd.,(4000 TPA) M/s Flex Foods Pvt. Ltd., (2600 TPA) M/s Weikfield Foods Pvt. Ltd., M/s. Himalaya International Ltd., located in these regions and contributing immensely to the white button mushroom production. Seasonal cultivation became more popular in Haryana and Punjab region producing more than 8000-8500 tons of white button mushrooms per year. Many medium to small scale units are located in the states of Himachal Pradesh, Gujarat, Tamil Nadu, Uttarakhand, Uttar Pradesh and Goa.

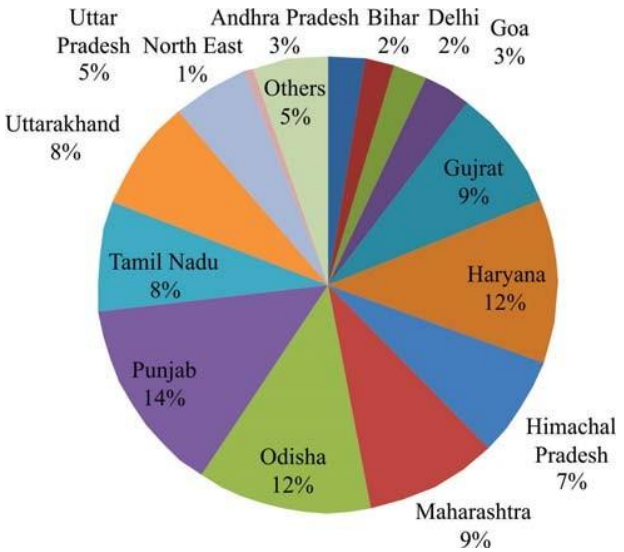


Fig. 2. Major mushroom producing state of India, 2016

References

Agricultural & Processed Food Products Export Development Authority.

Srivastava P. K., 2019. Bee Keeping And Honey Processing. MSME - Development Institute, Ministry of Micro, Small & Medium Enterprises, Government of India

ENVIS RP on Forestry and Forest Related Livelihoods, Forest Research Institute, Dehradun.

M.P. State Minor Forest Produce (Trading & Development) Co-op. Federation Ltd.

National Bee Board, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare , Gov of India.

National Horticulture Board

Odisha Forest Development Corporation

Production of wood and non-wood forest products, Section-III. Forestry Statistics India-2011.

Saboo S. 2018. Value Addition to Minor Forest Produce: Gateway to Economic Empowerment of Jharkhand Tribals. Indian Journal of Public Administration, Vol. 65(1).

Shah N.C.2014. Tamarindus indica – Introduction in India and Culinary, Medicinal, and Industrial Uses. Asian Agri-History, Vol. 18(4):343–355.

Sharma V.P., Annepu S.K, Gautam Y., Singh M., and Kamal S. 2017. Status of mushroom production in India. Mushroom Research, 26 (2):111-120.

Singh D., Wangchu L., and Moond S.K. 2007. Processed Products of Tamarind. National Product Radiance, Vol. 6(4):315-321.

TRIFED, Ministry of Tribal Affairs, Government of India

Chapter 3

Collection & Trading of Minor Forest Produce

Ms. Lovepreet Kaur, Dr. Pratibha Singh
Indian Institute of Food Processing Technology-Liaison Office, Bathinda(Punjab)

Significance of Minor Forest Produce in Tribal Economy

An important source of livelihood for tribal people is non-wood forest products, generally termed Minor Forest Produce (MFP). These includes all non-timber forest produce of plant origin and include bamboo, canes, fodder, leaves, gums, waxes, dyes, resins and many forms of food including nuts, wild fruits, honey, lac, and tussar.

The Minor Forest Produces provide both subsistence and cash income for people who live in or near forests. They form a major portion of their food, fruits, medicines and other consumption items and also provide cash income through sales. According to the Report of the National Committee on Forest Rights Act, 2011, an estimated 100 Million people derive their source of livelihood from the collection and marketing of Minor Forest Produce. They depend on this source for food, shelter, medicines and cash income. Approximately 20-40% of their annual income is derived from Minor Forest Produce.

3.1 Sustainable Cultivation of MFPs

Some of the MFPs have been overharvested and require revival. Some species are harvested without following sustainable harvesting techniques. There is a need to develop appropriate cultivation and harvesting techniques for those species. The appropriate techniques for the 12 selected MFPs are as follows:

Table 3.1. Cultivation and Harvesting Techniques of some MFPs

S.No.	MFP	Cultivation Technique
1	Chironjee (Buchanania lanzan) pods	Chironjee plants have a long gestation period of about 15–20 years. The seeds can be sown on raised beds or in polythene bags during the months of June–July and they germinate in about a month. The seedlings become ready for grafting after about a year from the date of sowing. Vegetative propagation through soft-wood grafting and chip budding is successful.
2	Bamboo (Bambusa bambos and Dendrocalamus strictus)	Bamboo is best raised through seeds, though vegetative propagation is also undertaken. Seedlings are raised in nursery beds and allowed to develop for a year before they are transplanted in the fields. Propagation is through rhizomes or Culm cuttings. In rhizome planting, one-year-old culms with roots are dug up, cut to about a meter high, and planted during rainy season.
3	Karanj (Pongamia pinnata) seeds	The direct sowing of karanj seeds is usually successful. The seedlings transplant easily from the nursery after about a year. Root suckers are plentiful as well. It is a rapid-growing coppice species that can be cloned.
4	Lac (Kusumi and Rangeeni)	Lac culture is the cultivation of lac insects for the production of lac. Kusum (Schleichera oleosa), Palash (Butea monosperma) and Ber (Zizyphus mauritiana) are common host plants for lac cultivation in India.

		Kusum seeds are sown directly, whereas those of other hosts, such as Palash and Ber are sown in nurseries, wherein the seedlings get duly transplanted. Lac is usually cultivated in natural conditions, although orchards or plantation conditions are more preferable for a better yield. Proper tendering and pruning of the host tree at the right time of the year is required for the feeding of the lac insect. The brood lac sticks are tied to the host twigs for allowing young lac larvae to emerge and settle on the host plant in a process called inoculation. The brood lac is scrapped from the twigs within 2–3 weeks' time.
5	Harra (Terminalia chebula)	The tree mainly propagates through the process of natural regeneration. It can be successfully raised in fields by directly sowing the seeds, transplanting the seedlings, and planting roots and short cuttings. The pre-treatment of seeds results in faster growth.
6	Sal (Shorea robusta)	Requires better management of the resource through natural regeneration.
7	Tamarind (Tamarindus indica) seeded	Tamarind is propagated through seeds or grafts. Fresh seeds are sown in nursery beds in March– April. Two-year-old seedlings are transplanted to the main fields. Seedlings tree in about 15–20 years. In order to obtain true-to-type plants with reduced pre-bearing age, uniform growth, and yield vegetative methods, such as budding and grafting can be used in establishing tamarind orchards.
8	Tendu (Diospyros melanoxylon)	Requires better management of the resource through natural regeneration.
9	Gum karaya (Sterculia urens)	Tapping of gum from gum-yielding trees is done by blazing and stripping off the tree bark. Gum flow starts after approximately 20 days. Tapping can be carried out throughout the year, but more so during hot weather. Incisions should be made carefully without injuring the inner tissue. Gum is usually collected in a polythene bag, or a polythene-lined basket, and dried.
10	Mahua (Madhuca longifolia) seeds	Seeding and grafting can be used for cultivation. Seeds can be sown on raised beds or polythene bags during July. They germinate in 10–15 days, after which the transplantation can be done in about a year. Grafts become ready for plantation after 2 months of grafting.
11	Wild honey	Non-violent techniques of honey harvesting from beehives need to be followed.

Source: The Energy and Resources Institute, 2018

3.1.1 Cultivation and harvesting techniques of approved ODOP MFPs:

1) **Areca nut**: The areca nut palm is the source of common chewing nut, popularly known as betel nut or Supari. In India it is extensively used by large sections of people and is very much linked with religious practices. India is the largest producer of areca nut and at the same time largest consumer also. Major states cultivating this crop are Karnataka (40%), Kerala (25%), Assam (20%), Tamil Nadu, Meghalaya and West Bengal.

Fig. 1. Arecanut- Plant and Bunch ready for Harvesting

a. **Varieties**: Mangala, Sumangala, Subamangala, Mohitnagar, Srimangala, Samruthi (Andaman), Hirehalli dwarf, VTLAH 1, 2 and Thirthahalli dwarf.

b. **Climate**: The cultivation of arecanut is mostly confined to 28º north and south of the equator. It grows well within the temperature range of 14ºC and 36ºC and is adversely affected by temperatures below 10ºC and above 40ºC. Extremes of temperature and wide diurnal variations are not conducive for the healthy growth of the palms. Arecanut can be grown in areas receiving annual rainfall of 750 mm in Maidan parts of Karnataka to 4,500 mm in Malnad areas of Karnataka. In areas where there is prolonged dry spell, the palms are irrigated. Due to its susceptibility to low temperature, a good crop of arecanut cannot be obtained at an altitude of more than 1000 m MSL.

c. **Soil**: The largest area under the crop is found in gravelly laterite soils of red clay type. It can also be grown on fertile clay loam soils. Sticky clay, sandy, alluvial, brackish and calcareous soils are not suitable for arecanut cultivation.

d. **Season**: June – December is found to be the optimum.

e. **Seeds and Sowing**: For raising seedlings seed nuts from pre-marked and pre-potent mother palms of outstanding performance are selected and sown at a spacing of 5 - 6 cm apart in sand beds under partial shade with their stalk end pointing upwards. After the sprouts have produced two to three leaves, they are transplanted to a polythene bag 30 x 10 cm filled with forest soil and are allowed to grow for 12 to 18 months under partial shade. The seedlings can also be transplanted in secondary nursery beds with a spacing of 30 cm on either side. Periodical watering should be given.

f. **Planting**: Dwarf and compact seedlings with more number of leaves should be selected. Seedlings of 1 - 2 years age are planted in pits of about 90 cm x 90 cm x 90 cm at a spacing of 2.75 m either way and covered with soil to the collar level and pressed around. Provide shade during summer months. Growing Banana or other crops in advance may also provide shade.

g. **Irrigation:** Irrigate weekly once during November – February, once in 4 days during March – May. Flood irrigation 175 lit/ tree/ day. In drip irrigation 16 – 20 lit/ tree/ day.

h. **Manuring:** Apply to each bearing palm (5 years and above) 10 - 15 kg of FYM or green leaf. 100:40:140 g of NPK/ tree/ year. To palms less than five years old, half of the above dose is recommended. Manures are applied during January - February after the North - East monsoon in a basin of 0.75-1.00 m radius around the tree to a depth of 20 - 30 cm.

i. **Harvest**: The bearing starts after 5 years of planting. Nuts are harvested when they are three quarters ripe. The number of harvests will vary from three to five in one year depending upon the season and place of cultivation.

j. **Yield**: An average of about 1250 kg/ha can be obtained.

2) **Tamarind:** Tamarind (*Tamarindus indica*) is a leguminous tree (family Fabaceae) bearing edible fruit that is indigenous to tropical Africa and because of its multiple uses, tamarind is cultivated around the world in tropical and subtropical zones. It is now approved as a minor forest produce. The tamarind tree produces brown, pod-like fruits that contain a sweet, tangy pulp, which is used in cuisines around the world. The pulp is also used in traditional medicine and as a metal polish. The tree's wood can be used for woodworking and tamarind seed oil can be extracted from the seeds. Tamarind's tender young leaves are used in Indian cuisine.

Fig. 2. Tamarind Pod **Tamarind Pod + Pulp**

a. **Varieties:** PKM 1, Urigam, Hasanur,Tumkur Prathisthan, DTS 1, Yogeshwari.

b. **Soil and climate**: Grown on variety of soils ranging from poor degraded, eroded, gravelly, saline and alkaline soils. Productivity is higher in red loamy, deep well drained soils. The absolute maximum temperature varies from 36-47.50 C and the absolute minimum temperature varies from 0-17.50 C. Rainfall requirement – 750-1900 mm. Altitude – up to 100 m above MSL.

c. **Season**: June – December is found to be optimum.

d. **Propagation**: Seeds / Grafts are used for propagation.

e. **Nursery:** Fresh seeds are sown in nursery beds in March – April. Soaking of seeds in 10 per cent cow urine or in cow dung solution (500 g in 10 l of water) for 24 hours. Two year old seedlings are transplanted to the main field.

f. **Spacing**: 8-10m x 8-10m is adopted.

g. **Planting**: The grafts should be planted in the pits of 1 m x 1 m x 1 m filled with FYM and top soil. Add 50 g of Methyl parathion 1.3% dust in the pit. Immediately after planting, support the graft with stakes.

h. **Irrigation**: Regular watering should be given once in seven days.

i. **Fertilizers**: Apply 200:150:250 g of NPK per tree per year along with 25 kg of FYM and 2 kg of Neem cake.

j. **Harvest**: Plants starts bearing from 4th year onwards and the economic yield will be achieved from 9th year onwards. Pods are harvested in March - April every year.

k. **Yield**: Tamarind yields about 150 - 200 kg of fruits/tree/year.

3) **Mushrooms:** A mushroom is described as the "fruiting body of a fungus plant that typically appears above the ground and contains spores". It is this fleshy bracket (fruiting body) that is commonly eaten and which reproduces by dispersing spores in the same way that other plants disperse seeds. Instead of drawing nutrients through the roots, fungi are sustained by a network of fine, microscopic threads known collectively as the "mycelium". This network can extend over vast distances, implanting into rotting wood, soil, or other preferred medium.

Fungi are more akin to molds and yeasts than to vegetable plants. Although mushrooms are technically part of the plant kingdom, they are very different organisms since they do not contain chlorophyll or have a root system. Mushrooms must also rely on organic material for their nutrition and do so in three ways:

- ❖ As Saprophytes (living on dead wood or dead tissue of living trees or dung)
- ❖ As Parasites (attacking living plant or animal tissue), or
- ❖ As Mycorrhizae (having a symbiotic relationship with plants).

a. **Cultivation of Shiitake Mushroom:** Shiitake mushrooms (Lentinula edodes) are grown on healthy hardwood logs of many species. Logs must be soaked or already moist, from 3-5 inches in diameter and around 3 1/2 feet long. Many holes are drilled for inoculum along the length of the log at a predetermined spacing. Sawdust inoculum is introduced into these holes to a depth of 1 inch. Soft wax is used to seal the hole, and it is also used to seal the log ends during dry seasons. Logs are stacked diagonally on a support or in triangles and then covered to help maintain humidity. During a 2-month period, they are inspected twice for growth and potential contamination by the green Trichoderma fungus.

Fig. 3. Shiitake Mushroom

Spawn growth is evident by the appearance of white thread-like growth (mycelium) around inoculation sites and at the end of the logs. During this time, keeping the logs moist is important if the climate is dry. Fruiting is forced by soaking the logs. The logs are ready when they show significant spawn run throughout and at the log ends. As the logs dry afterward, fruiting will begin.

b. **Cultivation of Oyster Mushroom:** In nature, oyster mushrooms (Pleurotis ostreatus) grow from fallen trees. They can be grown in the same manner as the shiitake, but spawn can be introduced in different ways, including cutting an inch slice off the end of the log and then nailing it back on after inoculating the cut end. Inoculated logs are placed in black polyethylene bags containing wet sand or vermiculite, and then placed in a cool area. Fruiting begins about a month later.

Commercial production of this fungus uses substrates like chopped wheat straw, cottonseed hulls, sawdust, composted straw or mixtures. Ground limestone is added at 1 percent weight/weight to some substrates to adjust the pH. These substrates are pasteurized before inoculum is introduced. Inoculum is added at from 1.5

to 5 percent of the substrate weight. The inoculated substrate can be placed in beds, plastic bags, trays or bottles. Production time is similar to that with logs.

Fig. 4. Oyster Mushroom

c. **Cultivation of Button Mushroom:** The Button Mushroom (Agaricus bisporus) is grown on a wide variety of composts, including those made with horse or chicken manure and plant wastes like wheat straw and corn cobs. Mushroom spawn is added to the pasteurized compost at around 1 pound per square yard of bed area (160 pounds of substrate). Once the fungus colonizes the compost, with 50 percent of the surface area showing white mycelium, the substrate is cased (topped) with a mixture of lime and peat (pH of 7-7.5). Mushroom spawn is sometimes added to the casing to increase yield. Thereafter, it takes a week to 10 days for the fungus to start pinning, or producing mushroom fruiting body precursors. Reducing the incubation temperature to 60 degrees F from the incubation temperature of 75 degrees helps initiate production. In a week to 10 days after pinning, mature mushroom buttons appear.

Fig. 5. Button Mushroom

4) Honey: Honey was the only sweetening agent in the West before the advent of cane and beet sugar. It contains simple sugars, e.g. Dextrose, Levulose, Sucrose, Vitamins, Dextrin etc., easily assimilable carbohydrates. Honey forms the main basis of Indian medicines. The hives of Rock Bees form source of honey in India. Raw honey extracted from the hives contains Honey, Wax and other impurities. Honey is collected by experienced collectors from October to May except the rainy season without damaging the original hive.

Fig. 6. Honey

Following techniques are used to harvest honey from beehives:-

a. **Honey hunting**: Honey hunting- plundering wild nests of honeybees to obtain crops of honey and beeswax – is still widely practiced where people are poor and living at subsistence level and wild honeybee colonies are still abundant. Honey hunting may be seen as part of the lives of the world's remaining hunter gatherers, often at the margin of the farming world. The colonies of honeybees are nesting in the wild and, depending on species, may be nesting in tree cavities, in trees, or rocks, termite mounds or underground. Where bees are plentiful, honey hunting may be practiced widely. Sometimes wild honeybee colonies are regarded like the 'hole in the wall' automated cash machines of industrialized countries. When a family or individual needs some cash – a quick way to obtain it can be by honey hunting – plundering a known colony for some honey and quickly gaining some cash or 'barter value' in this way. The products from honey hunting may be indistinguishable from the products from beekeeping in hives.

b. **Beekeeping**: For thousands of years it has been known that obtaining a honey crop is made much easier and more convenient than honey hunting if bees are encouraged to nest inside a man-made hive. The hive makes ownership of the colony very clear, it can be kept near to home, and harvesting the honey is easier. Depending on the type of hive, and the species and race of bees, it is also possible to manage the colony to some extent. This is beekeeping – although the term beekeeping tends to be used colloquially to describe all activities involving bees, including the subsequent harvesting, and processing of their products. There are many different routes to successful beekeeping that suit different situations. At one extreme is the placement of an empty hive and at some future point if it has been colonised by bees, cropping of honey – with no other interference by the beekeeper. At the other end of the scale is beekeeping involving expensive hives, the provision of selectively bred or instrumentally inseminated queens, sophisticated monitoring and control of honeybee diseases (now essential in many regions), the movement by the beekeeper of the bees to different crops as they come into flower, mechanical harvesting and processing of honey, and much else.

3.1.2 Challenges and Issues during cultivation of MFPs

The forestry sector has significant potential to enhance the income of the forest-dependent communities, including tribals, through sustainable harvesting, processing, value addition, and marketing of MFPs. At the present, however, the sector has a few concerns causing social and ecological stress. Some of these challenges and issues are as follows:

i. Unsustainable techniques of harvesting MFPs are leading to poor resource regeneration.

ii. There is a lack of standardization of the quality of MFPs.

iii. The value chain, from collection to the sale of the produce, is largely unorganized and informal leading to inequitable distribution of profits.

iv. MFP gatherers lack the knowledge of value addition techniques and skills.

v. Poor awareness and lack of capacity of the local communities and institutions to implement provisions of the FRA and PESA about the ownership and management of MFPs.

3.2 Collection of MFP

Collection and sale of Non-Timber Forest Products (NTFPs) is considered as an important means for improvement of socioeconomic conditions of the rural people. NTFPs are gathered by the people living in forested areas. Some amount of primary processing, such as drying of leaves, deseeding, etc. are taken up by gatherers. These are then sold to private traders or State Government agencies. An exception here is bamboo, which is harvested under the supervision of the Forest Department (in some areas with the help of JFMCs).

State Governments exercise control over the use and trade of MFP through various Acts and regulations. For trading in MFP, States generally follow two types of practices for different MFPs: monopoly by State owned or supported agencies and free market i.e. sale of MFP by gatherers to traders. The Jharkhand State Minor Forest Produce Marketing Cooperative Federation and Chhattisgarh State Minor Forest Produce (Trade and Development) Cooperative Federation have attempted to trade without monopoly for a few MFPs but they do not assure purchase. State-wise collection or procurement procedure of MFPs is given in below table:

Table 3.2. State-wise Procurement of MFPs

State	Minor Forest Produce		
	Bamboo	**Tendu leaves**	**Other MFPs**
Andhra Prtadesh	Area under bamboo is managed in two ways: 50% by the Van Sanrakshan Samitis (VSSs) and 50% where there are no VSSs, directly by the Forest Department. The VSS is elected by the people of the villages that are near the forest/ bamboo. In a village visited (Krishnapuram), two members from each family formed part of the VSS. There is a managing committee of the VSS, which includes the Forest Guard of the area. The VSS makes an action plan for the area which includes various activities for regeneration and preservation as well as extraction of bamboo.	The tendu leaves collected and the collectors (Beedi Leaves Labourer) will be purchased as the notified khallas of the units as per thecollection rates fixed by the Government.	There are weekly shandies in which thousands of people come and sell their produce especially in the months from January to May. MFP is bought by GCC agents from these shandies.
Chhattisgarh		Tendu leaves are plucked and bundled by tribals and collected by a 'Phad Munshi' appointed by the society at the local level, who makes them available to the Block Level Society. The Phad Munshi is paid an honorarium of Rs, 12-14 per 'bag' (1000 bundles). This is reported to be highly inadequate.	Other nationalized MFPs are also collected by the phad munshi as for tendu. For the rest, gatherers sell their collections in local haats/ weekly shanties to private traders.
Maharashtra	The entire area is divided into sections, which are	Entire tendu collection area is divided into units	At the village level, 'adivasi' societies of MFP

	leased out to paper mills or other industries by the Forest Department. The industry brings its own labourers or hires local people (most often tribal communities) and pays them labour (wage) rates to harvest bamboo from the leased out section. The FD also allows around 150-200 bamboo stalks per family to be harvested by the burood or basod communities. These communities are also allowed to collect bamboo shreds to make bamboo products. Bamboo collection for any other purpose by the local communities is strictly prohibited	based on the quality of the leaves. After auction, which ends by February, the contractor or licensee has to make arrangements for appointment of 'phad munshi', who collects form the primary collectors. Presently, primary collectors are paid is Rs.105/- for every 100 bundles (1 bundle= 70 leaves) of tendu leaves by the contractors. The contractor also pays the phadi-munshi (approx. Rs.4000/- in 2010), transportation charges, rent for go-downs, besides the auction amount (termed "royalty").	gatherers have been formed under the Societies Cooperative Act. MDTDC procures through 456 purchase centres in Schedule V areas along with other agricultural commodities from the 'adivasi societies' at the gram level. The gatherers can also deposit their daily collections at the purchase centres. At the centres, all items procured are graded by the designate 'Grader' or 'Marketing Inspector' (MSCTDC employee). Each purchase centre has a Centre Incharge (Coo erative Society employee), who submits daily reports at Sub-regional Office
Madhya Pradesh	-	Tendu harvesting areas are leased out to the private traders through open bidding system. The traders (contractors) then make arrangements for collection of tendu leaves in their designate areas. "Phad Munshis' in MP are chosen by the gatherers and not the private contractor and are usually trusted persons of families traditionally engaged in the work. The Munshi is paid by the contractor (payment for 2010 was Rs. 14 per standard bag). His responsibilities include procurement of tendu leaf bundles from collectors on daily basis during the season, drying of the bundles, making standard bags (1 std.bag= 1000 bundles or 50,000 leaves) and making entries	Nationalised MFPs namely sal seed, kullu gum and lac resin are procured exclusively by MP State MFP Cooperative Federation in a similar manner to the procurement of tendu, except that tenders are not issued for these MFPs. The gatherers directly sell these MFPs to the Federation at the designate centres. All other non nationalized items are open for free trade in the markets.

		of payments made to collectors in the 'tendu patta' cards. The collections are then transported to go downs by the private contractors. These go downs are either taken on rent by private contractors or they may be the Cooperative Societies' own go downs. Cost of transportation is also borne by the contractor	
Jharkhand	The ownership rights of bamboo are vested with Jharkhand Forest Development Corporation. Since 2003, however, the JFDC can harvest bamboo from forest areas subject to approval of working plans by the Centre. These working plans made by the State Forest department have yet not been approved, hence harvesting of bamboo has officially been put on the hold. The traditional bamboo weaving community in Jharkhand called the 'turis' have to obtain permits from the respective District Forest Office to harvest bamboo from forest areas. Whether, at present, they could manage to obtain permits without hassles could not be confirmed from field observation.	Kendu leaves are plucked by the tribals, bundled and brought to the 'khalihan' where the 'Munshi' collects. The 'Munshi' supervises the drying of the leaves and keeps an account of the daily collection. The process of drying takes around 9-10 days after which standard bags are made, each consisting of 1000 bundles. Ten 'khalihans' report to one depot and from there the payment is disbursed for the 'khalihans'. The trader who has won the bid for the area makes the payment to the gatherers at the site of the 'khalihan' in the presence of the Ranger and the Munshi. The Munshi keeps a record of the payments made to each family a copy of which is submitted to the Ranger	Open for free trading in the markets. Collectors bring their collections to local haats which normally function once a week. Payments in the form of kind (barter) were reported to be prevalent. Exploitation by private traders is also reported. For example, half a kg. of chironji would be exchanged for three fistful of salt. (Chironji has a huge export value in the middle-east). JHAMFCO Federation (government agency) has begun purchasing of MFPs from tribals at local haats, through their network of cooperative societies. The societies play the role of 'middle men', purchasing MFPs from collectors at rates decided by the Federation and then transporting it to the storage go downs. The societies are reported to get immediate payments from the Federation.
Orissa	Bamboo is cut and traded departmentally through the District Bamboo Development Agency. In some parts of the State,	Tendu leaves are collected at local centres called 'podhis'. These may be thatch- roofed structures or even small pucca	Since 2002, the remaining 69 MFPs have been 'transferred' to Panchayats. This in effect means that private traders buy the same.

	Joint forest management committees (JFMCs) are also involved. The bamboo is then handed over to the Forest Corporation, which sells it to paper mills through tenders	structures. A 'podhi munshi', engaged by the State Forest Department, mans the place. The munshi along with 2 labourers dries the leaves (duration is about 8 man days for proper drying), grades and bundles them into 5 kg. bundles each. 12 such bundles make 1 standard bag. Thus each standard bag = 60 kg. Subsequently, these are transferred to go downs and delivered to the OFDC. Tendu leaf plucking is banned in sanctuary area, which goes against the spirit of PESA as well as FRA. In these areas, the leaves are smuggled out and sold to private traders.	However, the price is fixed by the Panchayat Samiti, and traders have to register with the Gram Panchayat, which charges a registration fee of Rs. 100 per trader. There is a long chain of middlemen in the sale of MFPs (usually at least three). There is one person within the village who collects all MFPs, and then supplies them to traders. However for Siyali leaf, which is collected in large quantities, better marketing avenues are available at the district level and gatherers sell at the district level, not to the village trader. In some areas, pharmaceutical companies have begun to buy MFPs that have medicinal value directly from the traders.
Gujarat	Managed by the Forest department through its JFMCs. A total of 324 JFMCs exist of which 155 have bank accounts. 60% members of each JFMC are the village residents, the rest coming from the Forest dept. Field visit to Dangs district (largest quantity of bamboo is harvested here) revealed that the JFMCs or 'baans mandli' are formed by village residents on payment of RS.55 as registration fee. One mandli on average has 55 members. Bamboo harvesting begins after diwali (autumn) and continues for 4-5 months. The harvested bamboo is primarily for JK paper mill located in Songadh, Tapi	The phad-munshi, here, is a hereditary appointee. He is paid by the private trader who has won the auction for the particular area. In Gujarat, entire family gets involved during the collection period. Collectors bring their collections (fresh leaves) to the 'phadi' in the form of "podis". (1 podi= 50 leaves). Phad munshi supervises drying of leaves and then bagging them i.e.arranging them into lots of 1000 podis which make 1 std.bag. Children are employed for the task of drying the leaves (Rs.3 is earned for drying of 1 podi). Phad munshi keeps a 'kachcha record' of the	Mohua flower and seeds and all varieties of gums are procured exclusively by the GSFDC. They have appointed collection agents in villages, who earn 10% commission for the procurement made from the tribals on behalf of the Corporation. The remaining MFPs are open for free trade. Tribal communities are free to sell them to the GSFDC or the private traders. Trading for these MFPs is usually done at weekly haats.

	dist. Each harvestor earns Rs.400 500/- plus Rs.400 (paid by paper mill) for 1 tonne bamboo cut. Payment made by the paper mill is deposited in the joint account of a nationalized bank. The account is jointly held by the president of the mandli and the Range Forest Officer. There is a provision for each of the mandli members to get 500 bamboo stalks free from the Forest dept. However, it was reported during interactions that none of the members received this benefit.	daily payments made to collectors. Unlike Maharashtra, Jharkhand and MP, tendu patta cards are not distributed among the collectors. Therefore, no proof of earnings available with the collectors. On an average collectors earn Rs.2800/- for a fortnight of collection (average period of tendu leaf plucking) i.e. they earn Rs.200/ approx.per day (@55 paise per podi)	

Source: Report of Ministry of Panchayati Raj, Govt. of India, 2011

3.3 Mechanism for marketing of Minor Forest Produce (MFP)

Marketing of Minor Forest Produce through Minimum Support Price and development of Value chain for MFP is basically a scheme that was formulated by the Ministry of Tribal Affairs as a measure of social safety for MFP gatherers was implemented in 2013. The main aim of this scheme is to ensure fair returns to forest dwelling scheduled tribes and other traditional forest dwellers and as a solution to problems they were facing such as perishable nature of the produce, lack of holding capacity, lack of marketing infrastructure, exploitation by middlemen, and low government intervention. The scheme is designed as a social safety net for improvement of livelihood of MFP gatherers by providing them fair price for the MFPs they collect. Initially, this Scheme has been implemented in eight States having Schedule areas but from November 2016, the scheme is applicable in all States.

3.4 Role of various bodies in promotion of MFPs or Non Timber Forest Products' Marketing

The proposed entrustments of powers to Panchayat Raj Institutions under the promotion of MFP are given below:

Table 3.4. Role of various bodies in promotion of MFPs Marketing

S. No.	Panchayat Raj Institutions	Entrustments of Powers
1	Village Panchayat	i. Promote plantation of minor forest produce species under Drought prone Area Programmes under Social Forestry activity under Jawahar Rozgar Yojana, Western Ghat Development Programme and Tribal Development Projects ii. Facilitate the village artisans to get permits from Forest Department to collect MFP in Reserve Forest Areas

2	Panchayat Union	i. Assist in promoting collection of MFP, Primary processing and value addition to MFP before selling ii. Assist in ensuring timely payment and adequate collection charges to the minor forest produce collectors iii. Review the schemes operated by Forest and other departments in Promotion/Collection/Processing and Marketing of MFP in Panchayat Union areas
3	District Panchayat	i. Conduct annual conference of officers, users and organizers involved in MFP production/Collection/Processing ii. Organize credit linkage needed for the promotion of MFP Procurement, Processing and Marketing iii. Advise the state Governments on the measures to be adopted in respect to annual conferences, credit linkage for MFP Processing and Marketing

Source: Rural Development and Panchayat Raj Department, Tamil Nadu

References

ENVIS RP on Forestry and Forest Related Livelihoods, Forest Research Institute, Dehradun.

Guidelines for Mechanism for Marketing of Minor Forest Produce (MFP) Through Minimum Support Price (MSP) & Development of Value Chain for MFP, (2019). Ministry of Tribal Affairs, Government of India.

Koppell, C. Marketing information systems for non-timber forest products, (1995). Community Forestry Field Manual, FAO.

Oregon State University Extension Service, Shiitake Mushrooms. (2017). Non timber Forest Sharma, J.V. et al., (2018). Minimum Support Price of Minor Forest Produce (MFP) and Its Sustainable Harvest: A Social Safety Measure for MFP Collectors in India, The Energy and Research Institute, Delhi.

Products For Small Woodland Owners, Forestry & Natural Resources Extension Program.

Report of the committee on Ownership, Price Fixation, Value Addition and Marketing of Minor Forest Produce , (2011). Ministry of Panchayati Raj Government of India New Delhi.

Sekar, C. and Vinaya Rai, R.S. (1996). Role Of Minor Forest Products In Tribal Economy Of India : A Case Study, *Journal of Tropical Forest Science,* 8(3), 280 – 288.

Tamilnadu Agriculture University Agritech Portal Sponsered by Rashtriya Krishi Vikas Yojana(RKYY).

Tribal Cooperative Marketing Development Federation of India Limited (TRIFED), Ministry of Tribal Affairs, Govt. of India.

Chapter 4

Value Addition of Minor Forest Produce

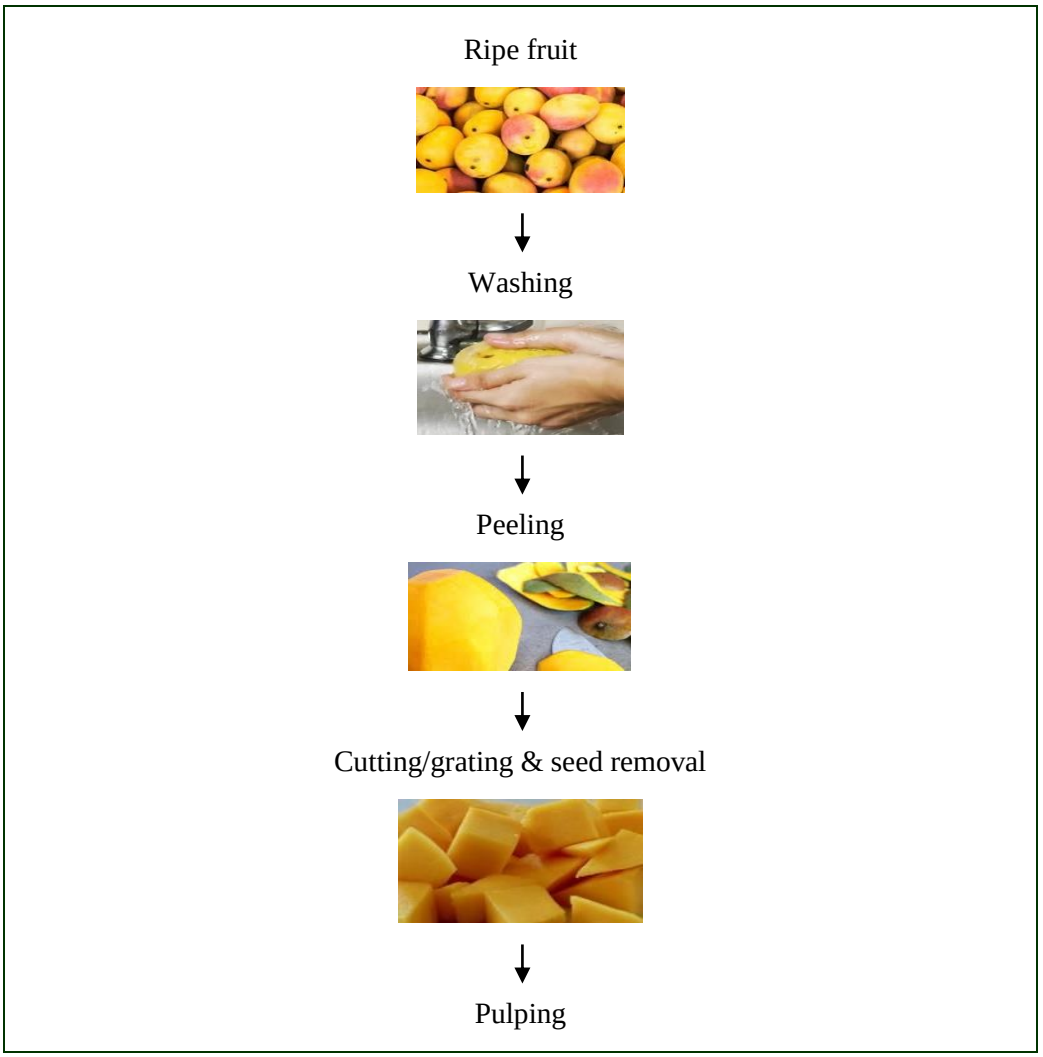
Ms. Upama Kalita, Dr. Sandeep Janghu
Indian Institute of Food Processing Technology- Liaison Office, Guwahati(Assam)

Sugar Conserves: Jam, Jellies, Toffee. Beverages: juices, squashes, syrups, nectars, RTS. Preparation of concentrates-puree,soup and paste. Preparation of pickles and chutneys. Medicinal and aromatic products.

4.1 Processing of Jam:

Jam is a product obtained by cooking fruit pulp with sugar and acid to a desired consistency. Jam contains 0.5-0.6 percent acidity and 68% total soluble solids. Jam can be prepared from several fruits such as: Apple, Aonla, mango,Pear, Papaya, Strawberry, Goose berry, Pineapple. FPO specifications for jam are (i) minimum per cent of total soluble solids in final product 68 and (ii) minimum per cent of fruit juice in final product should be 45.

FLOW CHART:



↓

Addition of Sugar and water

↓

Cooking upto desired consistency

↓

Addition of citric acid

↓

Judging the end point by temperature (105°C) or TSS (68-70%)

↓

Filling hot into clean and sterilized bottles

↓

Cooling

↓

Waxing

↓

Capping

↓

Storage in a cool and dry place

Problems & Precautions:

Problems	Cause	Precaution
Crystallization	Percent of invert sugar less than 30	Add corn syrup or glucose along with cane sugar
Sticky jam	High percentage of total soluble solids	Add pectin or citric acid
Premature setting	Low total soluble solids and high pectin content in Jam	Add more sugar

Surface graining and shrinkage	Evaporation of moisture during storage	Storing in cool place
Microbial spoilage	Sometimes moulds cause spoilage	Add 40 ppm, SO2 in the form of SMS

4.2 Processing of Jelly:

Jelly is a semisolid product obtained by boiling a clear strained fruit juice with sugar and acid to a thick consistency. Jelly contains total soluble solids not less than 65 percent and acidity 0.5 to 0.7 per cent. FPO specification for fruit jelly are (i) Minimum percentage of total soluble solid in final product is 65 and (ii) minimum percent of fruit juice in final product should be 45.

FLOW CHART:

Fruit (firm not over ripe)

↓

Washing

↓

Cutting into thin Slices

↓

Boiling with water(one and half time the weight of fruit for 20-30 minutes)

↓

Addition of citric acid while boiling (2g/kg fruit)

↓

Straining of extract

↓

Pectin test for addition of sugar (jell meter test)

↓

Addition of sugar

↓

Cooking

↓

Judging of end point by temperature (105°C) or TSS (65%) or sheet or drop test

↓

Removal of scum foam

↓

Add remaining citric acid

↓

Filling hot in clean and sterilized bottles

↓

Wiping

↓

Capping

↓

Storage

Qualities of Jelly:

1. Clear
2. Transparent
3. Sparkling
4. Attractive colour
5. Keep its shape in which it is cut not breaking or flowing

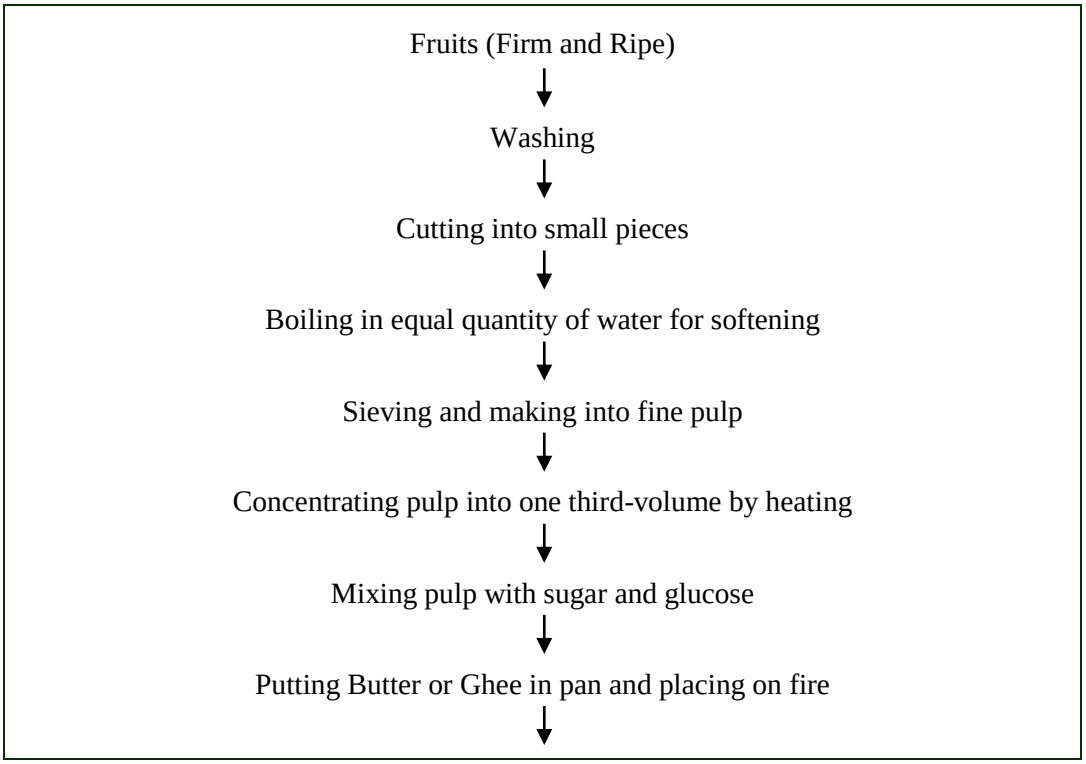
Problems in jelly

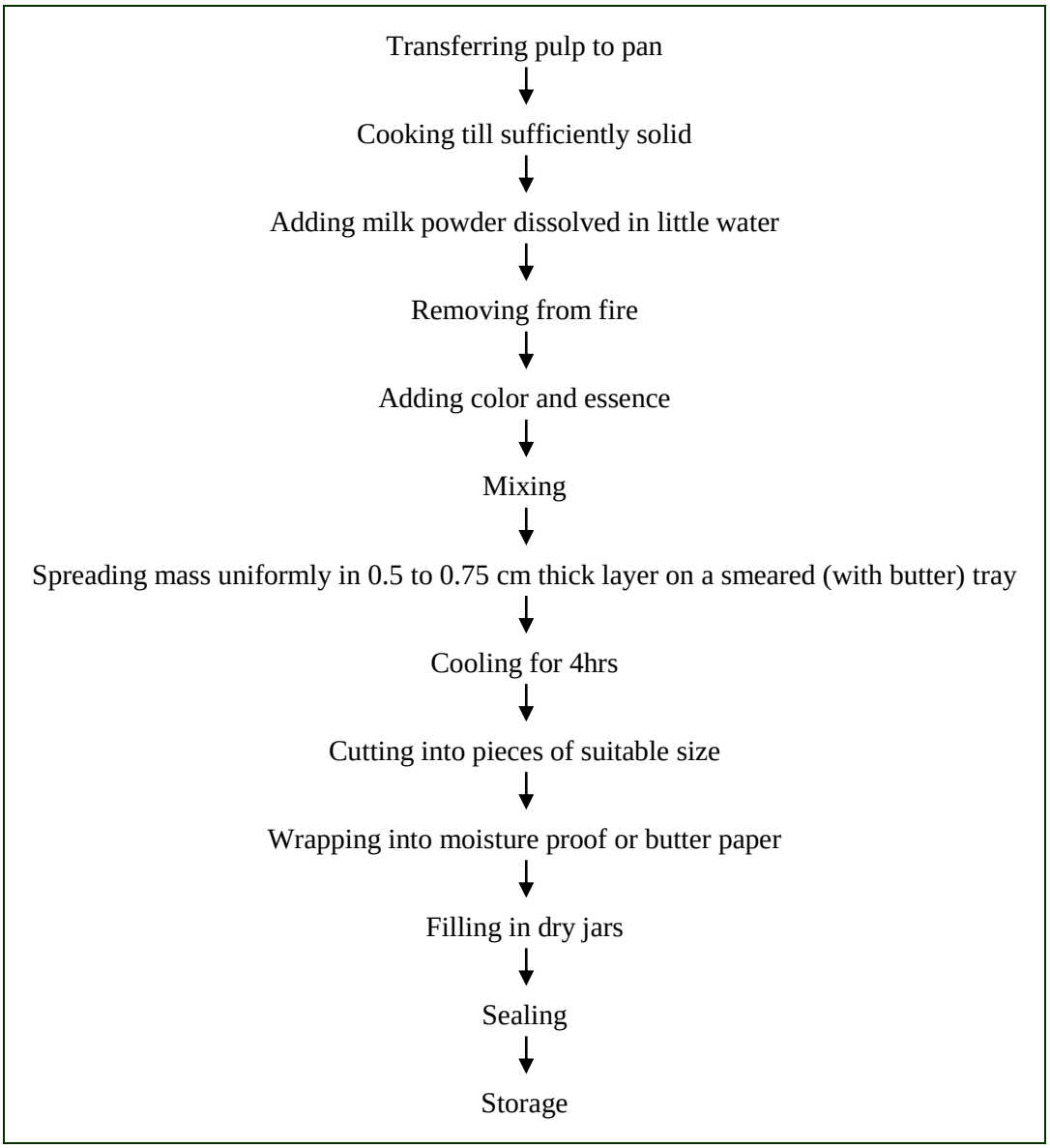
Problems	Causes
(1) Failure to set	1. Cooking below the end point. 2. Lack of acid or pectin. 3. Cooking beyond the end point. 4. Slow cooking for a long time.
(2) Cloudy and Foggy Jellies	1. Use of immature fruit 2. Use of non-clarified juice 3. Over cooking 4. Over cooling 5. Non-removal of scum
(3) Crystal formation	Use of excess sugar
(4) Synersis or weeping	1. Excess of acid 2. Too low concentration of Sugar 3. Insufficient pectin 4. Premature gelatin
(5) Fermentation	Caused by mould due to 1. Not covering the jelly properly 2. Break down of paraffin seal

4.3 Processing of Fruit Toffee:

Pulpy fruit like mango, guava, papaya, etc. can be used for making fruit toffee. It is prepared by using fruit pulp, sugar, glucose, skimmed milk powder and mixing with appropriate amounts of butter or ghee, essence and color.

FLOW CHART:





Problems in Toffee:

Problems	Causes
1. Fermentation	Sugar crystallization
2. Hardening of fruit	Inadequate blanching
3. Stickiness	Storage in humid place / poor packaging

4.4 Beverages: Juice, Squashes, Syrups, Nectars, RTS

JUICES:

Juice may be pure with natural sugar or sweetened, which has 10 per cent total soluble solids and 85% juice. A wide variety of fruit such as pineapple, apple, mandarin orange, mango, guava, litchi, pomegranate, grape, etc., be used for making juice. FPO specifications for unsweetened juice are: (i) minimum per cent of total soluble in natural content, (ii) minimum percent of fruit juice 100 per cent. The permissible limit of preservative as sulphur dioxide 350 ppm. FPO specification for sweetened juice is: (i) minimum percent of total soluble solid is 10 and (ii) minimum per cent of fruit juice 85.The permissible limit of preservative as sulphur dioxide 350ppm. The techniques for preparation of juices from various fruits are as under.

FLOW CHART:

Ripe fruit

↓

Washing

↓

Peeling

↓

Passing through pulping machine

↓

Addition of water 0.5 lit/kg of pulp

↓

Mixing with syrup solution (For 1 Kg pulp 200g sugar + 1g citric acid)

↓

Homogenization

↓

Heating at 85˚C

↓

Filling hot into cans (A21/2 size)

↓

Sealing

↓

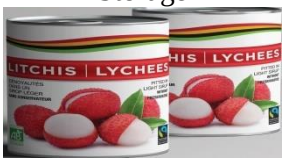
Processing at 100˚C for 15 minutes

↓

Cooling

↓

Storage



SQUASH:

A type of fruit beverage which contain atleast 25% percent juice and 45% total soluble solids. It also contains about 1% acidity and 350ppm sulphur dioxide and 600ppm sodium benzoate (in coloured juices). It is diluted before being served.

Squash can be prepared from a wide variety of fruit viz., mango, mandarin orange, lime/lemons, guava, aonla, pineapple, papaya, bael, litchi, phalsa, karonda, jamun, pomegranate, plum, etc. FPO specifications for squash are: (i) minimum per cent of total soluble solids 40 and (ii) minimum per cent of fruit juice 25. The permissible limit of the preservative as sulphur dioxide 350 ppm or as benzoic acid 600ppm.

FLOW CHART:

Ripe fruit

↓

Washing

↓

Peeling/trimming

↓

Cutting

↓

Grating

↓

Juice extraction

↓

Straining

↓

Measuring

↓

Calculation of ingredients (Sugar, water and citric acid)

↓

Preparation of syrup

↓

Mixing with juice/pulp

↓

Addition of preservative

↓

Mixing with squash thoroughly

↓

Filling into clean and sterilized bottles

↓

Capping

↓

Storage

SYRUP

A type of fruit beverage contains at least 25% fruit juice/pulp and 66% total soluble solids with about 1.3% acidity. Suitable fruits for preparation of syrup are lime, lemon, manadarin orange, pomegranate, phalsa, karonda, jamun and aonla. FPO specifications for syrup are: (i) minimum percentage of total soluble solids 65 and (ii) minimum percentage of fruit juice 25. The permissible limit of the preservative as sulphur dioxide and benzoic acid are same as mentioned for squashes.

FLOW CHART:

Ripe fruits

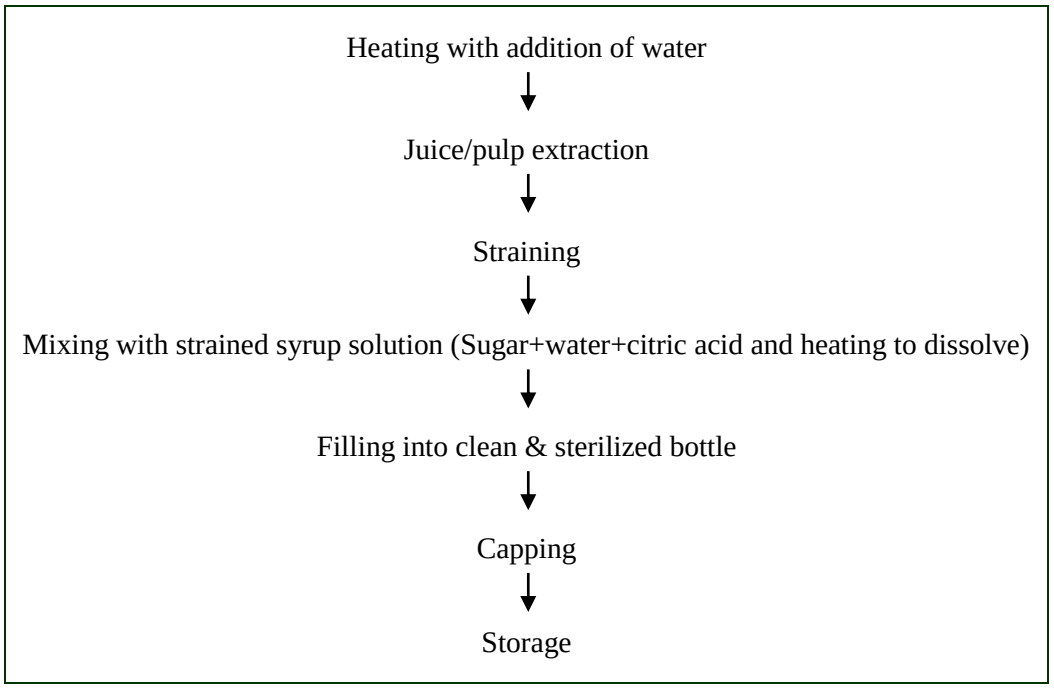
↓

Washing

↓

Peeling/cutting/grating/crushing

↓

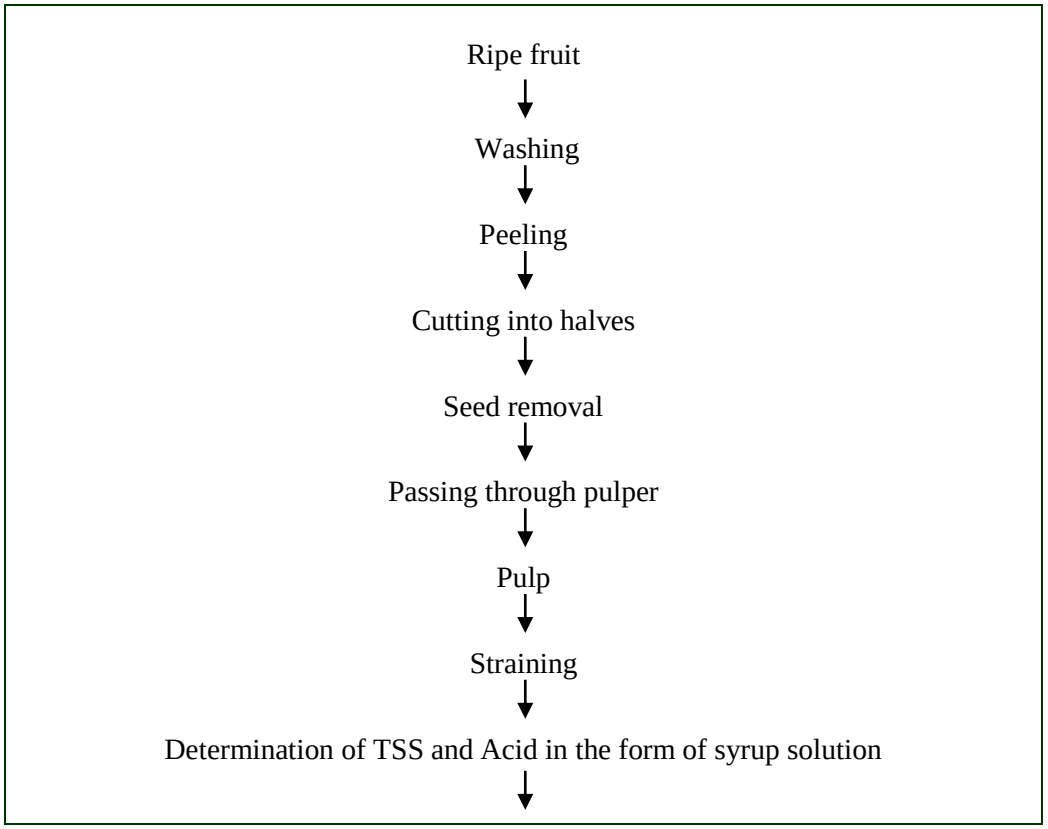


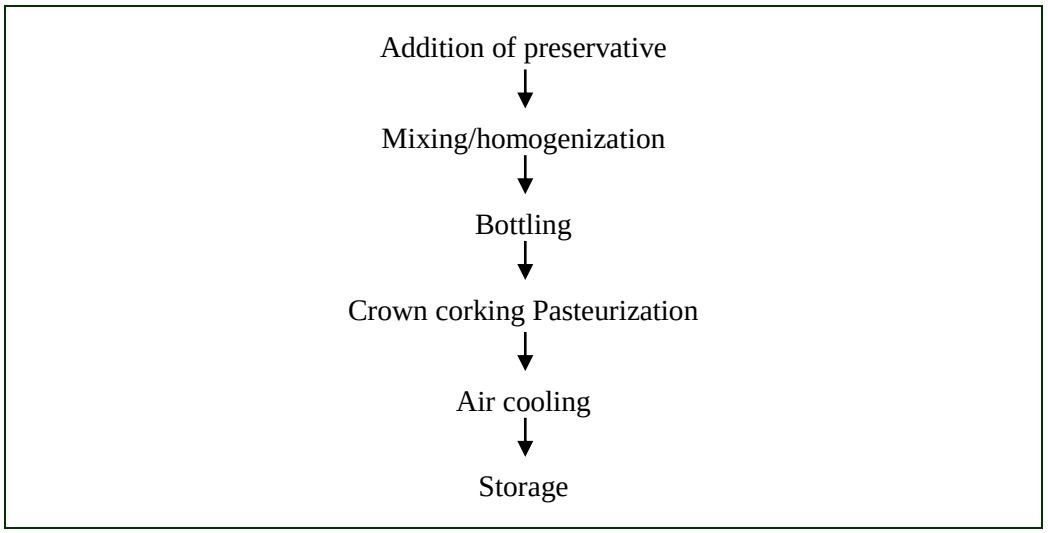
NECTAR:

This is a type of fruit beverage which contains at least 20% fruit pulp/juice and 15% TSS. Experiences however shown that nectar prepared with 15% sugar is very sweet. It has normally 0.3% acidity. Dilution is not required before serving.

The most suitable fruits for preparation of nectar are papaya, mango, peach, and apricot. FPO specifications for nectar are: (i) minimum percent of TSS 15 and (ii) minimum percent of fruit juice 20% except pineapple and orange(40). The permissible limit of preservative as sulphur dioxide 70ppm and as benzoic acid 120ppm.

FLOW CHART:

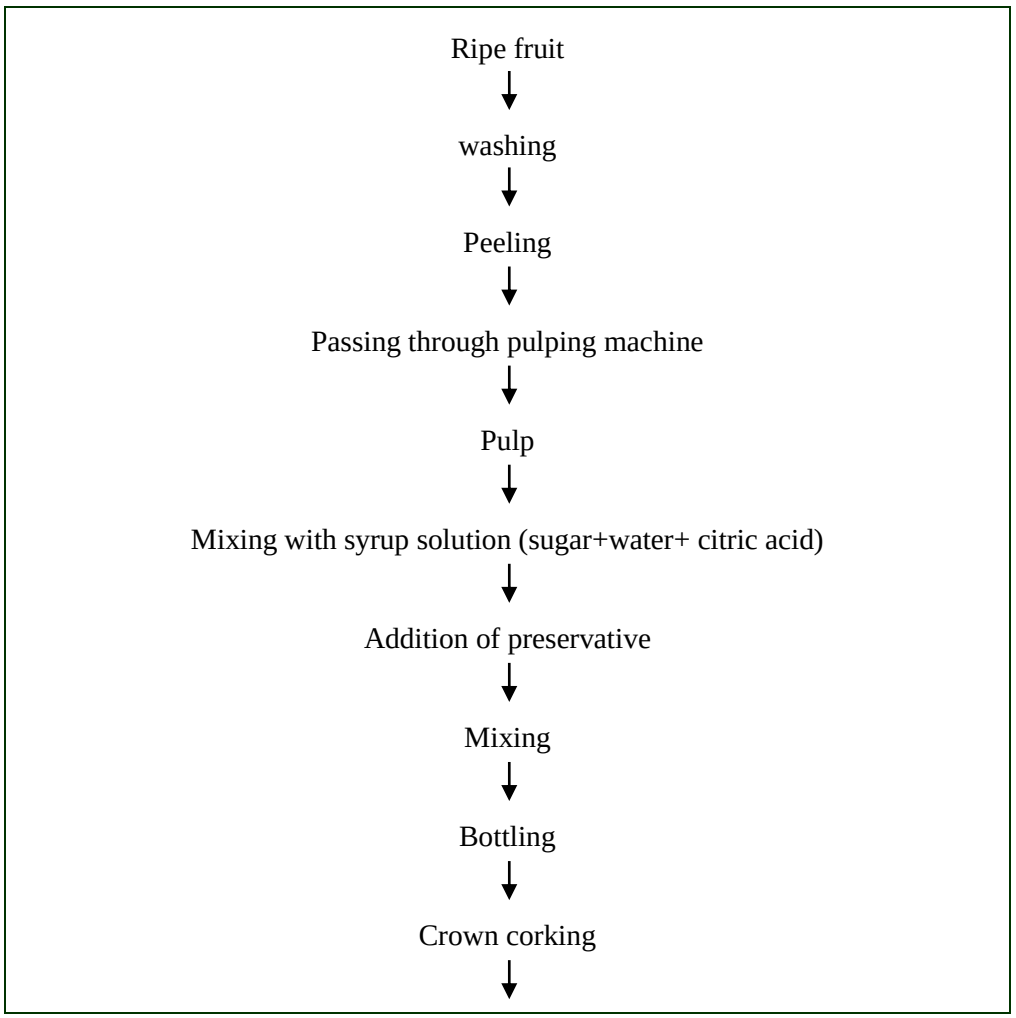


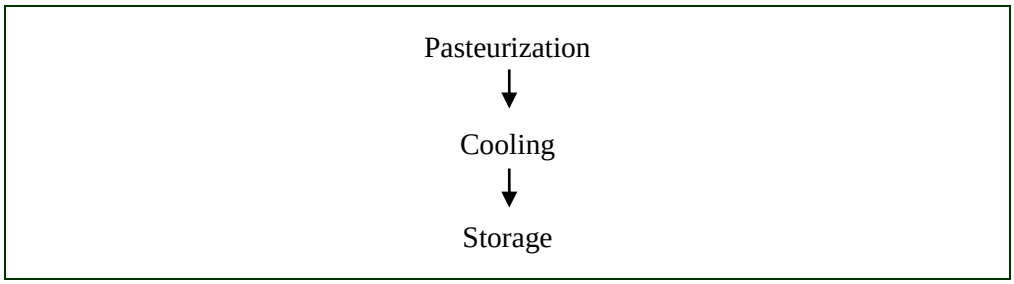


READY-TO-SERVE

Ready-to-serve beverages are the most popular bottled products which contains at least 10% fruit juice and 10% total soluble solids. Ready –to-serve beverage can be made from a wide variety of fruits such as mango, guava, bael, citrus, pineapple, litchi, papaya and plum. An excellent quality of soft drink can be also prepared from phalsa and blend of aonla and ginger. FPO specifications for ready-to-serve beverage are: (i) minimum percent of TSS 10 and (ii) minimum % of fruit juice 10 except lime juice (5%).The permissible limit of preservative as sulphur dioxide 70ppm and as benzoic acid 120ppm.

FLOW CHART:

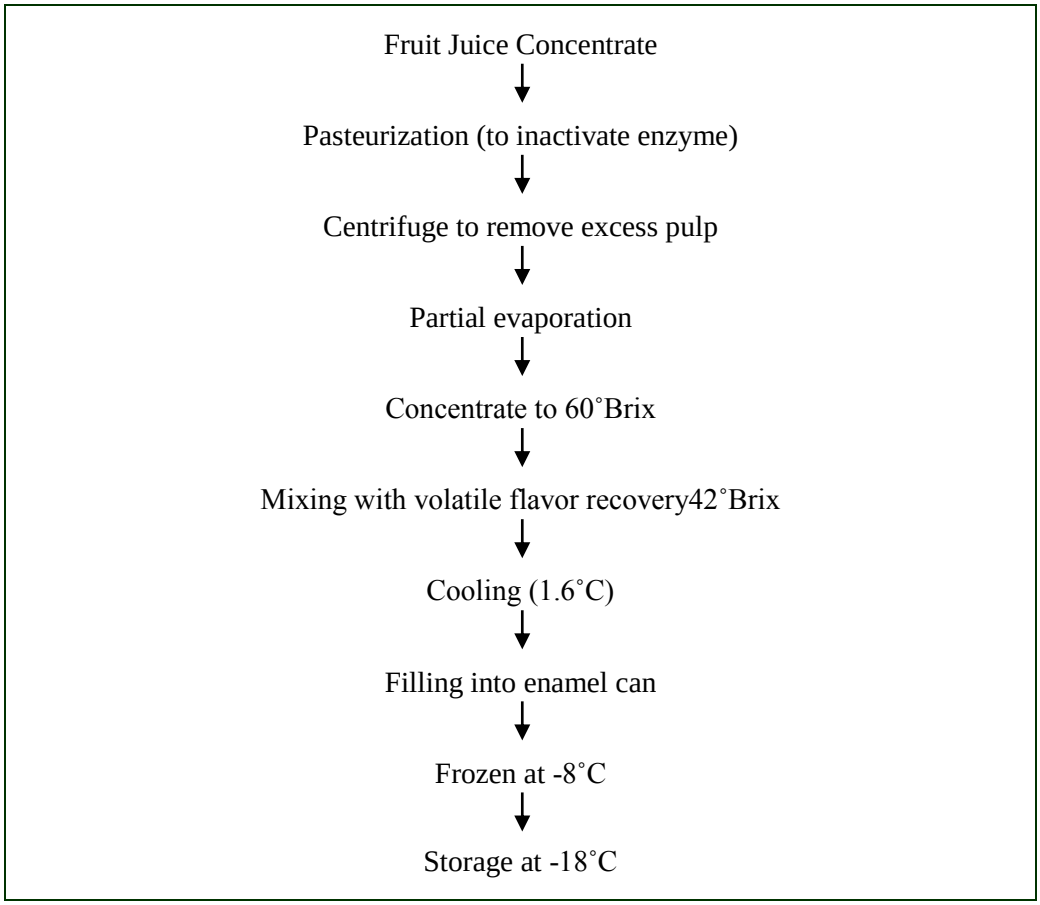




FRUIT JUICE CONCENTRATES:

This is a fruit juice, which are concentrated by removal of water either by heat or by freezing. Removal of water in order to concentrate the juice by heating is economically most favorable and widely used. Fruit juice concentrate contains at least 32% total soluble solids. Fruit juice concentrate is easier to handle during packaging, transport and storage due to reduced weight and bulk. Fruit juice concentrate can be used for preparation of various types of beverage including carbonated beverage. Fruit juice concentrate can be prepared from various fruits.FPO specifications for fruit juice concentrate are: (i) minimum percentage of total soluble solids 32 and (ii) minimum percentage of fruit juice 100. The permissible limit of the preservative as sulphur dioxide 1500ppm.

FLOW CHART:



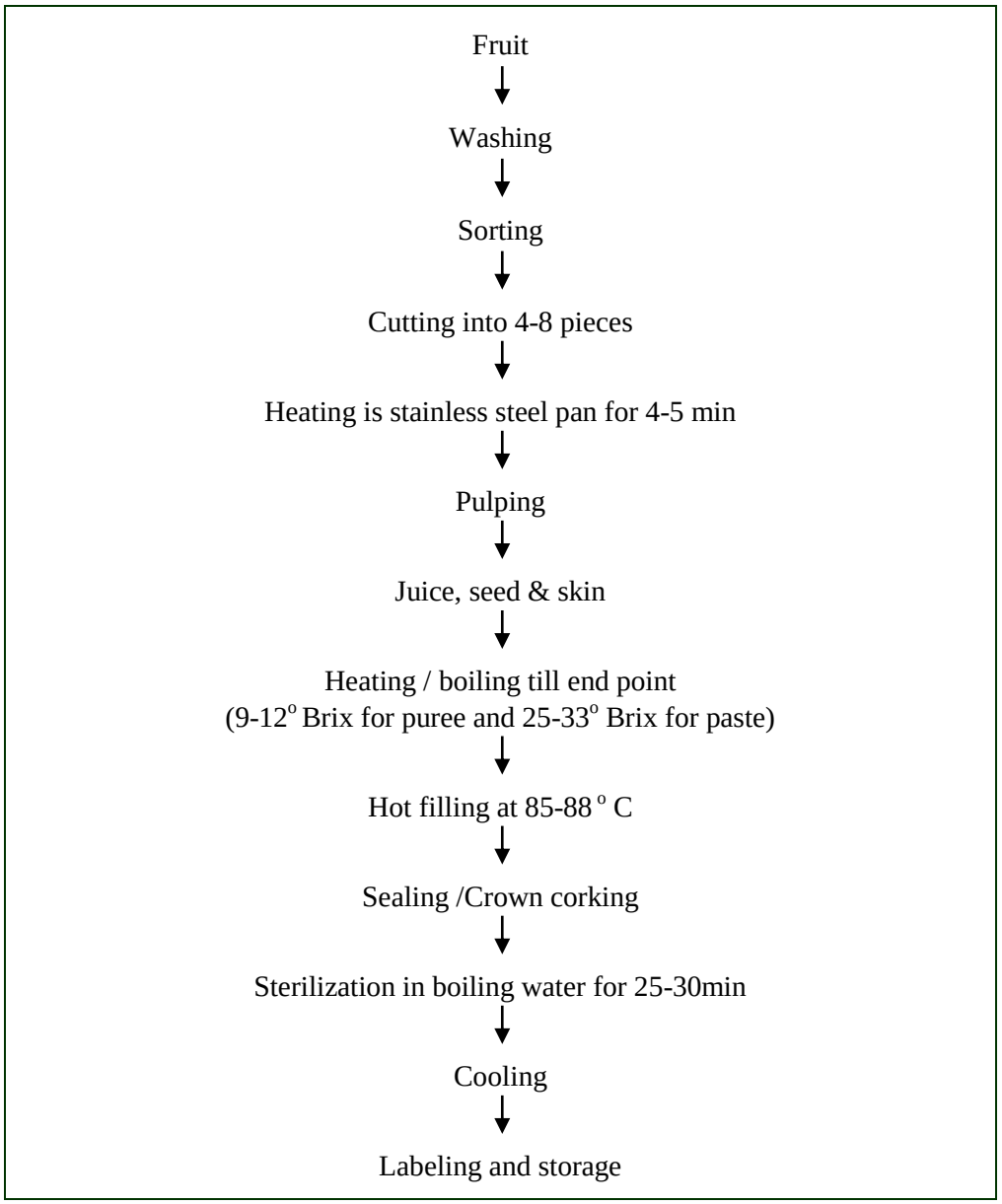
4.5 Processing Puree / Paste

PUREE: Tomato pulp without skin or seeds, with or without added salt, and containing not less than 9.0 per cent of salt-free tomato solids, is known as ‘medium tomato puree’. It can be concentrated further to ‘heavy tomato puree’ which contains not less than 12 per cent solids. One of the best example is tomato puree.

PASTE: It contains not less than 25 per cent fruit solids, it is known as tomato paste. On further concentration to 33 per cent or more of solids, it is called concentrated paste. Fruit pulp is prepared from ripe fruits. Cooking

for concentration of the pulp can be done either in an open cooker or a vacuum pan. In the former most of the vitamins are destroyed and the product become brown. On the other hand, use of vacuum pans, which are expensive, help to preserve the nutrients and also reduce the browning to a great extent. In vacuum pans the juice is boiled at about 71°C only. Ordinarily fruit juice can be concentrated to 14-15 per cent solids in an open cooker, but for obtaining higher concentrations a vacuum pan is required. Moreover, sterilization of the product is also possible in a vacuum pan. While cooking in an open cooker, a little butter or edible oil is added to prevent foaming, burning and sticking. If, after cooking, the total solids content of the juice is higher. Than required, more juice is added to lower it, if it is lower, cooking is continued till the desired concentration is reached. The end-point of cooking puree and paste can be determined either with a hand refractometer or by measuring the volume (a known volume of juice is concentrated to a known volume of final product) with the help of a measuring stick.

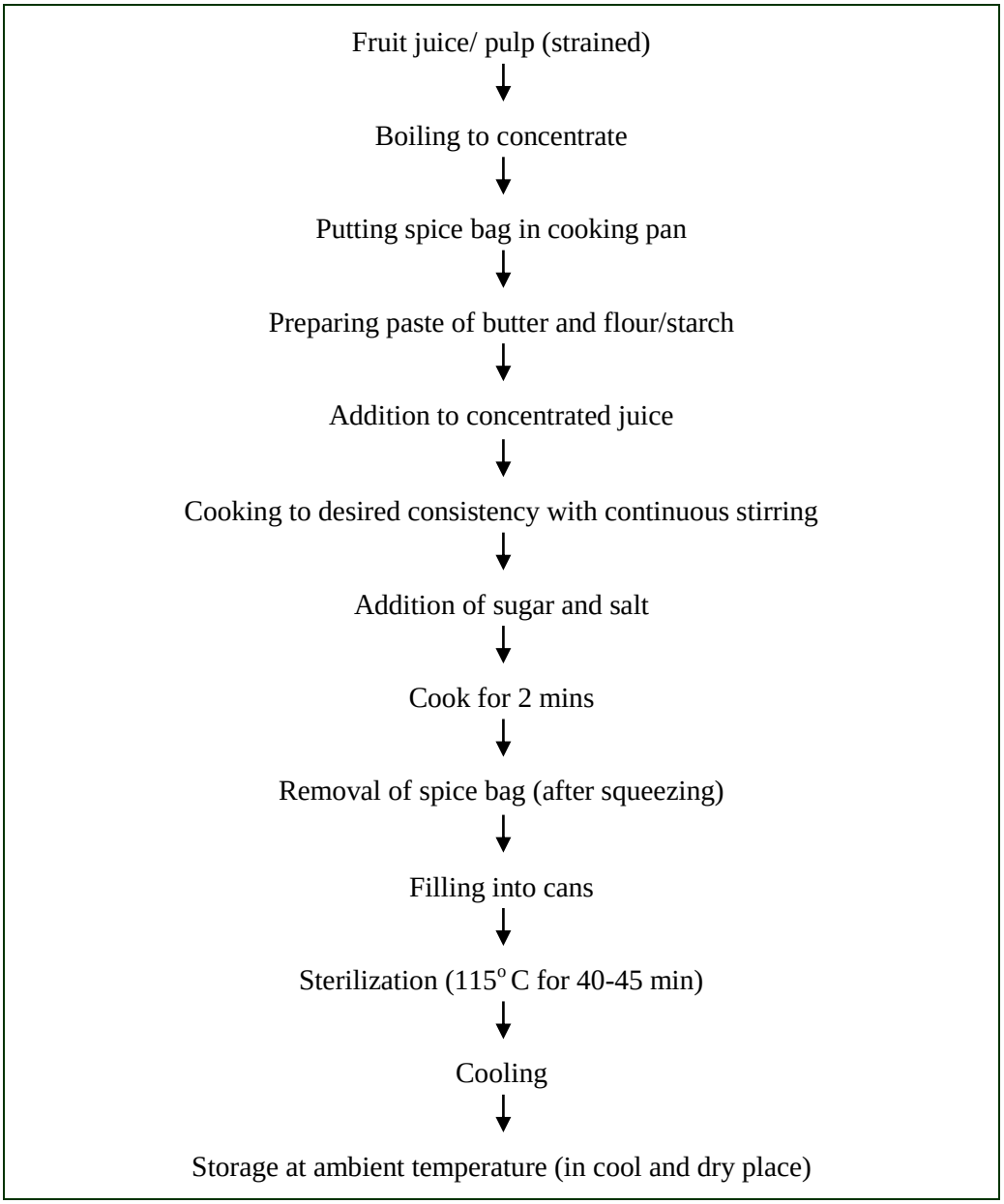
Flow chart for preparation of puree / paste:



4.6 Processing of Soups

SOUP: Soup is becoming very popular in homes. Stored soup is warmed at the time of serving. Recipe: fruit pulp 1 kg, salt 20 g, sugar 20 g, butter or cream 20 g, flour/starch 10 g, onion (chopped) 20 g, garlic (chopped) 5 g, clove (headless) 5 numbers, cumin, cardamom (large), black pepper, cinnamon (powdered) 1 g each and water 350 ml.

FLOW CHART:



4.7 Processing of Pickle

Pickle is one of the most ancient methods of preserving fruits and vegetables. Pickles are good appetizers and add to the palatability of a meal. They stimulate the flow of gastric juice and thus help in digestion. Pickling is the process by which fresh fruits and vegetables are preserved and with the addition of salt, chilly and spices, a tasty preparation known as "Pickles" is made. There are several varieties of pickles and they are consumed throughout the year by people from all walks of life. Unimaginable quantities of pickles are consumed round the year. On an average, each family consumes about 2 kgs of pickles every year. Several kinds of pickles are sold in the Indian market. Mango pickle ranks first followed by cauliflower, onion, turnip and lime pickles. These are commonly made in homes as well as commercially manufactured and exported. Millions of tonnes of mangoes, lemons, chillies and other items are used in India to prepare a variety of pickles. It is estimated that in our country numerous varieties of pickles are available for which the total annual market is valued at Rs. 40,000 million.

Principle of Pickling

Pickling is the result of fermentation by lactic acid-forming bacteria" which are generally present in large numbers on the surface of fresh vegetables and fruits. These bacteria can grow in acid medium and in the presence of 8-10 per cent salt solution, whereas the growth of a majority of undesirable organisms is inhibited -. Lactic acid bacteria are most active at 30°C, so this temperature must be maintained as far as possible in the early stage of pickle making. When vegetables are placed in brine, it penetrates into the tissues of the former and soluble material present in them diffuses into the brine by osmosis. The soluble material includes fermentable sugars and minerals. The sugars serve as food for lactic acid bacteria which convert them into lactic and other acids. The acid brine thus formed acts upon vegetable' tissues to produce the characteristic taste and aroma of pickle. In the dry salting method several alternate layers of vegetables and salt (20- 30 g of drysalt per kg vegetables) are kept in a vessel which is covered with a cloth and a wooden board and allowed to stand for about 24 hours. During this period, due to osmosis, sufficient juice comes out from the vegetables to form brine. Vegetables which do not contain enough juice (e.g., cucumber) to dissolve the added salt are covered with brine (steeping in a concentrated salt solution is known as brining). The amount of brine required is usually equal to half the volume of vegetables. Brining is the most important step in pickling. The growth of a majority of spoilage organisms is inhibited by brine containing 15 per cent salt. Lactic acid bacteria, which are salt-tolerant, can thrive in brine of 8-10 per cent strength though fermentation takes place fairly well even in 5 per cent brine. In brine containing 10 per cent salt fermentation proceeds somewhat slowly. Fermentation takes place to some extent up to 15 per cent but stops at 20 per cent strength. It is, therefore, advisable to place the vegetables in 10 per cent salt solution for vigorous lactic acid fermentation.

As soon as the brine is formed, the fermentation process starts and carbon dioxide begins to evolve. The salt content is now increased gradually, so that by the time the pickle is ready, salt concentration reaches 15 per cent. When fermentation is over, gas formation ceases. Under favorable conditions fermentation is completed in 7 to 10 days. When sufficient lactic add has been formed, lactic acid bacteria cease to grow and no further change takes place in the vegetables. However, precautions should be taken against spoilage by aerobic microorganisms in the presence of air pickle scum is formed which brings about putrefaction and destroys the lactic acid. Properly brined vegetables keep well in vinegar for a long time.

Selection of Ingredients for Pickles Making

1. Salt: For pickling any variety of common salt is suitable, provided it is pure. Salt should be free from impurities, tricalcium phosphate, magnesium phosphate, lime (reduces acidity of vinegar), iron (induce blackening of Pickle), magnesium salt (induces bitter taste). Unionized salt may make brine cloudy. Iodized table salt should not be used as it may darken pickles. Salt acts as a preservative and adds flavor and crispness; therefore, it is not advisable to use less salt or reduced-sodium salts

2. Vinegar: Gives a tart taste and acts as a preservative. For pickles of high standard and quality, the vinegar used should be of good quality and should be of 40-60 grain strength, that is, it should contain 4-6 % of acetic acid. Usually malt or cider vinegar is used. The final concentration of acid as acetic acid finished pickles should not be less than 2% to ensure good keeping quality.

3. Sugar: Sugar is used in the preparation sweet pickles. The white granulated sugar should be used.

4. Spices: Spices are added practically to all pickles, the quantity added depending upon the kind of fruit of vegetables taken and kind of flavor desired. The spices should be good quality and should be store in an airtight container in a cool, dark place.

5. Water: A soft water is recommended for pickle making. Very hard water may have an undesirable effect on the color and flavor of pickled products. However, some hard water might produce a firmer pickle. Hard water may be softened somewhat by the following method: Boil the water for five minutes. Skim off the scum and let the water sit for 24 hours. Then ladle off the water without disturbing the sediment in the bottom. Another option is to dilute hard water with soft water. To dilute, mix one part hard water with two parts soft

water. If hard water is to be used a small quantity of vinegar should be added to the brine to neutralize its alkalinity. Water should be iron free.

6. Fruits & vegetables: Select fresh, firm fruits or vegetables that are free of spoilage. Use a pickling variety of cucumber because the table or slicing varieties may result in a poor-quality pickle. Plan to pickle fruits or vegetables within 24 hours after the harvest for highest quality. If produce cannot be used immediately, refrigerate it and use it as soon as possible.

FPO Specification of Pickles

1. Any edible vegetable oil like rape seed, mustard, olive oil can be used.
2. Any suitable variety fruit can be used
3. The fruits used in the preservation, shall be wholesome. Ad only spices, salt, oil, sugar, jiggery, condiments and preservatives.
4. The permissible limit of preservative as sulphur dioxide 100 ppm and benzoic acid 250ppm.In case salt pickle minimum percentage of salt should be 12 and all ingredients used shall be thoroughly mixed clean and free from extraneous matter.

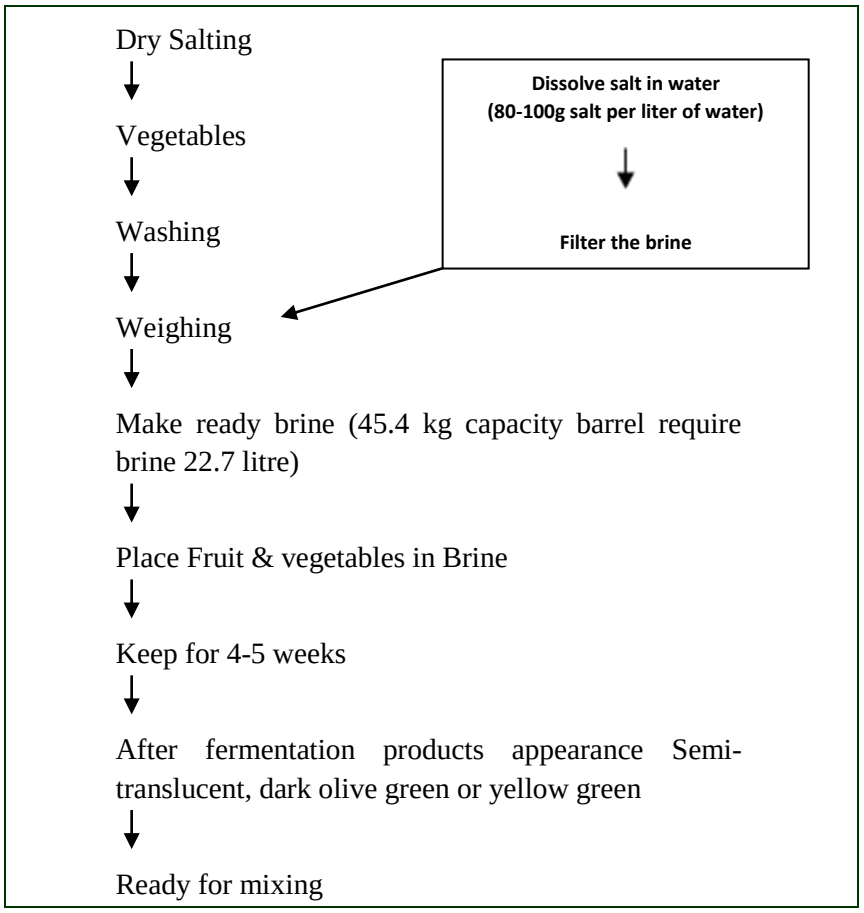
Pickling Process:

1. Curing or fermentation: (a) Dry salting fermentation (b) Brine fermentation
2. Finishing & packing.
    1. Curing or fermentation:

(a) Dry salting fermentation:

Dry Salting ↓ Vegetables ↓ Washing ↓ Weighing ↓ Make ready salt (100kg vegetables 3kg salt) ↓ Place the vegetables about 2.5cm deep in barrel/Keg ↓ Sprinkle small quantity of salt from weighing amount ↓ Place vegetable another layer ↓ Again sprinkle the salt	Salt is added layer by layer till barrel/keg is ¾ full ↓ Cover the salted vegetables with cheese cloth ↓ Put stone on it to extract brine ↓ After 24 hrs brine form and fermentation start ↓ After 8-10days fermentation completed at 27-32°C

(b) Brine Fermentation



1. Preservation with salt

Salt improves the taste and flavor and hardness the tissues of vegetables and controls fermentation. Salt content of 15 per cent or above prevents microbial spoilage. This method of preservation is generally used only for vegetables which contain very little sugar and hence sufficient lactic acid cannot be formed by fermentation to act as preservative. However, some fruits like lime, mango, etc., are also preserved with salt.

Recipe	
1. Cauliflower 250g 2. Carrot 250g 3. Bean 250 4. Radish 250g 5. Ginger 50 g 6. Red Chili powder 20 g 7. Turmeric Powder 20g 8. Cumin powder 20g 9. Mustard powder 15g 10. Coriander powder 20g 11. Salt 100g 12. Mustard Oil 120ml	Vegetables ↓ Washing ↓ Peeling ↓ Slicing ↓ Mixing with salt ↓ Keeping in salt for a week ↓ Mixing with spices ↓ Storage in cool and dry place

2. Preservation with vinegar

A number of fruits and vegetables are preserved in vinegar whose final concentration, in terms of acetic acid, in the finished pickle should not be less than 2 per cent. To prevent dilution of vinegar below this strength by the water liberated from the tissues, the vegetables or fruits are generally placed in strong vinegar of about 10 per cent strength for several days before pickling. This treatment helps to expel the gases present in the intercellular spaces of vegetable tissue. Vinegar pickles are the most important pickles consumed in other countries. Mango, garlic, chilies, etc., are preserved as such in vinegar.

Recipe	
1. Fruit 1kg 2. Vinegar 2litre 3. Sugar 0.75g 4. Water 0.75litre 5. Hot spices 5g 6. Coriander powder 1g 7. Salt 100g 8. Mustard powder 1g 9. Ginger 2g	Fruits ↓ Washing ↓ Peeling ↓ Slicing ↓ Blanching in salt solution (5%) 5 min ↓ Washing with plain water ↓ Shade drying ↓ Prepare solution of vinegar + water + sugar cook slowly ↓ Tie all spices in muslin bag and put in so that extract of spices mixed with vinegar solution ↓ Cooling ↓ Mixing with fruit pieces in ratio of 1:1 ↓ Filling ↓ Capping & labeling ↓ Storage in cool and dry place

3. **Pickle in oil:** The fruits or vegetables should be completely immersed in the edible oil. Cauliflower, lime, mango and turnip pickles are the most important oil pickles. Methods of preparation of some oil pickles are given below

Recipe 1. Sliced mango 1kg 2. Salt 100g 3. Garlic chopped 100g 4. Ginger chopped 50g 5. Chilli powder 25g 6. Fenugreek powder 25g 7. Nigella seed 15g 8. Aniseed powder 25g 9. Asofoetida powder 2g 10. Mustard oil 350ml	Mature Green Mango ↓ Washing ↓ Cutting into four pieces (Length wise) ↓ Removal of Kernal ↓ Dipping pieces in 2% salt solution (Prevent Browning) ↓ Draining the water ↓ Drying in shade 2-4 hours ↓ Heating oil and cooling ↓ Mixing spices in little oil ↓ Mixing with mango pieces ↓ Filling jar ↓ Keeping sun for a week ↓ Add remaining oil ↓ Capping ↓ Labeling ↓ Storage

4.8 Processing of Chutney:

Chutneys are generally hot and sweet and are relished by everyone poor and rich in the country. They improve digestion and are good appetizers. A good chutney is smooth to palate has mellow flavor and spicy. Chutneys can be prepared from various fruits such as mango, Anola, Gooseberry, Apple, Pear, Plum etc.

FPO Specification: Specification for chutneys is –1. Minimum per cent of prepared fruit in final product should be 40. 2. The permissible limits of preservatives in chutney as sulphur dioxide 100ppm and benzoic acid 250ppm.

Ingredients sweet chutney

1. Mango slices 1kg
2. Sugar 1kg
3. Salt 50g
4. Ginger Shreds 10g
5. Spices each (Cardamom, cumin, cinnamon, black pepper, aniseed) 10g
6. Vinegar 180ml

Ingredients Hot chutney

1. Mango slices 1kg
2. Sugar 0.5kg
3. Salt 50g
4. Ginger Shreds 50g
5. Onion 75g
6. Garlic 20g
7. Red chilli powder 15g
8. Spices each (Cardamom, cumin, cinnamon, black pepper) 10g
9. Vinegar 180ml

Fruit
↓
Washing
↓
Peeling
↓
Extraction of Pulp
↓
Mixing of salt & Sugar
↓
Allow to sweat (so that sugar and salt)
↓
Heating slowly
↓
Tie the spices in muslin bag and dip in the mixture Cooking & stirring till desire consistency
↓
Squeeze the spice bag & Remove it
↓
Addition of vinegar
↓
Heating up to jam consistency
↓
Cooling slightly
↓
Packing into clean sterilized bottles
↓
Cooling
↓
Capping
↓
Storage

Problems in chutney: Chutneys have little problems of spoilage due to the presence of vinegar, salt, sugar and spices. Sometimes rancidity and black compound formed in the product due to the contamination of iron with tannin of fruits and spices and their by adversely affect the colour, taste and flavor. Precaution should be taken to avoid the contamination.

Equipments require for Processing chutneys & sauces

1. Fruit washing machine
2. Fruit peeler
3. Fruit pulper
4. Steam jacketed kettle
5. Bottle filling machine/Pouch filling machine
6. Sterilizer

Medicinal and aromatic products of minor forest produce:

a. Arecanut: It has an important place in the ancient Indian system of medicine such as Ayurveda, Unani and Homeopathy. WHO has listed out as many as 25 different beneficial effects of arecanut on mankind. Chewing arecanut sweetens the breath, removes bad taste from the mouth, strengthens the gums and checks perspiration. It has potent antioxidant, anti-inflammatory and analgesic, antiulcer, hypolipidemic, antidiabetic and neuroprotective properties. It is also traditionally used in a number of ailments for its laxative, digestive, carminative, anti-ulcer, anti-diarrheal, anti-helmintic, anti-malarial, anti-hypertension, diuretic, prohealing, anti-bacterial, hypoglycemic, anti-heartburn properties.

b. Tamarind:

- In beverage form, it was commonly used to treat diarrhea, constipation, fever and peptic ulcers.
- The bark and leaves were also used to promote wound healing.
- The polyphenols in tamarind have antioxidant and anti-inflammatory properties.
- These can protect against diseases such as heart disease, cancer and diabetes.
- The seed extract may also help lower blood sugar, while the pulp extract may help you lose body weight and reverse fatty liver disease

c. Honey: Raw honey has been used as a folk remedy throughout history and has a variety of health benefits and medicinal uses.

- **A good source of antioxidants:** Antioxidants help to protect your body from cell damage due to free radicals. Free radicals contribute to the aging process and may also contribute to the development of chronic diseases such as cancer and heart diseases. The antioxidant compound in honey called polyphenol may help in preventing these diseases
- **Antibacterial and Antifungal properties:** Honey can kill unwanted bacteria and fungus. It naturally contains hydrogen peroxide, an antiseptic.
- **Heal wounds:** Honey is used to treat wounds because it's been found to be an effective germ killer and also aids in tissue regeneration.
- **Help for digestive issues:** Honey is sometimes used to treat digestive issues such as diarrhea. It's effective as a treatment for *Helicobacter pylori* (H. pylori) bacteria, though, a common cause of stomach ulcers. It's also a potent prebiotic, meaning it nourishes the good bacteria that live in the intestines, which are crucial not only for digestion but overall health.
- **Soothe a sore throat:** It also works as a cough suppressant. Helps in soothing a sore throat

d. Bael: The medicinal value of Bael fruit is enhanced due to presence of Tanin, the evaporating substance in its rind. The rind contains 20% and the pulp has only 9% of Tanin. This substance helps to cure diabetes, asthma, anaemia, healing of wound, swollen joints, high blood pressure, jaundice, diarrhea, troubles during pregnancy, typhoid and an ideal summer drink.

e. Elephant apple: Elephant apple/Chalta is prominent source of vital nutrients. They are rich in vitamin C, vitamin B complex, vitamin E, potassium, healthy fats, amino acids and proteins, and low in cholesterol. Moreover, the beneficial phytochemicals namely tannins, saponins, flavonoids, triterpenoids and phenolic compounds supply powerful anticancer, anti-bacterial and antioxidant characteristics. Elephant apple treats hypertension, kidney disorders, rejuvenates skin ageing, boosts vitality and vigor, and alleviates anxiety and depression.

f. Night Jashmin/Parijat: Night Jashmin/Parijat is a small shrub that has fragrant flowers. It has seven to eight petals arranged on an orangish –red stem.These beautiful flowers are used in many spiritual activities. The flower loses its brightness during day time and blooms at the night. From leaves to roots,the whole plant is very useful for various healing properties. Leaves are used to treat fever, cough, arthritis, worm infestation etc. The leaf is bitter and works as a tonic. The flowers work wonderfully for gastric and respiratory complaints. The stem powder is good to treat joint pain and malaria.

g. Ginger:

- Ginger and ginger oil have also been used to help nausea, arthritis, digestive upset, colds, migraines.
- Ginger essential oil can enhance concentration and it can soothe and reduce feelings of stress, sadness, anxiety, lethargy, agitation, dizziness, and fatigue.
- Ginger can be used fresh, dried, powdered, or as an oil or juice. It's a very common ingredient in recipes. It's sometimes added to processed foods and cosmetics.

h. Cinnamon:

- It has anti-viral, anti-bacterial and anti-fungal properties.
- Contains antioxidants with anti-inflammatory effects
- Its prebiotic properties may improve gut health
- Reduces blood pressure
- Lowers blood sugar and risk of type 2 diabetes
- Relieves digestive discomfort.
- Aromatherapy has been linked to many benefits, including reduced depression and anxiety, and better sleep.
- Food flavoring and cosmetics

i. Oregano:

- Oregano is a fragrant culinary and medicinal herb that has been used for thousands of years. Belonging to the mint family, or Lamiaceae, oregano is known for its earthy flavor that makes it a great addition to a wide variety of dishes
- Oregano has become one of the most popular cooking herbs in the world, featured prominently in Italian, Turkish, Mexican, and Greek cuisine.
- Oregano is most commonly sold and used in its dry form, as the aromas of fresh oregano are highly pungent and can easily overpower a dish.
- The plant is being packed with vitamins A, C, and K, and minerals like iron, calcium, and manganese. Oregano is also rich in dietary fiber.
- This leafy herb also contains essential oils like carvacrol and thymol, which have antibacterial, antimicrobial, and anti-inflammatory powers that help to fight harmful free radicals and prevent illness.

j. Bhoot Jolokia / King Chilly / Naga Chilly:

- The people of the north eastern India used the fruits of Bhoot Jolokia in different food formulations like flavoring curries, pickles due to its high-quality fragrance and pungency**.**
- Bhoot Jolokia contains more capsaicin (3-5%) as compared to any other Indian chilli.
- The capsaicin found has been reported to have various pharmacological activities and some of the clinical applications such as Pain reliever, Cancer prevention , Cardiovascular activity, Gastrointestinal benefits, Inhibition of bacterial growth, Anti-inflammatory property, Antiplatelet effect, Antioxidant activity, Hepatoprotective effects, Antidiabetic activity.

References

1. Hui, Y. H., & Evranuz, E. Ö. (Eds.). (2015). *Handbook of vegetable preservation and processing*. CRC press.
2. El-Ramady, H. R., Domokos-Szabolcsy, É., Abdalla, N. A., Taha, H. S., & Fári, M. (2015). Postharvest management of fruits and vegetables storage. In *Sustainable agriculture reviews* (pp. 65-152). Springer, Cham.
3. Singh, V., Hedayetullah, M., Zaman, P., & Meher, J. (2014). Postharvest technology of fruits and vegetables: An overview. *Journal of Postharvest Technology*, *2*(2), 124-135.
4. Sharma, S. K. (2010). *Postharvest Management and Processing of Fruits and Vegetables: Instant Notes*. New India Pub. Agency.
5. Jacob, P. (2008). *A handbook on post harvest management of fruits and vegetables*. Daya Books.

Chapter 5

Equipments involved in collection of Minor Forest Produce

Er. Tonmoy Hazarika, Dr. Sandeep Janghu
Indian Institute of Food Processing Technology-Liaison Office, Guwahati(Assam)

5.1 Automated Arecanut Climbing and Harvesting Machine

Arecanut tree has to be climbed three times every year for the purpose of harvesting. Only skilled labourers can do this, as the task is very risky.

The machine is powered by a 42cc petrol engine operated using a remote/mobile app. It consists of dumbbell shaped rubber-grip rollers, which are clamped on tree and their rolling motion along the tree trunk provides upward motion. The machine is self- adjusting for varying diameter (100 to 203 mm) of the tree and can climb over dents or bumps in the surface of the tree. The device can remotely be put in forward, reverse, neutral and cutting mode. The rate of climb can be controlled with an accelerator and the device has been designed such that on full throttle, it can climb the tree (approx. 50-60 feet) in one min, perform cutting operation in 1 min and climb down the tree in another minute. It weighs approx. 28 kg and can work for about 3 hours in 1 litre of petrol. If at all the machine stops functioning while climbing up or down the tree, a rope connected to it will enables the user to bring it down without climbing the tree.

Fig. 5.1: Areca Nut Tree

Fig. 5.2: Automated Arecanut Climbing and Harvesting Machine

5.2 Honey Extractor and a good bee keeper suit:

A honey extractor is a device that uses centrifugal force in squeezing honey out of the comb. They come in various sizes and styles and are designed to meet virtually any need and budget. However, for excellent efficiency, consider a model that can at least take in four frames at a time.

A beekeeper suit is very essential for any beekeeper, whether amateur or an expert. It gives the user confidence when around the bees. Even the most docile bees can send one or two sentinels that may scare you away. You should get a good quality suit, preferably one made with light color. Avoid any that has stripes or fancy imagery. Bees dislike wooly or rough materials. You should also avoid materials that have oil or animal scent. Always ensure any gap or hole in the suit is covered since bees always find away in. For the gloves use leather or thick latex material gloves. Thin materials can easily be penetrated by a bee sting and bees tend to sting the same spot.

Fig. 5.3: Honey Extractor

Fig. 5.4: Bee Keeper Suit

5.3 Bamboo Shoot Cutting Machine

This utility new type claims a one a bamboo shoot cutting machine, comprise machine frame and machine body, a machine body fixed on the machine frame upper, inner body set with rotating shaft, the rotating shaft with one end connecting with a motor, other end connected with a pallet, the pallet fixed connect with the machine body, the outer pallet of a rotating shaft fixing connecting with rotate cutting a cutting shaft, two shaft end set with fixed with cutter, inner body set with feeding channel, a pallet is set with feed inlet, feed inlet channel connected with the feeding, a feeding channel two end set with a transfer shaft, two shaft set with transfer surface of a transfer belt, and the pallet transfer shaft match of a uniform set with water seepage hole, the upper part of pallet a fixed body set with a water tank, a water tank set with a machine body is connected with the outer side of the water inlet, the cutting shaft organic cover, the upper hood set with a water inlet tube, a water outlet of the water inlet tube is connected with corresponding water tank, a rack of pallet bottom fixed set with a groove. The automatic cutting shoot machine increase the production efficiency and production quality of bamboo shoots.

Fig. 5.5: Bamboo shoot

Fig. 5.6: Bamboo shoot Cutter (Manual and mechanical equipment)

The other fruits also can be picked or collect individually, so that it does not fall on the ground to avoid cracking of the shell which may lead to spoilage during storage.

5.4 Specifications of machineries involved in processing of different minor forest produce:

5.4.1 For processing Jam, jellies, juices, squashes, syrups and RTS similar kind of machineries involved in different unit operation:

a) **Bubble washer:** Bubble washing machine is mainly used for washing various fruits, vegetables and medicinal materials. This cleaning machine is employing bubble washing system, having good processing effect with retaining the original quality of the product. It is a kind of practical equipment for washing foodstuff.

Fig. 5.7: Bubble washer

Features:

- Simple and continuous operation
- Variety of products
- Minimum maintenance and operation costs
- High washing efficiency with special selected water spray nozzles
- Hygienic Design
- Low water and energy consumption

Specification:

- Size : 4000 X 1300 X 1300 (mm)
- Power : 2.2kw
- Rated Voltage : 415V
- Frequency : 50 Hz
- Capacity : 1-3 ton / h
- Usage : Cleaning the surface of fruits or vegetables, Shrimps etc.

b) Blancher: Blanching exposes food products to boiling water or steam for a brief period of time and then quickly cools them to halt the cooking process. Blanching is one of the most important operations in the processing of foods. Blanching removes trapped air and metabolic gases within vegetable cells and replaces them with water. It is also used for the removing of skins in fruit and vegetable processing. Blanching a product is done by a food processing machine called a blancher.

Vegetable and Fruit Continuous Conveyor Blancher is made up by SS304 stainless steel, it works with continuous delivery for products. Temperature and speed are all can be adjusted according to the require. This machine also works with smooth running, low noise, and very easy be maintained. The water temperature can be controlled.

Fig. 5.8: Continuous Conveyor Blancher

Specification:

- Material: Stainless steel
- Voltage: 415 V
- Power: 3HP
- Frequency: 50-60 Hz
- Material grade: SS304

c) Pulper: The contacting parts of pulper machine are made of stainless steel the stand is made from rigid mild steel construction. Vegetable and fruit pulper machine is provided with a stainless steel suitable sieve which is ideal for most of the fruits. Inside the sieve a nylon brush and a blade are provided.

Fig. 5.9: Pulper

Specification:

- Material: Stainless steel
- Automatic: Yes
- Feature: Lower energy consumption, ECO friendly
- Computerized: No
- Voltage: 415-440 Volt(v)
- Warranty: 1 Year
- Motor: 0.5 hp
- Capacity: 80kg/hr

d) **Steam jacketed kettle:** The steam jacketed kettle or evaporating pan is an evaporator that can be used for the bulk evaporation of water from aqueous liquids. It is constructed in the form of a hemispherical shaped shell usually made of stainless steel that is comprised of an inner pan or 'kettle' and an outer pan or 'jacket'. Steam flows through the space between the outer and inner pans at a slightly elevated pressure. The hot steam causes heat to pass through the inner pan, by conduction, to the solution that is to be evaporated. As the temperature of the solution rises, so solvent molecules are evaporated. The pan can be permanent mounted and the product is emptied through an outlet at the bottom of the pan, or the pan can be mounted in such a way that it can be tilted so that the product can be poured out.

Fig. 5.10: Steam jacketed kettle

Specification:

- Capacity: 9.4 Liters
- Jacket Capacity: 0.9 Liter
- Diameter: 30.5 cm
- Depth: 23 cm
- KW at 208 V Single Phase: 3.6 KW, 17.3 Amp
- KW at 240 V Single Phase: 4.8 KW, 20 Amperes
- Base Width: 48.3 cm
- Base Depth: 23.5 cm

e) **Refractometer:** When light enters a liquid, it changes direction; this is called refraction. Refractometers measure the degree to which the light changes direction, called the angle of refraction. A refractometer takes the refraction angles and correlates them to refractive index (nD) values that have been established. Using these values, you can determine the concentrations of solutions. For example, solutions have different refractive indexes depending on their concentration in water.

Fig. 5.11: Refractometer

Specification:

- Measuring Scales: Sugar (°Brix)
- Measuring Ranges: Sugar (°Brix) 0 – 100
- Resolution: Sugar (°Brix): + 0.001
- Accuracy: ± 0.02
- Precision: ±0.005
- Sample Volume capacity: ~ 1.5 mL

f) **Bottle Filling Machine:** Based on the different filling pressure, liquid filling machine can be classified into ordinary pressure liquid filling machine, vacuum liquid filling machine and pressure liquid filling machine. Ordinary pressure liquid filling machine adopts gravity-flowing filling based on its own weight of the liquid. Greater requirements should be done for the viscosity and gas-bearing of the liquid.

Paste filling machine adopts volumetric method to measure, through the way to adjust the plunger volume to realize the control of filling quantity. The reciprocating movement of the piston achieves filling rapidly. The equipment has advantages of high filling efficiency and easy maintenance.

Fig. 5.12: Semi automated bottle filling machine

Specification:

- Automatic Grade: Semi-Automatic
- Feature: Machinery & Hardware
- Material: Stainless Steel
- Drive Type: Electric
- Type: Filling Machine
- Voltage: 380-440 Volt (v)

g) **Crown corking machine:** It gives a prefect sealing and bottles can be preserved for long with this method of sealing. Once opened crown cork cannot be used again. It is a hand operated machine in which corks crush are held by magnets and bottle is kept on the platform. By hand pressing crown is fixed on the bottles.

Fig. 5.13: Crown corking machine

Specification:

- Capacity: 10 - 15BPM
- Material: Steel
- Working Type: Manual
- Cork Holder: Magnetic
- Surface Finish: Color Coated

h) **Autoclave:** The basic principle of steam sterilization, as accomplished in an autoclave, is to expose each item to direct steam contact at the required temperature and pressure for the specified time. Thus, there are four parameters of steam sterilization: steam, pressure, temperature, and time.

Fig. 5.14: Autoclave

Specification:

- Insulation Wall: Single Wall
- Shape: Vertical
- Chamber Volume: 10-15 Litre
- Material: Stainless Steel
- Mount Type: Table Top Autoclave

5.4.2 For processing dried products like powder of spices, flakes and dehydration process similar kind of machineries involved in different unit operation:

a) Cabinet tray dryer: In a cabinet dryer, the feed is loaded onto trays that, depending on the required quantity of material to be processed and hence dryer size, are loaded onto trolleys or inserted into the drying chamber. The door is closed, sealing the system. The trays may have a solid or perforated bottom, depending on the feed particle size distribution. The carrier (typically, air) is drawn in through an inlet duct or recycle channel into the heating compartment. The air is heated to the required temperature in this region, then distributed from side-to-side (cross-flow) or bottom-to-top (through-the-bed flow) in a circular motion, according to specific drying requirements. Cabinet dryers come in various sizes and may have multiple fans on larger units. There also may be more than one heating compartment. Cabinet dryers can dry all types of feeds from liquids and slurries to granules, agglomerates and solids.

Fig. 5.14: Cabinet tray dryer

Specification:

MODEL	SS-6	SS-12	SS-24	SS-48	SS-96	SS-192
Capacity in trays	6	12	24	48	96	192
No.of Motors / (H.P.)	1/ 0.5 HP	1/ 0.5 HP	1/ 1 HP	1/ 1 HP	2/ 2 HP	4/ 4 HP
No. of Doors	1	1	1	1	2	2
No. of Trolleys	Nil	Nil	Nil	1	2	4
Heating load (KW)						
100^{o}C	1.5	3	6	9	18	36
200^{o}C	4.5	6	9	15	24	42
150^{o}C	3	4.5	7.5	12	21	39
250^{o}C	6	7.5	10.5	18	27	45
300^{o}C	7.5	9	12	21	30	48

b) Mixer grinder: When electricity is provided to a mixer grinder, the blades start rotating. A motor converts electricity to mechanical energy. A coil is placed between magnetic field. When, a current run in the coil, the coil experiences a magnetic force which causes it to rotate. The blades are attached with this. When the blades rotate, it mixes and grinds the ingredients.

Fig. 5.15: Mixer grinder

Specification:

- Power: 750 W
- Voltage: 220-240V
- Revolution: 20000
- No of Jars: 3
- Jar Size: 1.5L Liquidizing Jar, 1.2L Dry grinder, 0.3L Chutney Jar
- Jar Material: Stainless Steel
- Blade Material: Stainless Steel
- Speed Control: 3 speed control with incher for momentary operation

c) Pin mill: The pin mill also categorized as a disc mill is a kind of milling equipment that can break up cellular materials selectively without damaging the starch granules. It consists of two horizontal steel plates with vertical projections arranged in concentric circles on opposing faces and becomes more closely spaced towards the periphery.

Pin mill uses a series of pin breakers attached to discs instead of hammer in the rotating grinding head to achieve high energy impact between the mill and the particles. It is traditionally employed to disintegrate starch- protein bond that exist in the material and produce fine flour.

Fig. 5.16: Pin mill

Specification:

PIN MILL TYPE	PM 200	PM 300	PM 450	PM 600	PM 900
Power (kW)*	2 x 10	2 x 15	2 x 30	2 x 60	2 x 75
Speed (RPM)	0 to 10,000	0 to 8000	0 to 5000	0 to 3000	0 to 3000
Dimensions	1.5 x 0.7 x 0.7	1.7 x 0.8 x 0.8	2 x 0.9 x 0.9	2.8 x 1.5 x1.2	3.2 x 1.8 x 1.4

d) Ball mill: A ball mill also known as pebble mill or tumbling mill is a milling machine that consists of a hallow cylinder containing balls; mounted on a metallic frame such that it can be rotated along its longitudinal axis. The balls which could be of different diameter occupy 30 – 50 % of the mill volume and its size depends on the feed and mill size. The large balls tend to break down the coarse feed materials and the smaller balls help to form fine product by reducing void spaces between the balls. Ball mills grind material by impact and attrition.

The degree of milling in a ball mill is influenced by;

- Residence time of the material in the mill chamber.
- The size, density, and number of the balls.
- The nature of the balls (hardness of the grinding material)

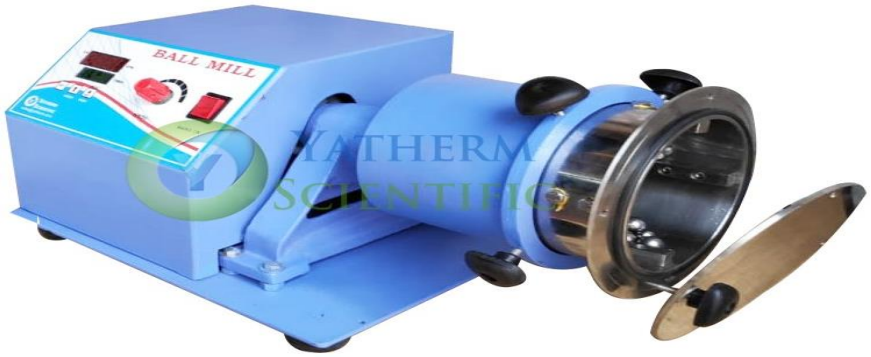


Fig. 5.17: Ball mill

Specification:

Input Power	Available for both 110V/60Hz or 220V AC, 50 Hz, single phase, 375 Watts
Milling principle	Impact and friction force
Operation mode	Two or four grinding jars working simultaneously
Compatible non-vacuum grinding jars	(50ml~100ml)*4
Size of milling balls (diameter)	6mm, 10mm and 20mm
Max feeding capacity	2/3 capacity of a grinding jar
Operation mode	2 or 4 grinding jars work simultaneously
Feeding granularity	Soil materials<10mm, other material<3mm; (larger samples need preliminary size reduction)
Discharging granularity	Down to 0.1 μm
Sample type	Hard, medium hard, soft, fibrous, brittle, moist, dry or wet
Rotation speed of mill jar	600 rpm
Rotation speed ratio (planetary disk/jar)	1:2 for 0.4L, 2L and 4L
Drive mode	Gear drive and belt drive
Speed control	Stepless speed regulation
Speed control mode	Speed regulation mode: stepless speed regulation with frequency converter; program control; clockwise or counter clockwise revolving; manual or automatic timing
Max. continuous grinding time (full load)	72 hours
Shipping weight	170 lb
Dimension (L*W*H)	24*14*17.5 inch
Shipping dimension (L*W*H)	27*17*23 inch

e) Form fill seal machines:

Fig. 5.18: Form fill seal machines

Specification:

- Packaging Material: Plastic, Paper, Aluminum foil
- Driven Type: Electric
- Voltage:220V
- Dimension(L*W*H):600*700*1500mm
- Weight:260kg
- Range of measurement:1-50ml
- Bag size:(L)15-160 (W)20-100mm
- Sealing type: 3 or 4 sides sealing
- Machine material: 304 stainless steel
- Control type : PLC computer screen

5.4.3 For processing of chips and fried product machineries involved in different unit operation:

a) Slicer: Different fruit or vegetable have different size and shape. Machine able to slice all kind of fruits & vegetable having different size. The slicing machine works on the principle of simple cutting and slicing mechanisms. As initial moment of inertia is overcome by manual feeding and hopper inclination.

Fig. 5.18: Fruits and Vegetables slicer

Specification:

- Function: For slicing vegetables into small required slices.
- Minimum cutting size: 1mm
- Property: Stainless
- Power: 1.1-1.5KW
- Voltage: 220 - 240V
- Capacity: 400-1000 Kg/h

b) Deep Fat Fryer: Deep-frying involves the immersion of food in hot oil or fat to cook it to a crisp golden colour. The popularity of deep-fried food makes it a part of every catering operation. Since the development of good frying compounds and improved deep-fryer design, the responsibility rests with the cook to produce first-class deep-fried food.

Fig. 5.19: Deep Fat Fryer

c) Nitrogen Flushing Machine: Nitrogen flushing is a method used to preserve and protect food from damage during shipping and storage. Nitrogen replaces the oxygen in a food storage bag, and it cushions the contents. Unlike oxygen, nitrogen doesn't react with foods or affect the flavor or texture, so they stay fresher longer.

Fig. 5.20: Continuous Nitrogen Flushing Machine

Specification:

- Power Supply: Single Phase 220 V / 50 HZ
- Power Consumption: 500 W
- Sealing Speed: 0 to 12 Mtr/ Min.
- Sealing Width: 10 mm
- Temperature: 0 to 300 C
- Conveying Load: 3 Kg
- Dimensions: 1040 x 380 x(450 to 630 Adjustable) (mm)
- Weight: 40 Kg

5.5 CIP: Cleaning-in-place

Cleaning-in-place (CIP) is an automatically performed and combination of mechanical and chemical method of cleaning, applied to remove residues from complete items of plant equipment and pipeline circuits without dismantling or opening the equipment.Cleaning in place means that cleaning takes place without dismantling the system. It is a system of cleaning engineered to provide fast, productive, consistent and reproducible high quality cleaning of all product contact surfaces to a predetermined level of cleanliness, by circulating chemical (detergent and disinfectant) solutions and rinsing water through tanks and piping of a food processing plant that remains assembled in its production configuration, and by jetting or spraying of the product contact surfaces under conditions of increased turbulence and flow velocity.

5.5.1 Objectives of CIP

1. To assure food safety in food processing plants.
2. To avoid potential contamination by successful cleaning between production runs.
3. To minimize the uses of water and detergents by maximizing the re-use of resources.
4. To contribute an overall low cost of ownership (TCO).

5.5.2 Importance of CIP

CIP is an important component in guaranteeing food safety in food processing plants. Successful cleaning between production runs avoids potential contamination and products that do not meet quality standards. Carrying out CIP correctly from design to validation ensures secure barriers between food flows and cleaning chemical flows. It is also important that CIP is carried out effectively and efficiently and contributes to an overall low total cost of ownership. From the point of view of food processing, any cleaning time is downtime the equipment is not productive. Cleaning must also be carried out safely, because very strong chemicals are involved that can be harmful to people and to equipment. Finally, it should be carried out with the least impact on the environment by using minimal amounts of water and detergents and by maximizing the re-use of resources.

5.5.3 Factors affects the cleaning-in-place (CIP) process

To clean the whole process equipment and piping system in a minimum of time, a CIP system aims to combine the benefits of high solution temperature (thermal energy) and chemical activity of the detergent chemicals (chemical energy) with the mechanical action caused by the turbulent flow and impact of the sprays/jets of cleaning solution on the equipment surfaces (mechanical energy). But to be successful, other factors are equally important, such as the quality of the water to prepare the cleaning solutions (low counts of spoiling microorganisms, low water hardness), the intimate contact between the cleaning solution and soil (all surface to be cleaned must be covered), the applied CIP programme, the hygienic design of the process equipment to be cleaned, and the quality of work of the cleaning staff.

5.5.4 Cleaning process

A cleaning process can be considered to consist of three primary steps:

1. displacement of organic and/or inorganic soil from the equipment substrate by chemical reactions and physical processes,
2. dispersion of the soil into the cleaning medium and
3. prevention of soil re-deposition on the substrate.

The first step demands a cleaning agent with an excellent wetting power to reduce the surface tension of the cleaning medium and to help the cleaning liquid to penetrate into the soil and surface pores. The solubilization

of the soil can be increased because detergents may disperse and sequester respectively the organic and inorganic soil. The second step requires detergent chemicals with excellent suspending and emulsifying power to bring the insoluble soils into suspension and to keep oils and fats dispersed within the cleaning solution. To finally prevent the re-deposition of the soil, the dispersing and sequestering properties involved in the first and second step are addressed again. Because there exists no universal detergent formulation that has the ability to remove every type of soil and that may clean every type of process equipment, a detergent should be selected that gives the best cleaning results for a specific process equipment.

5.5.5 Cleaning parameters

Type of impurities or inadequate substances like soil is held on the surfaces by adhesive forces. To get the soil to leave a surface the forces that hold the impurity on the surface have to be overcome.

There are four parameters that make up cleaning:

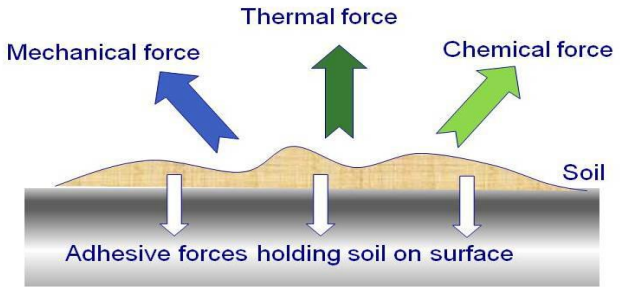


Fig. 5.21: Mechanical force, thermal force (heat), chemical force and the time the forces act.

Energy is required in a cleaning process in order to remove the soil and once dissolved, keep it in solution and carry it away. The energy required is kinetic, chemical and thermal energy. These three factors, together with the contact time determine the effectiveness of the cleaning.

5.5.6 Selection of cleaning chemicals

The selection of an adequate cleaning agent is a demanding task, because a preferred detergent must meet several criteria:

- Effective against a wide range of soils
- Excellent wetting, fat emulgation and sequestration properties
- Potential to bring soil in suspension and keep it dispersed within the cleaning solution
- Provide optimal cleaning at low concentration
- Allow quick and complete mixing with water (fast and complete solubility in water)
- Possess an excellent hard water tolerance
- Low foaming to allow fast and complete rinsability;
- Allow fast and free rinsing (with no detergent residues left)
- Food grade (non-toxic, free of perfumes and dyes, etc.)
- Safe to use
- Compatible with all materials of construction, non-corroding
- No deleterious effects on the equipment surfaces
- Environmentally friendly (e.g., biodegradable)
- Preferably authorised by regulations
- Low cost

In function of the cleaning result required, which varies from physically clean over chemically clean to microbiologically clean, a broad selection of multiple-component detergent formulations are available on the market. They are of the alkaline, neutral or acid type.

5.5.7 Disinfectants

Disinfection aims to reduce the number of food spoiling microorganism (responsible for off-colours, off flavours and off-odours) and pathogens which may be present on process equipment after cleaning. For the disinfection process to be successful, process equipment surfaces have to be cleaned to a sufficient level. If large quantities of soil are still present, the efficiency of the disinfectant will decrease. The disinfectants must be correctly applied to the equipment surfaces according to the pre-scribed procedure of application and in the correct amounts. disinfectant formulations may contain:

- Disinfectants, with two main types: oxidizing disinfectants (hypochlorites, iodophores, ozone, peracetic acid, hydrogen peroxide) that kill microorganisms as result of their oxidizing activity, andnon-oxidizing disinfectants (quaternary ammonium compounds, ampholytes, alcohol) that inactivate microorganisms by non-oxidative complex reactions on either the outside or inside of the microbial cell. Formaldehyde and phenolics are very effective but they are either toxic, either irritating or maycause off-odours. Avoid the use of quaternary ammonium compounds for reasons of foaming.
- Buffering agents, pH-regulators (bases, acids or salts), that are used either to provide the optimumpH required for the biocide to be active, either to control the corrosion risk typical for oxidizingdisinfectants, or to provide the necessary stability to the disinfectant in solution or concentrated form.
- Non-ionic or anionic surfactants improve wetting or enhance foam applications
- Hydrophobic non-ionic surfactants working as defoamers
- Hydrotrophic substances

5.5.8 Water quality

Water is the main component in cleaning solutions, usually 95% and more. To obtain optimal and consistent cleaning results, the water used to prepare the cleaning solutions must be of sufficient quality. The following substances or parameters have proven to be problematic during cleaning in place processes and must be carefully monitored:

- Total bacterial count, which must be < 100 cfu (colony forming units)/ml. Coliforms and E. coli must be absent in 100 ml.
- Objectional tastes, odours and colours may be removed by ozone treatment or activated carbon filtration.
- Dissolved gases such as O_2, CO_2 and H_2S may cause a lot of problems. Dissolved oxygen promotes oxidation of metals, especially iron, brass, and galvanized metal, while CO2 may form weak acids that may cause corrosion. Hence, supplementation of additional alkali will be required. Hydrogen sulphide may disrupt the ion-exchange activity of ion-exchange resins, may promote tarnishing of certain metals and may cause organoleptic deviations. De-aeration is the most common method to remove dissolved gases.
- Total dissolved solids (TDS) is the total of all chemicals dissolved in the water (usually not problematic for cleaning and disinfection).
- The conversion non-carbonate hardness into insoluble deposits is due to the presence of certain alkalis. Specific constituents are incorporated into a detergent to minimize the precipitation.
- Silicate in high concentrations can form dull layers on stainless steel surfaces. The removal of silica may proceed by means of a strong base anion exchanger.
- Iron and manganese may react with sequestrants, being a major disadvantage because both ions,
- as part of the waters redox system, contribute to the corrosivity of water. Soluble iron and manganese salts in concentrations above 0.3 ppm will cause coloured deposits on equipment surfaces. Iron and manganese may be removed by precipitation and filtration.

5.5.9 Types of CIP systems

A CIP system is usually composed of one or more tanks, a CIP supply and CIP recirculation pump, metering pumps for feeding cleaning chemicals, a heat exchanger for heating the cleaning solutions, CIP supply and

CIP return piping, valves, instrumentation (temperature and conductivity probes, pressure transmitters, etc.), flow meters and a more or less automated control system.

There are four basic types of CIP concepts: fill-boil-and-dump cleaning, single-path CIP systems, single-use CIP systems and re-use CIP systems. To choose what type of CIP station should be installed in a process plant, economic criteria, local regulations regarding water and waste water as well as the size and numbers of objects to be cleaned, the frequency of cleaning operations and the risk of potential cross contamination by allergens must be considered

I. Fill-boil-and-dump-cleaning

This method is possible when, at the start of a process, an ingredient tank with a volume sufficient to contain enough cleaning solution for the whole system to be cleaned is present. In fill-boil-and-dump cleaning after manual cleaning, the tank is filled with water and detergent is supplied. The cleaning solution is then heated to boil-up, and line flushing which is effective for cleaning piping 7.5cm or smaller in diameter is executed. The advantages of boil-up are that it is straightforward and requires no additional piping or spray devices beyond those required for the process. As no additional equipment is needed, no or little capital investment is required. However, in addition to being time and energy intensive, boils-up do not make the most effective use of aqueous cleaning solutions. There is no residual circulation, and the cleaning solution is drained, making this concept of cleaning expensive because high amounts of water and detergents are used. This technique also suffers from poor repeatability and the results may be inconsistent or unsatisfactory. Hence, the fill-boil-and-dump cleaning method is also difficult to monitor and to validate

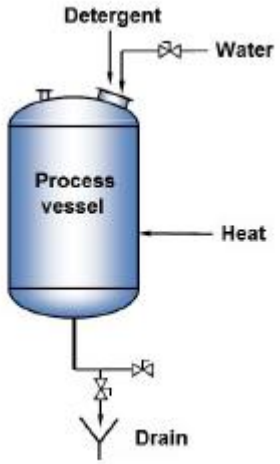


Fig. 5.22: Fill-boil-and-dump-cleaning system

II. Single-path CIP system

In the single-path CIP system, a freshly made-up cleaning solution is supplied from a single tank filled with water to which cleaning agents are dosed in the tank or in-line. There is no residual circulation in the cleaning system (wash and rinse solutions are not returned to the CIP-installation), and the cleaning solution is drained. Hence, no soil is spread through other parts of the system. In this concept, hardly any investment in additional equipment is needed. The main disadvantage of this system is that cleaning fluids are used only once because they are discharged at the end of the cycle. Hence, running costs may be high in energy, water and detergent and disinfectant chemicals, and large quantities of effluent are produced increasing the water treatment and waste disposal costs. Cleaning also may take a long time because, after each cycle, a new batch of cleaning solution has to be prepared. The single-path cleaning system is also difficult to monitor and to validate

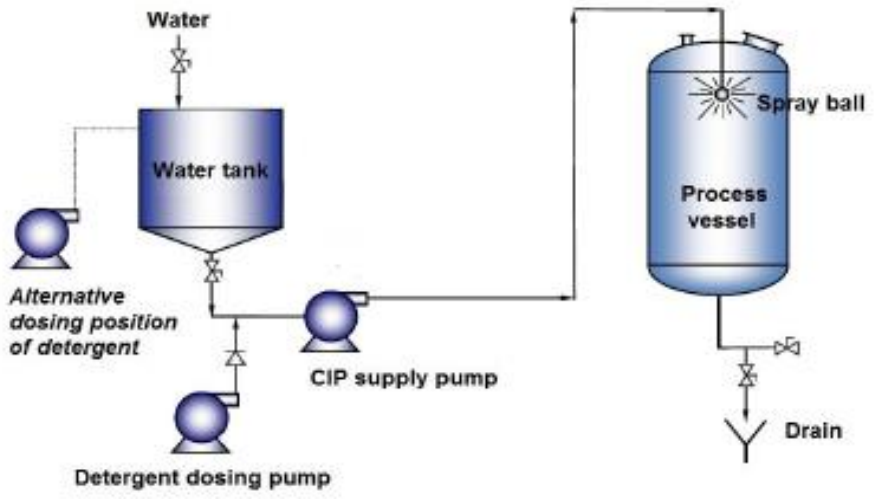


Fig. 5.23: Single-path CIP system

This single-path cleaning-in-place method is only recommended for relatively small process plants, very dirty processing equipment or special process equipment (e.g., separation membranes because of the specificity of cleaning products that are used). This concept is also appropriate when the risk of cross-contamination is high. This method of cleaning-in-place is commonly used in the pharmaceutical industry.

III. Single-use CIP systems

Single-tank, single-use systems operate on the basis of smaller volumes of solution automatically adjusted to the required detergent concentration and temperature by using a preparation loop. Single tank single-use systems are usually small, packaged units (skids) with one tank, pipes, centrifugal pumps, valves, a direct steam injection device (direct heating of detergent solutions), a heating coil in the tank or an external heat exchanger (indirect heating of detergent solutions), several dosing pumps to automatically feed cleaning chemicals from the shipping containers or bulk storage, etc. These systems use the solution only once at the lowest possible strength and discharge it to the sewer at the end of each cycle.

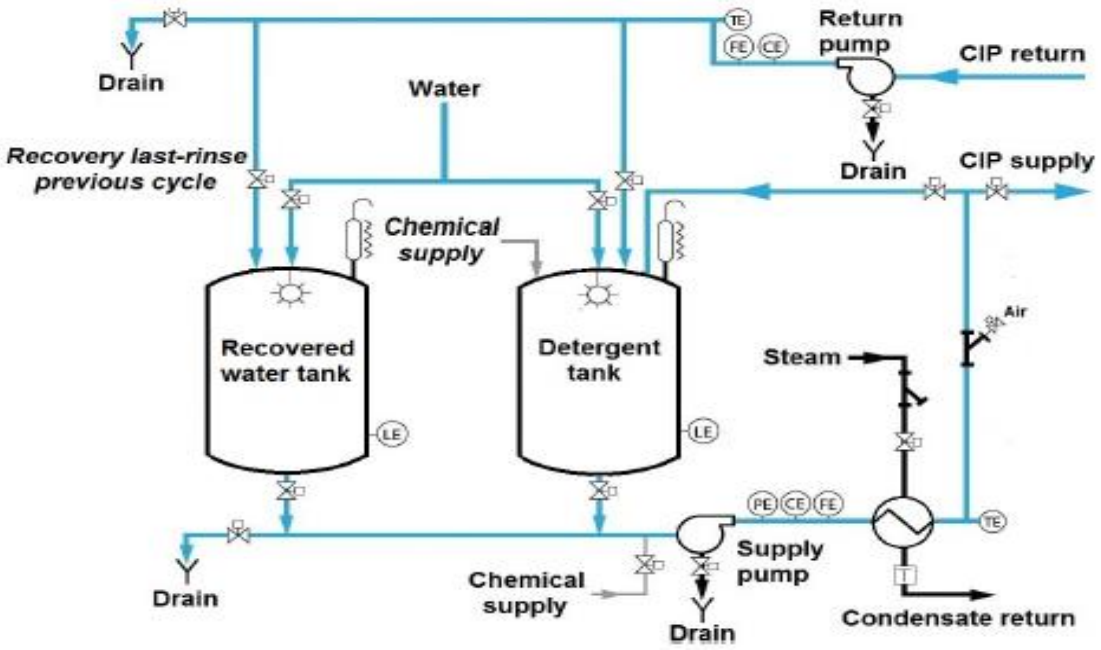


Fig. 5.24: Single-use CIP systems

Single-use CIP systems are small in size, simple in design, low in initial investment, and flexible inapplication. However, single-use CIP stations are seldom used in the agro-food industry (AFI). They are

suitable for relatively small equipment that is heavily soiled, or for processes where cross contamination is strictly forbidden (e.g., process installations with solids and chunks, process equipment containing allergens, membrane plants, etc.). Single-use systems are especially used in the pharmaceutical industry due to the fear of cross contamination that could arise by recycling of cleaning solutions.

IV. Re-use CIP systems

A typical reuse CIP system consists of (a) caustic tank(s), an acid tank, a water recovery tank (e.g., to recover the last-rinse water of a previous cleaning cycle, which is re-used as pre-rinse water for a next cleaning cycle), and one tank containing the water for the final rinse. All tanks are interconnected by piping, provided with valves and manifold fitted with CIP supply and return pumps. From containers, metering pumps feed metered amounts of concentrated caustic or acid cleaning chemicals directly into the water-filled caustic and acid tank, or these chemicals are injected in-line in a preparation loop. A preparation loop is a very efficient system, especially when the caustic and acid tanks of the CIP station are tall**.**

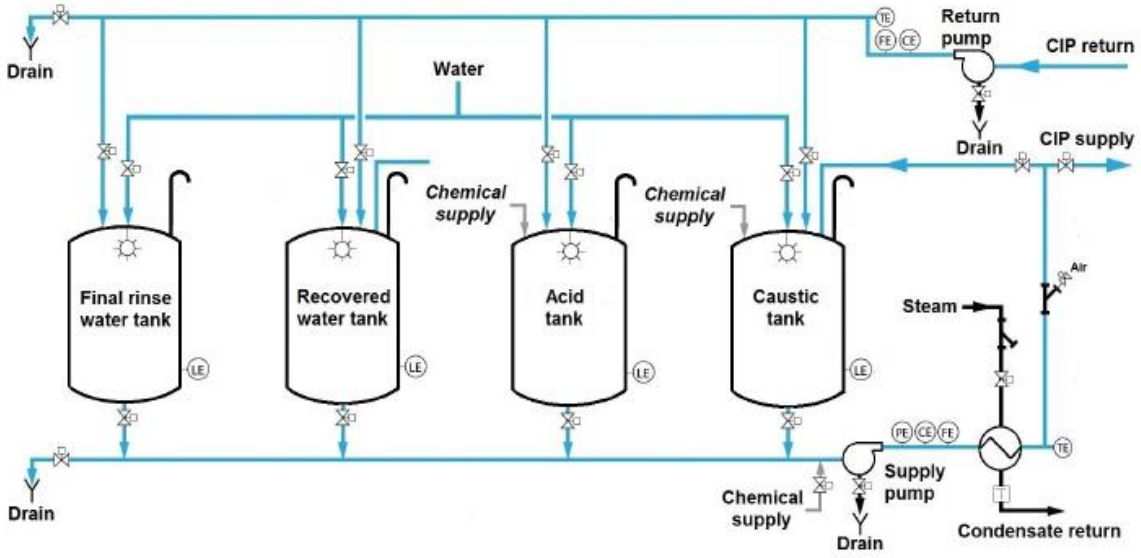


Fig. 5.25: Re-use CIP systems

Detergent chemicals are fed in-tank or in-line. The content of each of the CIP tanks is mixed by recirculation over the corresponding CIP tank through the CIP supply/recirculation pump and is meanwhile heated during its passage over the heat exchanger. At the adequate strength and temperature, all monitored by conductivity and temperature sensors, the recirculation valve closes, and the cleaning solution flows in the CIP supply line. The cleaning solutions can be routed back to the CIP system either by gravity (where feasible) or via a low-speed CIP Return pump. Solutions are recovered to the corresponding tanks or sent to drain (courtesy of Sanimatic).

5.5.10 Parameters that determine the effectiveness of a tank cleaning process:

- Stationary spay devices
- Rotary spray devices
- Rotary jet devices

Stationary spay devices:

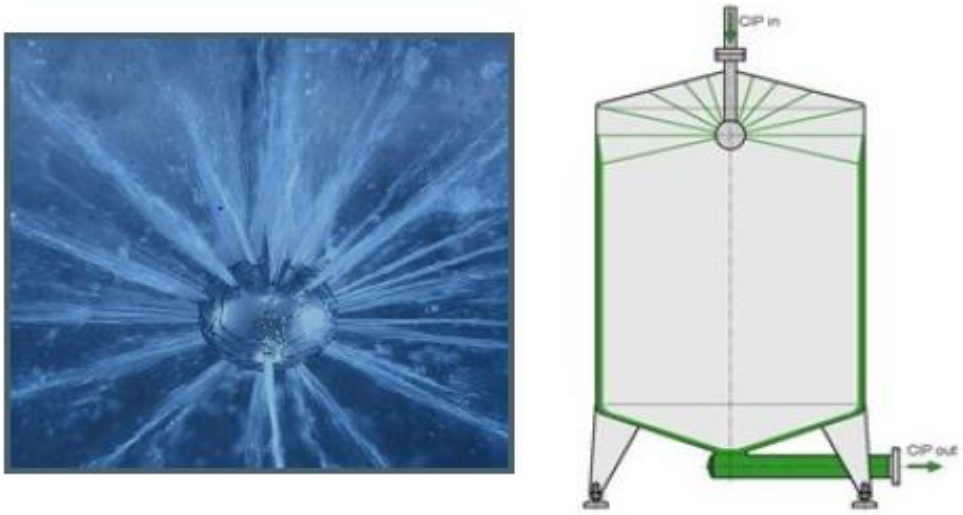


Fig. 5.26: Static spray balls

Fig. 5.27: Stationary "cluster" spray device

Rotary spray devices:

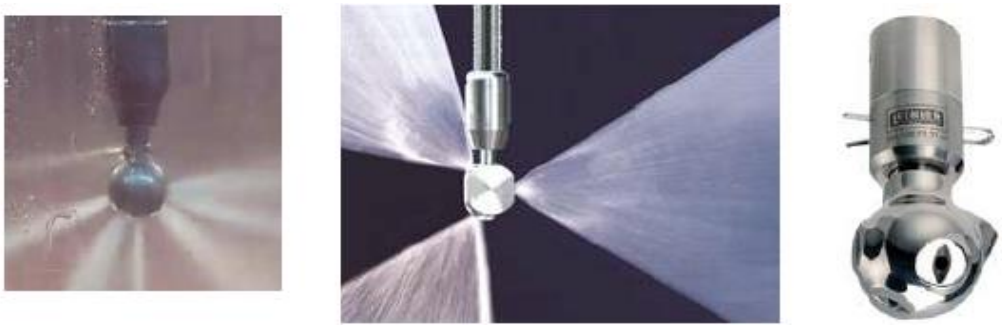


Fig. 5.28: Rotary spray devices

Rotary jet devices:

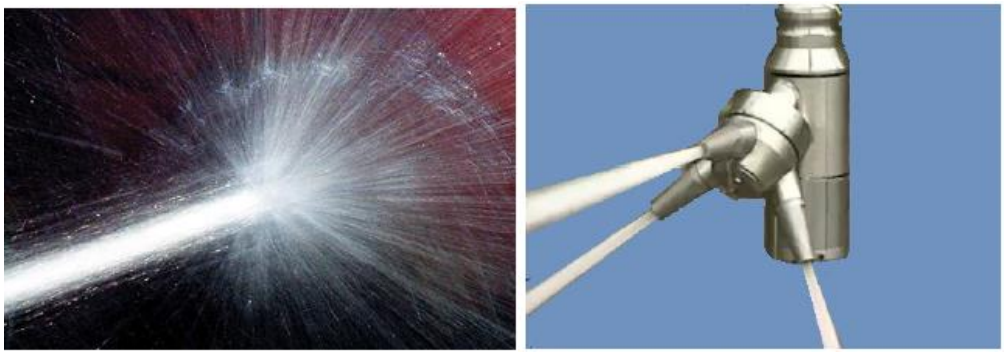


Fig. 5.29: Rotary jet devices

5.5.11 Sterilization and disinfection of food process

Cleaning, sterilization, and disinfection of processing lines are performed before production re-starts. Sterilization is performed in aseptic lines and lines for extended shelf life (ESL) products. Disinfection is used in non-aseptic production lines (except ESL lines).

After sterilization all microorganisms are inactivated or removed from the surface. Disinfection inactivates all pathogenic microorganisms and reduces the total amount of microorganisms on the surface. Both sterilization and disinfection require cleaning first to be successful.

- **Cleaning**

Before sterilization or disinfection is done a proper cleaning of the surfaces has to be performed. Cleaning removes the organic soil that can protect the microorganisms from sterilization and disinfection. Cleaning can also reduce the number of microorganisms on the surface and thus make it easier to sterilize or disinfect. Chemical disinfection is usually more sensitive to how well cleaning is performed than disinfection with heat.

- **Sterilization**

Sterilization is the complete destruction or elimination of all living microorganisms, viable spores, viruses, and viroids. Sterilization can be accomplished by physical (dry or moist heat) and/or chemical methods.

Sterilization of food processing lines with circulation systems are usually done with moist heat. Sterilization can be performed with steam under pressure that gives a temperature of 125 °C for 30 minutes.

- **Disinfection**

Disinfection is a process by which microorganisms are reduced to a level that does not compromise food safety or suitability and is done with chemical and/or physical methods. The major aim of disinfection is to inactivate microorganisms that are harmful to humans. (The term sanitization is more commonly used in the food industry in the USA.)

Disinfection of food processing lines with circulation systems can be done with moist heat (hot water at 90-95 °C for 15-20 min or steam <1 bar) or at room temperature using chemicals, to save energy. Disinfection with chemicals requires rinsing with water after disinfection.

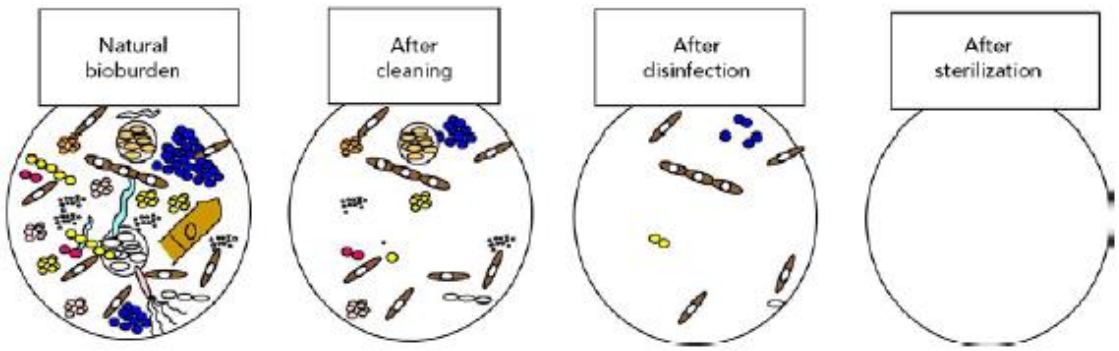


Fig. 5.30: Bioburden load in cleaning process

- **Novel disinfectants**

A lot of work is going on to find new disinfection technologies that can be used in recirculation applications (CIP). The aim is to reduce the environmental impact by replacing traditional chemical disinfectants and reducing the energy consumption used in hot water disinfection. Here we take up two of them: electrolyzed water and ozonated water.

5.5.12 Future trends

Irrespective of what a company manufactures, reducing production costs is the most important objective everywhere. It makes the difference between dead or survival, and the food industry is not an exception with respect to this issue. More than in other industry sectors, cleaning and disinfection is an essential part of daily life in a food factory. It is a necessary evil that prohibits food producer's to produce 24 hours a day. Cleaning and disinfection means downtime, and less production. Therefore, the main objective of every company is reducing the time spent on cleaning and disinfection. Reducing cleaning time starts with the process itself. If the food manufacturer operates the installation for longer than the specified manufacturer's recommended processing times and if he runs his production process in far from optimal conditions (e.g., to high temperatures), major fouling and more adherent deposits may form on equipment surfaces (e.g., plate heat exchangers) increasing the time needed for cleaning and hence reducing the time to produce. To reduce the time required for cleaning and disinfection, detergent manufacturers try to develop cleaning formulations that allow combination of one or more steps in a normal cleaning cycle. Developing cleaning formulations that permit removal of organic and inorganic soil in one step, or that allow to clean and disinfect simultaneously (e.g., removal of inorganic deposits and simultaneous disinfection with per acetic acid) is a major research objective of every supplier of cleaning agents. To facilitate the removal of heavy soil deposits, the use of detergent formulations based on enzymes has gained a lot of interest in the food industry. However, the present generation of enzymes is still quickly inactivated at high temperatures, making development of more heat resistant enzymes a major challenge. Problems with allergic reaction and cost price also prohibited enzymes from becoming the new cleaning agents of the future.

References

Adams, D.G. & Agarwal, D. (1990),'CIP system Design and Installation', Pharmaceutical Engineering, 10 (6), 9-15.

Bylund, G. (1995) 'Cleaning of Dairy Equipment', Ch. 21, in Teknotext AB (ed.), Dairy processing handbook, Tetra Pak Processing Systems A/B, Lund, Sweden, pp. 403-413.

Jensen, B.B.B., Nielsen, J.B., Falster-Hansen, H., Lindholm, K.-A. (2011), 'Tank cleaning technology: innovative application to improve cleaning-in-place', EHEDG Yearbook 2011/2012, EHEDG, Frankfurt, Germany, pp.26-30.

Majoor, F.A. (2003), 'Cleaning-in-place', Ch. 11, in Lelieveld, H.L.M., Mostert, M.A., Holah, J. & White, B. (eds.*), Hygienic in Food Processing, 1st ed., Woodhead Publishing, Cambridge*, England, pp. 122-166.

Seiberling, D. (1997), 'CIP Sanitary Process Design', Ch. 15, in Valentas, K.J., Rotstein, E., Singh, R.P. (eds.), Handbook of Food Engineering Practice, CRC Press, Boca Raton, United States, pp. 581-631.

Suresh PV Malappuram, Automated Arecanut Climbing and Harvesting Machine, 10 National Grassroots Innovation and Outstanding Traditional Knowledge Awards 2019

TRIFED, Ministry of Tribal Affairs, Government of India.

Chapter 6

Food Safety Regulations & Certification

Dr. Ashish Rawson
Indian Institute of Food Processing Technology, Thanjavur (Tamil Nadu)

Need for Testing of Food

Food Testing is a scientific analysis of food and its content. It is done to provide information about various characteristics of food, including the structure, composition and physicochemical properties. Food testing laboratories have plays an important role in safeguarding food supply and maintaining public health.

Food testing labs are also critical for investigating and identifying sources of foodborne illness outbreaks (such as the recent issues of contaminated spinach and romaine lettuce supplies) as well as conducting food safety tests during recall campaigns to ensure, for example, that all affected products that are removed from store shelves and restaurants.

It is also conducted to analyze:

1. The quality of a food products- this is done to verify the claim made by the manufacturer of the product on certain issues eg ingredients used
2. For quality control- this is done before, during and after the manufacturing process to analyse the quality of the food ingredients and the finished products.
3. Food inspection and grading- is performed regularly to ensure food manufacturer meet the set regulations and standards.
4. Food must have a standardized nutritional label therefore food needs to be analyzed to verify the claims made
5. Research and development is necessary for manufactures to improve and provide food high quality, healthy and affordable food, this requires studying and analyzing the products already in the market.
6. To protect a manufacturer from rumors and smears. Many products in the market is being labeled by competitors or other rumor, such rumors can be sorted out.

Over time, the mandate for food testing labs has been expanding far beyond what was originally envisioned within the Food Code.

For example, large chain restaurants are now required to post the caloric content of their menu items so consumers can make more informed dietary choices.

Testing for the presence of food allergens is another example. An increasing number of people are at risk for an anaphylactic shock when exposed to certain kinds of foods, from peanuts red meat to certain kinds of seafood. As a result, food testing laboratories have been called on to certify food products as being nut-free or to identify the exact species of fish served at restaurants. (Mislabeled fish is an ongoing problem within the industry that can cause great harm to consumers allergic to certain species.)

List of Notified Reference Laboratories

S.No.	Name of the laboratory/ Institution/Organization	Address	Specific area
1.	Central Food Technological Research Institute	FS & AQCL Department, CFTRI, Mysore-570020	Nutritional Information and labelling
2.	Export Inspection Agency	27/1767A, Shipyard Quarters Road Panampilly Nagar, Kochi, Kerala 682036	GMO testing
3.	Punjab Biotechnology Incubator	SCO 7-8 Phase-V, SAS Nagar, Mohali-160059, Punjab	Sweets and confectionary including honey
4.	ICAR-National Research Centre for Grapes	P.O. Manjiri Farm, Solapur Road, Pune-412307	Pesticide Residues and Mycotoxins
5.	Central Institute of Fisheries Technology	CIFT Junction, Wellingdon Island, Matsyapuri, PO- Kochi	Fish and Fish Products
6.	Centre for Analysis and Learning in Livestock and Food-National Dairy Development Board	Opposite IRMA main gate , Near Anadalaya Nagar, Anand 388001.	Dairy and Dairy products
7.	CSIR-Indian Institute of Toxicological Research	Vishvigyan Bhawan, 31 Mahatma Gandhi Marg Lucknow-226001	Toxicological Evaluation/Rsik Assessment for Nutraceuticals, functional foods and novel/emerging food/food ingredients
8.	Trilogy Analytical Laboratory, Pvt. Ltd	Plot No.7, C.F. Area, Phase II, IDA, Cherlapally, Hyderabad	Mycotoxins and PT services
9.	Edward Food Research and Analysis Centre Limited	Subhash Nagar, Nilgunj Bazar, Kolkata	Veterinary Drugs, Antibiotics and Hormones
10.	Vimta Labs Limited	Life Sciences Campus, 5, MN Park, Genome Valley, Hyderabad-500101	Water, Alcoholic and Non Alcoholic Beverages
11.	Fare labs Pvt Ltd	L-17/3, DLF, Ph-II, IFFCO Chowk, Gurugram-122002	Oils and Fats
12.	Neogen Food and Animal Secuity (India) Private Limited	Uchikkal Lane, Poonithura, PO-Kochi	Food Allergens
Ancillary National Reference Laboratory			
13.	EIA Chennai	Chennai	Support Facility in microbiological testing
14.	EIA Kolkata	Kolkata	Support Facility heavy metals in food testing

List of Notified Referral Laboratories

Table -1		
Serial No.	**Name of the Referral Food Laboratory**	**Local Areas or States or Union Territories**
(1)	(2)	(3)
1.	(i) Director, Central Food Laboratory, 3 Kyd Street, Kolkata - 700016.	West Bengal, Orissa, Bihar, Jharkhand, Assam, Arunachal Pradesh, Chhattisgarh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Union Territories of Andaman and Nicobar Island
	(ii) Director, Food Research and Standardization Laboratory, Ahinsa Khand-II, Indirapuram, Ghaziabad-201014.	
2.	(i) Director, Food Safety and Analytical Quality Control Laboratory, C/o. Central Food Technological Research Institute, Mysore –570013.	Andhra Pradesh, Karnataka, Kerala Tamil Nadu, Telangana, Puducherry and Lakshadweep
	(ii) Director, State Public Health Laboratory, Stavely Road, Cantonment Water Works Compound, Pune-411 001.	
3.	(i) Director, State Public Health Laboratory, Stavely Road, Cantonment Water Works Compound, Pune-411 001.	Gujarat, Maharashtra, Madhya Pradesh, Rajasthan, Dadar and Nagar Haveli, , Goa and Daman and Diu
	(ii) Director, Food Safety and Analytical Quality Control Laboratory, C/o. Central Food Technological Research Institute, Mysore –570013	
4.	(i) Director, Food Research and Standardization Laboratory, Ahinsa Khand-II, Indirapuram, Ghaziabad-201014.	Delhi, Haryana, Himachal Pradesh, Punjab, Union Territory of Chandigarh, Uttar Pradesh, Uttarakhand and Jammu & Kashmir
	(ii) Director, Central Food Laboratory, 3 Kyd Street, Kolkata 700016.	

Table -2		
Serial No.	**Name of the Referral Food Laboratory**	**All over India - as per Scope of Testing defined hereunder**
(1)	(2)	(3)
5.	Director, Indian Institute of Horticultural Research, Hessaraghatta lake post, Bangalore - 560 089.	Pesticide residue analysis of fruits and vegetables, cereals and pulses, water, spices (curry leaves), Nutritional, Proximate and microbiological analysis of fresh and processed food products.
6.	Director, Indian Institute of Vegetable Research, Post Bag No. 01; P.O. JAKHINI, (SHAHANSHAPUR), Varanasi - 221 305.	Analysis of pesticide residue, heavy metals, microbial contaminations, mycotoxins, antibiotics, disinfectants, colouring agents, adulterants, food additives, phytohaemagglutinin, allergens etc. in Vegetables.
7.	Director, Quality Evaluation Laboratory, Spices Board, Palarivattom P.O., Kochi – 682025.	Analysis of chemical contaminants (pesticide residues, heavy metals, illegal dyes and any other chemical contaminant), mycotoxins (aflatoxins, ochratoxin etc.), microbial contaminants, physical contaminants and adulterants in Spices.
8.	Director, Quality Evaluation Laboratory, Spices Board, Chuttugunta Center, GT Road, Guntur – 522004.	-Do-
9.	Director, Quality Evaluation Laboratory, Spices Board, Plot No. R-11, Sipcot Industrial Complex, Gummidipoondi, Thiruvallur District, Chennai – 601201.	-Do-
10.	Director, Quality Evaluation Laboratory, Spices Board, First Floor, Banking Complex II, Sector 19A, Vashi, Navi Mumbai – 400703	-Do-
11.	Acting Director, Centre for Analysis and Learning in Livestock in Food (CALF), National Dairy Development Board (NDDB), Anand – 388001, Gujarat	Milk and Milk Products, Analysis of pesticides, antibiotics and veterinary drugs, microbial contaminants and mycotoxins, heavy metals, Polycyclic Aromatic Hydrocarbons, dioxin, other emerging contaminants and Microbial parameters in milk and milk products.
12.	Director, Council of Scientific and Industrial Research - Indian Institute of Chemical Technology, Uppal Road, Tarnaka, Hyderabad – 500007	Analysis of moisture, hexane insoluble matter, acid value, unsaponifiable matter, iodine value, saponification value, allyl isothiocyanate, Reichert Meissl value, peroxide value, fatty acid composition, presence of animal body fat in the vegetable fat, cold test, test for physical properties, nickel in vanaspati,

		phosphorous in soyabean oil, presence rancidity, soluble colors, presence of beef fat, phospholipids, tocopherol, trans fatty acid detetmination, Pesticide Residues, Heavy metal analysis in fats and oils.
13.	Director, National Research Centre on Meat, Chengicherla, Buduppal, Hyderabad – 500092	Physico-chemical analysis (meat species identification, proximate composition, pH value, water holding capacity, meat pigments, emulsifying capacity, free fatty acid, peroxide value, TBA value, cholesterol content, nitrite content, sensory evaluation, texture & tenderness of meat & meat products, instrumental colour value, COD level of slaughter house effluent), Microbiological analysis, Pesticide Residues and Fatty acid profiles of meat and meat products".
14.	Director, Indian Institute of Crop Processing Technology, Food Safety and Quality Testing Laboratory, Pudukkottai Road, Thanjavur – 613005, Tamil Nadu	Nutritional, Proximate and Microbiological analysis of fresh and processed food products; Packaged Drinking Water analysis; Analysis of pesticide residues, heavy metals and microbiological analysis of Cereals and Cereal Products and Spices."
15.	Director, Central Institute of Fisheries Technology, Indian Council of Agricultural Research, Willingdon Island, CIFT Junction, Matsyapuri P.O., Cochin – 682029, Kerala	Physio-chemical analysis, Bacteriological Tests, detection of Viruses, Bacterial toxins, Antibacterial substances, other microbiological tests, analysis of pesticide residues & heavy metals in Fish & Fishery Products.
16.	Director, Indian Institute of Integrative Medicine, Council of Scientific & Industrial Research, Canal Road, Jammu-Tawi-180001	Analysis of Aflatoxins, Free fatty Acids, Peroxide value, Iodine value, Pesticide residues, Metals & Other soluble Residues in Nuts; Presence of Moisture content, Specific gravity, Reducing sugar, Fructose-Glucose Ratio, Acidity, Ash content, Analysis of Heavy Metals, Pesticide residues in Honey; Analysis of Aflatoxins, Energy Organics, Vitamins, Total fatty Acids, Total Saturated Fatty & Unsaturated Fatty acids, pesticide residues & heavy metals in Nutraceuticals.

List of State/Public Food Laboratories

S.No.	State/UT	Laboratory Address
1.	Andaman & Nicobar Island	State Food Laboratory, G.B. Pant Hospital Campus, Andaman & Nicobar Islands, Port Blair – 744103
2.	Andhra Pradesh	State Food Laboratory, Nacharam Industrial Area, Hyderabad – 501507
3.	Andhra Pradesh	Regional Public Health Laboratory, Govt Hospital Complex, Pedda Waltair, Visakhapatnam – 530017
4.	Assam	State Public Health Laboratory, Bamuni Maidam, Guwahati 21, Assam
5.	Bihar	Combined Food & Drugs Laboratory, Agamkuan, Patna- 800 007
6.	Chhattisgarh	State Food Testing Laboratory, Near Mahila Police Station, Opp. Nagar Nigam Office, Kalibari, Raipur
7.	Delhi	Combined Food & Drugs Laboratory, Directorate of PFA, NCT of Delhi, A- 20, Lawrence Road, Industrial Area, Delhi- 110035
8.	Jharkhand	State Food & Drug Laboratory, Namkum, Ranchi Tata Road, Ranchi – 834010
9.	Goa	Food and Drug Laboratory, Directorate of Food & Drugs Admn. DHANWANTARI, Opp, the Shrine of Holy Cross, Bambolim – Goa – 403202
10.	Gujarat	Public Health Laboratory, Urban Health Centre Bldg, Nr. Lal Bungalow, C.G. Road, Navarangpura, Ahmedabad 380009
11.	Gujarat	Food and Drugs Laboratory, Near Polytechnic College, Nizampura, Vadodara – 390 002
12.	Gujarat	Public Health Laboratory, Municipal Corporation, Laheripura Road, Vadodara - 390 001
13.	Gujarat	Regional Food Laboratory, New Lotus Ring Road, Nr. Mahakali Temple, Opp. District Panchayat Staff Quarters, Bhuj, Kutch – 370001
14.	Gujarat	Regional Food Laboratory, University Road, Nr. Forensic Lab, Opp. Kidney Hospital, Rajkot, Gujarat – 360005
15.	Gujarat	Public Health Laboratory, Surat Municipal Corporation, 304, Ambedkar Shopping Centre, Mann Darwaza, Ring Road, Surat – 395003
16.	Haryana	District Food Laboratory, Civil Hospital, Karnal – 132001
17.	Haryana	State Food, Water and Excise Laboratory, Govt. of Haryana, Ground Floor, Sector – 11 D, Chandigarh
18.	Himachal Pradesh	Composite Testing Laboratory, Kandaghat, Distt. Solan, Himachal Pradesh
19.	Jammu & Kashmir	Public Health Laboratory, Patoli Mangotrian, Jammu
20.	Jammu & Kashmir	Public Health Laboratory, Nr. CD Hospital, Dalgate, Srinagar
21.	Karnataka	State Water and Food Laboratory, Public Health Institute, Sheshadri Road, Bangalore- 560 001
22.	Karnataka	Bruhat Bangalore Mahanagara Palike Laboratory, Dasappa Hospital Compound, N R Circle, Silver Jubilee Park Road, Bangalore - 560002
23.	Karnataka	Divisional Food Laboratory, Umar Khayam Road, Tilak Nagar, Mysore-570001

S.No.	State/UT	Laboratory Address
24.	Karnataka	Corporation Laboratory, Corporation of the city of Mysore, Corporation office Building, Mysore
25.	Kerala	Regional Analytical Laboratory, Kakkanand, P.O. Ernakulam, Kochi
26.	Kerala	Regional Analytical Laboratory, Malaparamba, Kozhikode – 673009
27.	Kerala	Government Analyst Laboratory, Vanchiyoor P.O Red Cross Road, Thiruvananthapuram – 695035
28.	Madhya Pradesh	State Food Laboratory, Controller Food and Drug Administration, Idgah Hills, Bhopal – 462001
29.	Madhya Pradesh	Food Laboratory, Municipal, Corporation, Shivaji Market, Nagar Nigam Road, Indore
30.	Madhya Pradesh	State Food Testing Laboratory, Municipal Corporation, Chhatrapati Shivaji Bhavan, Agar Road, Ujjain
31.	Maharashtra	Regional Public Health Laboratory, Nizam Bunglow, Cantonment Area, Aurangabad – 431002
32.	Maharashtra	District Public Health Laboratory, Dhobhi Ghat Building, General Hospital Compound, Jalgaon – 425001
33.	Maharashtra	District Public Health Laboratory, 330/2, B, Y.P. Powar Nagar, Bendre Building, Kolhapur – 416002
34.	Maharashtra	Municipal Laboratory, Room No. 49, 2nd Floor, G North Ward Office, J.K. Sawant Marg, Dadar, Dadar West, Mumbai- 400 028
35.	Maharashtra	Room No. 606, Public Health Laboratory, Konkan Bhawan, 6th Floor, CBD Belapur, District Thane, New Mumbai - 400 614
36.	Maharashtra	District Public Health Laboratory, New Civil Hospital Compound, Nashik – 422002
37.	Maharashtra	State Public Health Laboratory, Stavely Road, Cantonment Water Works Compound, Pulgate, Near St. Mary's School, Pune - 411001
38.	Maharashtra	District Public Health Laboratory, Vasantdada Co-op. Industrial Estate, Madhavnagar Road, Nr. R.T.O., Sangli – 416416
39.	Maharashtra	District Public Health Laboratory, Sai Darshan, 5 – Babanagar, Near Polytechnic College, Nanded – 431602
40.	Maharashtra	Regional Public Health Laboratory, Mental Hospital Compound, Chindwada Road, Nagpur- 440 029
41.	Maharashtra	District Public Health Laboratory, Opposite Irvin General Hospital, Amravati-444601
42.	Meghalaya	Combined Food and Drug Laboratory, Pasteur Institute, Shillong – 793001
43.	Nagaland	State Public Health Laboratory, Merhuliesta Colony, Near CMO Office, Kohima, Nagaland
44.	Odisha	State Public Health Laboratory, In front of Ram Mandir, Convent Square, Bhubaneswar – 751001
45.	Puducherry	Public Health Laboratory, Indira Nagar, Gorimedu, Puducherry – 605006
46.	Punjab	State Food, Drugs and Excise Laboratory, Govt. of Punjab, Second Floor, Sector – 11 D, Chandigarh
47.	Punjab	District Public Health, Laboratory, Nehru Garden, Jullundhar (Punjab)

S.No.	State/UT	Laboratory Address
48.	Punjab	District Public Health, Laboratory, Old Civil Hospital, Bhatinda (Punjab)
49.	Rajasthan	Food Safety and Standards Laboratory, E-1, Behind Kamla Nehru T.B. Hospital, Jaipur Road, Ajmer
50.	Rajasthan	State Public Health Laboratory, Mini Swasthya Bhawan, Mandir Marg, Sethi Colony, Behind Mental Hospital, Jaipur - 302004
51.	Rajasthan	Regional Public Health Laboratory, C-27, Railway Road, Jodhpur – 342001
52.	Rajasthan	Food Safety and Standards Laboratory, Rajiv Gandhi Hospital Campus, Alwar – 301001
53.	Rajasthan	Public Health Laboratory, Maharana Bhopal Cancer Hospital, Near Dhobighat, Udaipur
54.	Rajasthan	Public Health Laboratory, P.B.M. Hospital Premises, Bikaner (Rajasthan)
55.	Rajasthan	Public Health Laboratory, Sriganganagar (Rajasthan)
56.	Rajasthan	Public Health Laboratory, Banswara (Rajasthan)
57.	Tamil Nadu	Food Analysis Laboratory, No.219, Race Course Road, Coimbatore - 641018
58.	Tamil Nadu	Food Analysis Laboratory, King Institute Campus, Guindy, Chennai - 600032
59.	Tamil Nadu	Food Analysis Laboratory, Gandhi Nagaram, Near Gandhi Musiam, Poor Home Campus, Madurai – 625 020
60.	Tamil Nadu	Food Analysis Laboratory, Kamaraj Nagar Colony Post, Salem – 636014
61.	Tamil Nadu	Food Analysis Laboratory, Medical College Road, Near Membalam, Thanjavur – 613001
62.	Tamil Nadu	Food Analysis Laboratory, No.5, Old Police Hospital Road,Palayamkottai, Tirunelveli – 627002
63.	Tamil Nadu	Food Analysis Laboratory, Corporation of Chennai, Chennai- 600 003
64.	Tripura	Regional Food Laboratory, Pandit Nehru Office Complex, Agartala – 799006
65.	Uttar Pradesh	Regional Public Analyst Laboratory, HB Training Campus, Halwai KiBageechi, Agra
66.	Uttar Pradesh	State Government Laboratory, UP Behind Nehru Batika, Sector C, Aliganj, Lucknow – 226020
67.	Uttar Pradesh	Regional Public Health Laboratory, Shivpur, Varanasi – 221003
68.	West Bengal	Public Health Laboratory, 2, Convent Road, Kolkata 700015
69.	West Bengal	Central Food Laboratory, Kolkata Municipal Corporation, I-A, Hogg Street, Kolkata 700087
70.	West Bengal	District Public Health Laboratory, Murshidabad, CMO Office Campus, P.O. Berhampur, Murshidabad (W.B.)
71.	West Bengal	Public Health Laboratory, GM Hospital, P.O. Netaji Subhash, Santorium, Kalyani-741 251, Nadia (W.B.)
72.	West Bengal	Assansol Mines Board of Health Laboratory, Asansol, District Burdwan-713304

Good Laboratory Practices

Good Laboratory Practice (GLP) was first introduced in New Zealand and Denmark in 1972

Why use GLPs?

Generating reproducible, accurate analytical results is important for laboratory success, but isn't necessarily easy to do.

- There are processes and tools that are critical components of successful laboratory quality assurance programs.
- In general many of the practices that lead to a successful quality assurance program are also required for general business success such as:
- good communication
- engaged employees
- management
- a strong training program
- a facility that supports work to be done in the lab.

An Overview on Good Food Laboratory Practices

A Good Laboratory Practice (GLP) process is an important component of all Quality Programs.

- It includes a set of principles that provides the framework within which the laboratory is planned, performed, monitored, reported and archived.
- It is applicable in all aspects of a laboratory including; implementing, validating and maintaining the laboratory compliance.

Elements of Good Laboratory Practice

Quality Assurance - Establishing Confidence in Reported Data.

- Standard Operating Procedures (SOP's)
- Statistical procedures for data evaluation
- Instrumentation validation
- Reagent/materials certification
- Analyst certification
- Laboratory facilities certification
- Specimen/Sample tracking

Documentation and Maintenance of Records.
Accountability.

Why use GLPs?

- Generating reproducible, accurate analytical results is important for laboratory success, but isn't necessarily easy to do.
- However, there are processes and tools that are critical components of successful laboratory quality assurance programs.
- In general many of the practices that lead to a successful quality assurance program are also required for general business success such as: good communication, engaged employees and management, a strong training program and a facility that supports the work to be done in the lab.

6.1 Scope of Good Food Laboratory Practices

1.0 These Guidelines specify the general requirements for the competence to carry out systematic sampling of food samples, conduct chemical, microbiological tests and testing of packaging materials to ascertain the quality of food. It covers the tests performed using standard methods, non-standard methods, and laboratory-developed methods.

1.1 These Guidelines are applicable to all organizations performing tests to ascertain the quality of food material including packaging material. These include, for example, first-, second- and third-party laboratories, and laboratories where testing forms part of inspection and product certification.

These Guidelines are applicable to all laboratories regardless of the number of personnel or the extent of the scope of testing and/or calibration activities. When a laboratory does not undertake one or more of the activities covered by this Standard, such as sampling and the design/development of new methods, the requirements of those clauses do not apply.

1.2 The notes given provide clarification/guidance of the text and examples. They do not contain requirements and do not form an integral part of these Guidelines.

1.3 These Guidelines are for use by laboratories in developing their management system for quality, administrative and technical operations. Laboratory customers, regulatory authorities and accreditation bodies may also use it in confirming or recognizing the competence of laboratories. This International Standard is not intended to be used as the basis for certification of laboratories.

NOTE 1 The term 'management system' in these Guidelines means the quality, administrative and technical systems that govern the operations of a laboratory.
NOTE 2 Certification of a management system is sometimes also called registration.

1.4 Compliance with regulatory, calibration of equipment/glassware and safety requirements on the operation of laboratories is not covered by these Guidelines. These Guidelines are over and above ISO/IEC 17025:2005 framed specially for those testing laboratories engaged in sampling, conducting chemical and/ or microbiology tests and testing of packaging materials to ascertain the quality of food. Laboratories seeking accreditation as per ISO/IEC 17025:2005 should comply with the requirements of ISO/IEC 17025:2005.

6.2 Structure of Food Lab:

6.2.1 Personnel:

Personnel need to clearly understand the nature of the foods they are testing and reasons for testing when undertaking contract review and method selection.

6.2.2 The Management Structure:

An up-to-date chart showing the organizational structure and lines of responsibility of the laboratory is an important feature of the quality assurance programme and should appear in the Quality Assurance Manual. When the laboratory is part of a larger organization it may also be desirable to have a chart showing the management and operational relationships which control the input of work requested and the output of results from the laboratory, the overall picture of the laboratory and the resources available for it.

6.3 Infrastructure and Accommodation and Related Requirements:

6.3.1 General Principles:

Facilities must allow the laboratory's work to proceed both effectively and safely.

Laboratory design should reflect the general features of the work programme anticipated in the long-term (10-20 years) rather than the specific pattern of current work.

6.3.2 Design of the Laboratory:

Even though the final design of the laboratory is made by architects and engineers, the analytical staff should be involved in some of the decisions that will ultimately affect their working environment and conditions. The food control laboratory have several functions such as chemical analysis of foods for proximate composition, trace metals, additives, GM testing, nutrients and toxicants, some basic food microbiology analysis and product organoleptic evaluation.

6.3.3 General Considerations:

Laboratory layout should be devised with efficiency in mind. For example, the distances staff have to walk for the different steps of the analytical processes they undertake should be as short as possible, though bearing in mind that some procedures may have to be segregated from others for analytical and/or safety reasons.

There is often a 5-year period from the decision in principle to build a new laboratory to when it is accepted and operational. Also there will usually be an expectation that it will not require major alteration for a further 10 years. Given that the work load may change in this time span there are real disadvantages in designing a laboratory just to reflect the detail of the currently anticipated work load. Even within a given work volume, events may demand that the relative emphasis given to the different types of analyses may change. Additionally, advances in instrumentation and analytical methodology may alter the space and environmental requirements for a particular analysis. There is an argument for designing a laboratory in terms of "generic" activities and "specialised" activities.

Generic activities can be categorized as "wet chemistry" which will require extensive provision of fixed benches with water, power, sinks, fume cupboards, reagent shelves, glassware cleaning and storage, as compared to "instrument rooms" where less extensive servicing (though with additional piped gas supplies and perhaps stabilised power supplies) and flexible arrangements of movable tables/benches may be adequate.

Specialised rooms may be required for "clean air" work (e.g. on some environmental contaminants) or for work with substances which need to be handled with special care either for safety or for cross-contamination reasons, e.g. radioactive materials and some particularly toxic substances or for storage and dispensing of standards of pure compounds which are being analysed at trace levels elsewhere in the laboratory. A specialised room for large-scale and/or dusty sample preparation activities, e.g. grinding, blending, mixing, stirring will be invaluable, particularly if work is envisaged on heterogeneous analytes (e.g. aflatoxins in nuts or figs where primary samples of 30 kg are sometimes needed). With this approach the important design parameters are those concerned with correctly identifying the needs for specialised activities and with estimating the relative needs for the generic activities of "wet chemistry", "instrument room" and - for that matter - "food microbiology" if, as is often the case, that is to be carried out in the same premises.

Offices are needed for management and for clerical staff. There must be toilet and washing facilities for all staff. Eating, drinking, and smoking are always discouraged, and should be prohibited, in the laboratory proper. It is the responsibility of management to provide an appropriate alternative area for these activities. A separate staff room, however small, deserves consideration since it not only provides a greater degree of safety to laboratory personnel but also helps to ensure sample integrity. To provide for a prompt exit in the event of fire or other emergency, at least two entrances/exits must be provided for each laboratory whenever possible.

6.3.4 The Chemical Laboratory:

From a quality assurance standpoint, the design features which are important are those which can lead to erroneous results or to "lost" work, leading to missed deadlines and cost overruns. Erroneous results can arise from test materials becoming contaminated (e.g. by dust) or by cross-contamination from another sample or from a standard. Whilst good working practices will usually control most situations satisfactorily, a design which provides complete segregation of trace analyses from highly concentrated formulations and from pure substances used in preparing analytical standards is virtually essential: the segregation must apply to all

facilities for washing/cleaning equipment, washing and storage of glassware, use of protective clothing and even transfer of notebooks and records.

Design features which avoid dust, whether from environmental sources or from other samples are highly desirable from the quality assurance standpoint. Dust contamination of test materials is essentially sporadic and uneven; as such it is likely it will often be missed by the normal quality control checks. Design should aim for dust avoidance by using glass-fronted reagent shelves, keeping work-tops clear of unnecessary "static" items, regular cleaning of work surfaces with absorbent cloths, floor and furniture designed so that they can be cleaned with vacuum cleaners with suitable exhaust filters or absorbent mops. Designs which involve cleaning by the traditional "duster and brush" approach which simply spread contamination more widely should be avoided. Ventilation intakes and fume cupboard exhausts must be sited carefully so as to avoid re-circulation of laboratory air and the associated risk of contamination of test materials and hazard to laboratory staff.

Equipment and Instruments:

Some of the instruments and equipment needed for chemical analysis by a modern food control laboratory are: (for purposes of this listing, 'instruments' are measuring devices and 'equipment' are processing devices. Apparatus made primarily of glass are not included).

Instruments:

1. Analytical Balance
2. pH meter
3. Spectrophotometer, UV-visible, double-beam
4. Spectrophotometer, atomic absorption
5. High Performance Liquid Chromatograph (with UV and differential refractive index detectors)
6. Gas Chromatograph (with flame ionization and electron capture detectors)

Equipment:

1. Blender
2. Grinder
3. Pulverizing hammer mill
4. Air oven, forced draft
5. Vacuum oven, with pump
6. Muffle furnace
7. Centrifuge
8. Refrigerator
9. Freezer
10. Heaters and hot plates
11. Steam and water baths
12. Water distillation still or deionizer

All of the above equipments and instruments are moveable, although the larger or more sensitive units are generally not moved, once placed. The major items of fixed equipment constructed in place are the fume hoods. The extensive use of solvents, ashing and noxious chemicals in food analysis, requires more fume hoods than other types of laboratory work. In fact, to experienced food analysts, there never seem to be enough hoods, even in a well-equipped laboratory. Fume hoods may be purchased pre- fabricated with outlets for services. The material of construction is most important, especially if the hood has to withstand acid fumes in general and perchloric acid in particular. The supplier must be given full details of the use to which the fume hood will be put. Hoods can be constructed out of local materials such as wood, preferably hard woods, coated with epoxy resins. Such should never be used for acid digestions, but only for solvent extraction work.

Utilities:

Electricity must either be a stable supply, or the voltage must be stabilized by either one large stabilizer for the whole laboratory, or by a unit for each of the instruments requiring it. The lab should have sufficient number of electrical sockets. There must be several cold water taps per bench to allow for rinsing, condensers, etc., but hot water can be restricted to those sinks where apparatus is washed. In a larger laboratory a distribution system for distilled or deionized water would be advantageous. Fume hoods should have adequate provision for water taps, compressed air valves, electrical sockets etc.

Utility services require a large space but need to be concealed for aesthetic reasons, yet require an easy access for repair purposes. To satisfy these conflicting demands, the main runs may be in voids above false ceilings and in floor ducts. Secondary services are then run to outlet points on benches taken from floor level along the wall behind benches in voids especially incorporated in the design of the bench fittings. Frequent access points are provided for maintenance purposes.

Drain pipes should be of high density polythene or copolymer polypropylene with screwed joints. These show good resistance to most organic and inorganic chemicals. The drainage lines may be embedded in the flooring. As it is not acceptable to discharge laboratory wastes directly into the sewerage system, all waste from laboratory sinks and other waste fittings should be led first into dilution pots (about 5 litre capacity) before being released into the main sewers. Buildings can be designed to include a large dilution tank where all laboratory sink waste is directed before entering the sewerage system.

6.4 Environment Conditions, Safety and Related Requirements:

1) Environmental Control:

Adequate control of temperature, humidity and dust is important to staff comfort, instrumental performance and safe working (e.g. with flammable solvents). If they are to perform properly optical instruments often require stable temperature conditions. Electronic equipment may have prescribed operating ranges for environmental temperature and humidity. Computers may need to be protected from strong magnetic fields from other equipment; any staff or visitors with heart pace-makers must avoid such fields. Cooling water, either from mains supplies or localised refrigeration may be necessary for the proper functioning of some equipment. Test materials, reagents, standards may need to be stored under controlled conditions. Some substances are affected by sunlight or fluorescent lights and must be protected from it. Delicate balances and optical instruments may need to be protected from vibration (e.g. from blenders, shakers and centrifuges) or may even need stabilised supports. All these needs have to be identified and documented so that proper procedures for monitoring them and taking necessary action can be included in the quality assurance system.

Records will be needed which show that: samples are received, stored, handled and analysed under environmental conditions that will not adversely affect analyses; temperature, humidity and light controls are adequate in sensitive areas to protect samples, extracts from them, personnel and equipment; the results of environmental sampling in laboratory areas are recorded; these should include records of air-flow rates across fume cupboard apertures.

2) Housekeeping Control:

As with any other aspect of the laboratory's activities, the responsibility for housekeeping activities must be clearly defined. Cleaning staff and laboratory staff must each have clear instructions as to their respective duties in relation to:

1. cleaning of floors, vertical surfaces (e.g. cupboards, walls, windows and doors),
2. horizontal surfaces (e.g. work surfaces, shelves), equipment, interiors of refrigerators, freezers, fume cupboards, controlled environment stores
3. control of the contents of refrigerators, freezers, fume cupboards, controlled environment stores
4. checking the performance of air-conditioning and dust extraction equipment and fume-cupboards
5. pest control

The quality assurance programme will include work schedules, records of observations and of action required/taken covering housekeeping activities of this nature.

3) Safety Features:

The building and laboratory design should include a number of safety features including:

1. The fire areas of corridors should be formed of concrete blocks.
2. Services should include a shower sprinkler system near each doorway so that a worker can take an immediate shower, clothes and all, in the case of accidental general contact with corrosive or poisonous liquids or fire.
3. There should be built-in eye wash fountains or at least portable eyewash stations (obtainable from most chemical supply firms).
4. The traffic flow, the egress pattern and the proportions of the laboratory are all safety considerations. It must always be possible to leave the laboratory safely irrespective of the initial site of a fire. Serious thought must be given to the number and location of fire extinguishers and stand pipe systems, and to the availability of sprinkler systems.
5. Laboratories should be well-lit so that the operator does not have to peer too closely over potentially hazardous material in order to see what he is doing. There should be ample working space and bench tops and other surfaces should be kept clear of all material except that in current use.
6. Benches are best without shelves, only services, these being operated from the front so that the operator does not have to stretch across the bench. It is still common to see reagents on shelving at the back of benches (or above the centre of double-width benches) but it is probably safer if such reagents can be kept on side - shelve or in trays which are brought to the bench as required.
7. Flooring needs to be of a non – slip material, resistant to acids and solvents, but not so hard as to be tiring to stand on for a few hours at a time. No material is entirely satisfactory. Well-laid linoleum and a filled epoxy resin on top of concrete are among the best available. It is advisable not to polish laboratory floors.
8. Pollutants generated within the laboratory must be removed safely, quickly and efficiently. In particular, toxic or noxious gases must be removed expeditiously through a duct system that does not exhaust near the building air conditioning intake.
9. The building must be planned for security. Restriction of access is of considerable importance because of the extremely valuable and sensitive equipment used in the laboratory work as well as to protect the integrity of official samples.
10. It is very advisable to have an efficient fire and smoke detection system with appropriate alarms. Common fire detection equipment is usually either rate-of- temperature-rise or fixed-temperature detector using a substance of known melting point. There are advantages (and disadvantages) to each type of detector and the laboratory Head should select the one he feels best fits his laboratory.

Designing a laboratory to afford protection against every kind of hazard should be aimed at, but, the level of safety for the most general applications and to provide supplementary systems in areas of higher hazard has to be achieved.

A safe solvent storage area is ideally separate from the laboratory building in a stand- alone structure. It can be a small building of one room and some possible design features are: (reasons are given in parenthesis)

1. Construction of cement blocks or bricks. (Only non-flammable materials surround the solvents.)
2. For a stand-alone building, double walls with insulation between. The exterior wall can be material other than block or brick. (Provides insulation from the sun and makes air conditioning more effective.)
3. An epoxy film to cover the entire floor plus 10 cm up the base of the walls. (Any solvent spillage will pool and evaporate, rather than soak through the floors or walls.)
4. A copper pipe (about 25 mm) inside the room, which goes through the floor and is embedded about

2 m in earth. (A ground pipe to bleed off any static electricity charges - which often build up when solvents are poured).All metal objects in the room are to be attached to the pipe using heavy guage single strand copper wire. Also, attach a short wire with an alligator clip. (This grounds all metal. The clip is used to ground any metal cans used for solvent transfer.)

5. Storage shelves of metal and connected by wire to each other and the grounding pipe.
6. Air conditioning is external, with the entrance duct at the top of one corner of the room and the exit duct at the base of the opposite corner. (The room must be cooled as many solvents will boil at hot outside temperatures. The air entrance on top and exit on the bottom diagonally across the room, will cool the room and will also serve to sweep and remove any solvent fumes on the floor - solvent fumes are generally heavier than air and will pool on the floor.)
7. The door is of metal and fire-rated for at least one hour, with a positive closure. It must seal well when closed. The door sill is at least 10cm high. (Fire doors are metal sheathed around cement. The closure, the sea land the high sill all act to prevent escape of solvent, either floor spillage or fumes.)
8. Air conditioner exits duct with a fire baffle (to prevent flashback) and ducted to exit in the outside air at building roof height. (Fumes have a better chance of being carried away by breezes and someone smoking nearby will not present a fire risk.)
9. An extinguisher system, which should be carbon dioxide or Freon type and not water sprinklers.

6.5 Personnel Related Requirements:

1. The personnel should be technically competent to perform their duties as allotted to them whether operating on specific equipments / performing tests /evaluating results/signing the reports.
2. Qualification for doing specific tasks shall be judged on the basis of their education, training, specific experience and demonstrated skill.
3. Regular and refresher training should be organized to keep the personnel update in their domain of activity.
4. Specific job description for each personnel should be defined with their role and responsibility.
5. Personnel should wear proper uniform and protective clothing's, etc as required depending upon the test method.
6. While doing test no phone calls/ cell calls should be attended to avoid any type hazards and carelessness while performing the test.
7. Normally blank determination along with the known-standards must be carried out in duplicate/ replicate to check the accuracy of the results obtained and human error etc.
8. All the analysis records must be documented either through hardcopy or through soft copy to demonstrate that the tests are really been carried out.
9. Random checking of the result should be done inter-laboratory and intra- laboratory to check the proficiency of the personnel.
10. In case of hazardous analysis, special precautions as provided in the methods should be taken for self and surroundings.
11. While opening and closing the laboratory room, safety precaution should be taken care of depending upon the nature of the laboratory, equipment and test method. Special care should be taken for microbiological lab. Instructions in this regard must be displayed in the lab.
12. In case of contractual appointment, technical competency of the personnel should be judged and they should be put on job only after they are trained and their competency in the respective field is established.
13. Alternative arrangement of personnel should exist in case one is not available but not at the cost of their technical competency.
14. Personnel should be medically fit depending upon the test method he is deployed to avoid any hazards.
15. Special precaution should be taken by the personnel during break time to ensure that tests are carried out as per prescribed method and no relaxation is given in the test method.

16. Calculation should be rechecked on random basis by the supervisor.
17. Daily wages should not be put to job.
18. The personnel at the time of working in the laboratory should be alert and concentrate on their work only.
19. Supervisory officer should randomly watch the analysis activity and guide from time to time to increase the competency of analyst.
20. Eating habits should be avoided in the laboratory.
21. First Aid box should be available in the lab. along with emergency Telephone no. of hospital/doctors/contact person.
22. During odd times person should avoid working lonely.
23. Fuming chamber must be used for test requiring ash, protein determination, evaporation of solvents etc.
24. While pouring down acids etc in the basin, water taps should be kept on slowly.
25. Electrical equipments should be handled with great care.
26. Poisonous and hazardous chemicals must be kept under safe custody.
27. Manual sucking from mouth of liquid should be done with bulb type pipette.
28. Competency of the personnel should be judged regularly by giving unknown samples.
29. No external or internal pressure should be put on analyst.
30. Output should not be linked with quantum of work. More emphasis should be on quality output or results.

6.6 Test Methods:

The laboratory shall use only official methods depending on the requirement of the test, its sensitivity and nature of the commodity which is being tested and quality/safety factors to be determined. In case of non-official method, validation of the methods as per set norms is a must and their range of detection/quantification, L.O.D./L.O.Q. limitations etc. must be established. Standard solution/CRM Solution should be stored at required temperature and condition and its strength should be checked regularly and record thereof should be maintained. SOP as far as possible should be available for test method along with the protocol.

Equipments:

1. All the equipments being used should be under permanent control of the laboratory and should be capable of in context of the test method. They should be calibrated. Instruction manual, operation manual and other details of the equipments like calibration, due date of calibration, safety precaution, etc must be available at the side of the equipment. Each equipment should be uniquely identifiable. Each sophisticated equipment should have IQ, OQ and PQ Certificate from the manufacturer.
2. LOD/LOQ/ Range of detection/ range of quantification must be established for each equipment in context of the test method, nature of the food commodity, constituent to be determined. The reason being that normally in official methods, the model of the equipment being used along with its accessories becomes old whereas due to technological advancement a model of the equipments are upgraded along with accessories and software, hence the LOD, LOQ, etc must be established and should be checked as claimed by the manufacturer which may not commensurate with the limits given in the official methods. SOP must be available for operation.
3. Equipments not working should be placed under a tag " out of order"
4. Software being used in the equipment must be validated and a record thereof should be available.
5. Maintenance plan of the equipment should be available and should be done under annual maintenance contract.

6. Equipments should not be subjected to overloading or mishandling which could give erroneous results.
7. Intermediate checks of the equipments must be done through known and certified standards regularly. The equipment should be handled by technically competent and trained personnel only. Such personnel should be trained on routine maintenance and minor repair of the equipments.
8. Proper procedure as prescribed by the manufacturer should be followed for cleaning of the equipments and its accessories before and after use.
9. The SOP for safe handling, transportation, storage, use and plant maintenance of the equipments must be available to ensure proper functioning and to prevent deterioration /contamination.
10. Do and don'ts regarding important instruction should be available along with side of the equipments and should be visible all the time.
11. Due care should be taken to ensure constant voltage supply of electricity as required for the equipment to avoid fluctuation and thus variation in results.
12. After return of the equipment from repair, the same procedure should be followed as that for new equipment to ensure that the results rendered by the equipments are as per capability of the equipment. In such cases the instruments needs to be recalibrated before put to use.
13. Equipments where gases are being used, the purity of the gas should be as per requirement of the equipment/test method.
14. Gas cylinders should be put outside the laboratory room at a well secured and approachable place.
15. Temperature and humidity of the room where the equipments are placed must be recorded daily. In case of micro biological laboratory, special precaution should be taken as per requirement of the test method for environmental conditions especially in case of isolation and determination of pathogens.
16. In case of a mobile food testing laboratory a separate SOP should be available and the equipments used in such laboratory should be technologically sturdy to avoid variation in results. Calibration of such equipments needs to be done very frequently preferable daily before being put to use.
17. Software being used in the equipment should be capable of achieving the accuracy required and should be complied with the specification related to the test method.
18. Software should be upgraded and validated from time to time.
19. Obsolete equipments giving erroneous results in context of the requirement of the test method should not be put to use.
20. The equipment should be placed on a vibration free platform.
21. Daily cleaning of the equipment should be done by trained personnel as per SOP
22. Proper safety precautions should be taken for equipments running round the clock in the absence of the personnel.

CERTIFIED REFERENCE MATERIALS / STANDARDS AND REFERENCE CULTURES:

As per the lab quality assurance procedure reference materials are required for all types of testing and validation/calibration. These are widely used for validation/calibration of an apparatus and testing procedure, assessing the true value.

The laboratory shall ensure to maintain the reference standards, which are certified by the competent body having traceability to a national/international system like NIST etc. The certificate provided by the supplier/manufacturer shall be maintained in the laboratory for records.

The reference standards having high purity, critical characteristics and require to store in special condition and hence its, to be stored in appropriate special condition as per the requirements. The substances are to be kept in sealed vial and shall be stored in dry place, away from heat, sunlight & moisture.

The reference standard solutions are required for sample analysis, quantification and QC checks. The laboratory shall be prepared the standard solution as needed like stock / primary, intermediate & working solution and wherever applicable the purity shall be considered during preparation. The standard solutions shall be kept in screw capped glass vials, standard volumetric flasks/stoppered conical flask (transparent/amber coloured) in air-conditioned room / refrigerate /deep freezer depending upon storage condition & requirements.

The standards shall be prepared from bulk reference standard materials received from the market as A grade material. The selection criteria for the bulk material intended to accept as working standard in assay and purity of substances. For accepting the material to be taken as working standard the molecule must be subjected to chemical characterization. First the standard stock solution to be prepared from which different working standard is made. The preparation of standards is generally carried out in regular interval as per the requirement / laboratory protocol and the records of those are to be maintained and labelled with concentration & date of preparation.

The preparation of working standard is generally carried out during analysis/ whenever necessary and records of these are to be maintained.

CALIBRATION AND PERFORMANCE ASSESSMENT RELATED REQUIREMENTS:

For accurate test results, lab shall be ensured that the equipments which are suitable for intended purpose and capable of providing valid results, such instruments would be regularly inspected, checked & calibrated accordingly. So laboratory should establish a schedule for the calibration and performance verification of equipments/instruments, which will be direct influence on the test results. The calibrations to be done by in-house (internal)/external agencies/competent body having traceability to a national / international standard (NABL accredited lab) depending upon the type of equipment / instruments.

The status of calibration (internal / external) of all the equipments/instruments including frequency of calibration, date of last calibration, due date of next calibration, plan and procedures shall be maintained by the laboratory

PURCHASE OF CONSUMABLES/ EQUIPMENTS:

The laboratory should be maintained a proper system on purchase service & supplies of all media, chemical, reagents & other requirements/appliance, consumables to avoid undesirable, unconfirmed supplies of them and also ensure there should not be any effect on the of test analysis / result.

Requirements like name of the chemicals, appliances, glassware's, consumables, brand name, quantity, Management, rate contract/ comparative quotation, quantity available in stock shall be well documented by the laboratory.

The laboratory must be maintained procedures / instruction & documents / records for all.

SAMPLING & SAMPLE HANDLING:

Sampling for testing or analysis is a process of taking a representative portion from a material or product to test (e.g. by physical measurements, chemical analysis, microbiological examination), typically for the purposes of identification, quality control, or regulatory assessment. The sampling is a significant role in testing activities as it reflects the ultimate test results.

It is not mandatory that all the laboratories shall be involved in sampling activities. However the laboratory involves in sampling shall maintain at least the following

The laboratory policy & declaration on sampling. The laboratory should have authorized personnel / sampler with adequate knowledge, training etc on sampling. The laboratory shall maintain the sampling plan & procedure in respects of the products / materials that shall include selection, withdrawn & preparation of

samples during sampling. The same shall be based on appropriate statistical method / regulatory guidelines / references.

The laboratory shall maintain a system on traceability of all accepted samples and the same shall be maintained throughout the retention of the sample in the laboratory without any confusion.

The laboratory must have documented system, procedures, instructions & facilities for conditioning and preparation of sample according to the standard method or laboratory protocol to maintain the homogeneity, avoid loss / damage of the test sample.

The laboratory should ensure to maintain a proper documented system procedure for handling of test items including sample receiving, storage, transportation, retention / disposal, integrity, avoid and prevent loss/damage of the test samples.

1) General Principles:

The identity, homogeneity and integrity of the materials being handled by the laboratory must be ensured throughout the time they are under the control of the laboratory e.g. from sample receipt to data report and authorized disposal of the surplus material. The analytical data report must reflect the composition of the received material as a whole.

2) General:

The sampling procedure should describe the selection, sampling plan, withdrawal or preparation of sample from a substance, material or product to yield the required information. If the customer requires deviations, additions or exclusions from the documented sampling procedure, these shall be recorded in detail with appropriate sampling data and shall be included in all documents containing test and /or calibration results.

The laboratory shall have the procedure for recording relevant data and operations relating to sampling that forms part of the testing and calibrations that is undertaken. These records shall include the sampling procedure used, the Identification of the sampler, environmental conditions (if relevant) and diagrams and other equivalent means to identify the sampling location as necessary.

3) Samples may be conveniently classified under two broad divisions:

I. Formal samples – These are samples taken to determine if the food complies with national or local laws or regulations and
II. Informal Samples – These are samples taken for the purpose of monitoring or as part of survey work. Formal follow-up samples can be taken if informal samples receive adverse laboratory reports. Formal or informal sample are also taken under others such as follow-up to a consumer complaint.

4) Sample Collection:

Work scheduling is greatly facilitated by arranging a sampling programme for routine monitoring with the inspectorate. As part of a general food control programme there is need to:

1. Regularly inspect foods at different stages in the manufacture and distribution chains, using planned surveillance programme.
2. carry out general surveys of the quality of the food supply through random sampling and analysis.
3. monitor certain specific problem areas with regards to food safety – specific potential risks, e.g. level of metallic contaminants pesticide residues, mycotoxins etc.
4. inspect foods for export, for certification of quality (if needed)
5. inspect food import. This is best done on all imported consignments by formal sampling carried out systematically in a manner representative of the lot.
6. formal sampling should also be done on locally produced food products based on the food inspector's observations or because a random or investigatory samples under the regular

programme was unsatisfactory or the product is one that requires thorough surveillance. Analysis of formal or informal samples is also necessary in an emergency such as an outbreak of food poisoning.

5) Quantity of Samples to be collected, product wise is shown at Annex 11.1

(Ref. Annex II of FSSAI Manual on General Guidelines on Sampling)

6) Sample Receipt and Assignment:

Receipt and identification of a sample have to be clear and unambiguous for the quality assurance to be maintained. The laboratory register of test materials should be of a type where papers are numbered and cannot be removed. Entries on computer- based registers must be protected against deletion and /or alteration. A back-up copy must be produced and stored separately from the original.

When a sample is received for analysis, there must be a system to track the sample throughout its initial stage, analysis and later reserve storage. This is usually embodied in a record-keeping system, which is keyed to a unique identification number assigned to the sample at the time of sampling. This number can be sequential (i.e., 00001 to 9999) or can be devised to give information (i.e., 024-95-07) the 24th sample taken in 1995 under sampling programme No. 7) The record must show the movement of a sample, its receipt, assignment to a laboratory person for analysis, return to the sample and eventual dispersal. One of the administrative staff should be given this record – keeping function and closely supervised by the laboratory Head. It is preferable to use a card system rather than a logbook as cards are more flexibly handled. There are certain items of information, which should be on each card:

1. Sample number
2. Product name
3. Date Sampled
4. Date received at the laboratory
5. Type of sample (Survey, Complaints etc.)
6. Method of storage (dry, refrigeration, freezing etc.)
7. Storage location (coded for easy finding)
8. Date assigned for analysis
9. To whom assigned (the analyst should initial to show receipt)
10. Date retuned (from analysis)
11. From whom returned (maybe different from the original analyst)
12. Reserve storage method and location
13. Final disposal of samples, method and date.

Example of a typical sample record is given at Annex 11.2 (ref. Appendix 5.1 of FAO 14/14)

7) Control and Storage:

The storage of test materials is of major importance if the analytical data produced is to reflect and be traceable to the original sample. Deterioration of test materials invalidates any results. Therefore; test materials must be stored so as to ensure their integrity, safety, legality and stability. The laboratory must guard against deterioration, contamination and loss of identity. Special care will be needed where trace analysis is involved in order to ensure that extraneous materials do not contaminate the test materials and equipment.

There are three basic forms of storage - room temperature (dry room), refrigeration and freezing. The QA programme should specify the conditions to be used (Annex 11.3 - reference Appendix 5.3 of FAO 14/14). There are also problems associated with the type of container in which food can be stored. Foods that contain fats and oils should not be stored in copper or metallic vessels and foods that easily desiccate such as fruits need to be stored in ways, which avoid loss of water.

Perishable, unfrozen food must be maintained at 0C – 4C and frozen food kept preferably at -18 C or below. All perishable items should be examined within 36 hrs. Of collection .Perishable samples that have been examined within 36 hrs after being sampled should be frozen, canned. Dry non-perishable foods maybe stored at room temperature before analysis.

The test material could also be dried and stored pending analysis, if analysis will not be affected by drying.

Special conditions apply to test materials, which are to undergo microbiological examination as well as chemical analysis. If a test material is to be stored frozen and a number of separate analyses are to be performed, it is preferable to sub-sample before freezing.

All test materials when stored must be properly and indelibly labelled so that identification is not lost. The most effective method of labelling maybe to place the label in its own plastic bag, inside the test material container, but separated from the food by a suitable layer.

The sample is then stored until it can be matched with a suitable test note containing all the above information and any other relevant information required for analysis and interpretation of the results. The test note should preferably be of the type that incorporates enough space for the test results and observations. The sample and the test note should (when matched if they arrive at different times) be clearly and indelibly marked with a registration number and passed to the analyst. From this point onwards, the analyst will identify everything pertaining to that sample with the laboratory number.

8) The Analytical Sample (Test Portion):

Before removing the test portion (s) for analysis, the analyst must be certain that all records are in order, integrity has been maintained containers are intact and sealed (if any), unbroken.

Any ambiguity in the analytical requirement must be resolved, e.g. with canned pickle in oil, is the analysis to be done on the pickle, oil or the whole contents of the can.

For analysis, the analyst first removes a test portion. If the test material comprises more than one item (fruit, vegetable etc.) the test portion should contain material from each item – usually achieved by comminuting a number of items and removing a portion. After the test portion has been removed, the remaining test material is returned to the storage.

9) Referral of the Test Material:

On occasions it may be necessary to pass a test material to another laboratory for some specialized analysis or because of some analytical facility not being available with the laboratory or because of overload of work. Unless the other laboratory is a part of the same QA programme or the two laboratories are accredited by the same (or equivalent schemes), this referral would mean that the test portion sent for that analysis ceases to be quality assured by the parent laboratory. This should be made clear in the analysis report to the customer.

10) Test Material Disposal:

Sample disposal is relatively a simple matter. The only problem arrives when there is a hazard involved in the destruction or the sample remains must have specific treatment e.g. a sample of groundnut heavily contaminated with alfatoxin. Any residual material if valuable such as flavouring concentrate maybe required to be returned to the originator. The register should therefore have a column in it for details of when, how and where the test material was disposed.

11) Documentation for QA Programme:

1. Register for sample receipt: Test material identification
2. Flow chart of the sample submitted for laboratory examination
3. Storage conditions for food test materials

THE INDIAN FOREST ACT, 1927

An Act to consolidate the law relating to forests, the transit of forest-produce and the duty leviable on timber and other forest-produce.

The Indian Forest Act of 1927 consolidated all the previous laws regarding forests that were passed before the 1920s. The Act gave the Government and Forest Department the power to create Reserved Forests, and the right to use Reserved Forests for Government use alone.

It also created Protected Forests, in which the use of resources by local people was controlled. Some forests were to be controlled by the village community, and these were called village Forests. The Act remained in force till the 1980s when it was realized that protecting forests for timber production alone was not acceptable. The other values of protecting the services that forests provide and its valuable assets such as biodiversity began to overshadow the importance of their revenue earnings from timber.

This led to the Forest Conservation Act of 1980 and its amendment 1988. India's first Forest Policy was enunciated in 1952. Between 1952 and 1988, the extent of deforestation was so great that it became essential to formulate a new policy on forests and their utilization.

The earlier forest policies had focused only on revenue generation. In the 1980's it became clear that forests must be protected for their other functions such as the maintenance of soil and water regimes centered on ecological concerns. It also provided for the use of goods and services of the forest for its local inhabitants.

The new policy framework made conversion of forests into other uses much less possible. Conservation of the forests as a natural heritage finds a place in the new policy, which includes the preservation of its biological diversity and genetic resources.

It also values meeting the needs of local people for food, fuel wood, fodder and Non-Timber Forest Produces (NTFPs). It gives priority to maintaining environmental stability and ecological balances. It expressly states that the network of Protected Areas should be strengthened and extended.

The Forest Conservation Act of 1980 was enacted to control deforestation; it ensured that forestlands could not be de-reserved without prior approval of the Central Government. This was created as some states had begun to de-reserve the Reserved Forests for non-forest use.

These states had regularized encroachments and resettled 'project Affected people' from development projects such as dams in these de-reserved areas. The need for a new legislation became urgent. The Act made it possible to retain a greater control over the frightening level of deforestation in the country and specified penalties for offenders.

Penalties:

Penalties for offences in Reserved Forests:

No person is allowed to make clearing or set fire to a reserved forest. Cattle are not permitted to trespass into the reserved forest, cutting, collecting of timber, bark or leaves, quarrying or collecting any forest products is punishable with imprisonment for a term of six months or with a fine which may extended to Rs. 500 or both.

Penalties for offences in protected Forests:

a. A person who commits any of the following offences like cutting of trees, stripping the bark or leaves of trees, set fire to such forests or permits cattle to damage any tree, shall be punishable with imprisonment for a term which may extended to six months or with a fine which any extended to Rs. 500 or both.

b. Any forest officer even without an order from the magistrate or a warrant can arrest any person against whom a reasonable suspicion exists.

Certification of Non-timber forest products

Non-timber forest products (NTFPs) are of socio-economic and cultural importance for the forest dwelling communities, particularly for the tropical countries like India. The sustainable management of NTFPs possesses real challenges for forest certification. Forest certification refers to two separate processes viz. forest management unit certification (FMU) and chain-of-custody certification (CoC). Forest management certification is a process which verifies that area of forest/plantations from where the wood, fiber and other non-timber forest products are extracted is being managed to a pre-defined standard. CoC certification is a process of tracking forest products from the certified forest to the point of sale to ensure that the product has originated from a certified forest. Although the basic idea of forest certification is readily understandable, forest certification is not yet a customary practice or a long-standing tradition. Rather, it is an emerging practice. This means that its basic elements must be worked out and converted into standard practices and procedures before forest certification can achieve wide social recognition, particularly in the context of tropical countries like India (Yadav et al. 2011). The certification programs have existed in other economic sectors, such as appliance manufacturing, quality control and health care services. The rise of certification programmes in the forestry sector is striking because non-governmental actors are taking up functions traditionally claimed by the agencies and ministries of nation states and the setting and implementation of forestry standards intended to protect broad public interests in proper forest management. But, despite the traditional state predominance in the forestry sector in most countries, forest certification programmes did not have to invent themselves out of thin air. Rather, they were able to draw upon models and techniques that had been developed and standardized by programmes performing similar functions in other sectors. Thus, forest certification is inherently linked to developments in other sectors (Yadav 2012). NTFP's availability, exploitation, management practices, utilization, commercialization, policies and tenure systems in different parts of India have high diversity and variability, which imposes even greater challenge for development of any generic standards for certification, even though many of the principle, criteria, indicators and verifiers are universally applicable for NTFP certification (Yadav and Dugaya 2013)

NTFP resource and its management in India

India is home to an amazing diversity of plants, with over 46,000 plant species recorded to occur there. Many of these species are used for medicinal purposes, with approximately 760 known to be harvested from the wild for use by India's large herbal medicine industry (Jain 2004). There is concern, however, that collection methods for many if not most of these species are destructive and wild populations are declining as a result. NTFP's availability, utilization, commercialization, exploitation, management practices, policies and tenure systems in different parts of India have high diversity and variability, which imposes greater challenge for development of any generic standards for certification, even though many of the principle, criteria, indicators and verifiers are universally applicable for certification. The harvest of NTFP is coming under increasing scrutiny from certification programmers, as it plays a key role in the sustainable forest management and community benefit worldwide. Thus, NTFPs present many new challenges and opportunities in certification due to the wide range of management practices and difficulty in monitoring their harvest and processing (Source: Yadav et al. 2011 IIFM research report unpublished). (Yadav and Dugaya 2013).

Indian initiatives for developing NTFP certification standards

Among the few efforts (studies and pilots) for developing standards for NTFP certification in India include developing sustainable harvesting and management standards for Medicinal & Aromatic Plants (MAPs) from the wild (Bhattacharyya et al. 2009) supported by the National Medicinal Plants Board (NMPB), pilot studies undertaken by IIFM with support from Ministry of Environment and Forests (MoEF) and other studies

undertaken by IIFM at its own. The initial framework developed by IIFM was based on the premise that NTFPs can be categorized on the basis of the parts used in medicine and other formulations. According to this approach, the NTFPs can be categorized in eight categories depending upon the parts used in the trade (IIFM 2007) (Table 3). (Yadav and Dugaya 2013)

Table 3. Types of NTFPs and plant parts used

S no.	Plant part	Type of NTFP	Some examples
1	Underground parts	Root, rhizome, tuber, etc.	*Chlorophytum* spp., *Cyperus* spp., *Vetiveria zizanoides* and the like
2	Stem	Bark, gum, resin, etc.	*Terminalia arjuna*, *Sterculia urens*, Anogeissus *latifolia*, *Shorea robusta*, *Pinus roxburghi*, etc.
3	Leaf	Biri making, leaf plate making, etc.	*D. melanoxylon*, *Bauhinia vahli*, *Shorea robusta*, etc.
4	Flower	For food, medicine, dye, etc.	*Madhuca indica*, *Woodfordia fruticosa*, etc.
5	Fruit	For food and medicine	*E. officinales*, *T. chebula*, *T. bellirica*, etc.
6	Seed	Edible and oil	*B. lanzan*, *Shorea robusta*, *Schlishera oleosa*, etc.
7	Entire plant	Mostly the herbs, medicinal importance	*Andrographis paniculata*, *Boerhavia diffusa*, *Phyllanthus niruri*, *Centella asiatica*, etc.
8	Animal products [excluding the scheduled species under wildlife (protection)]	Honey, lac, fishes	*Apis* spp., *Laccifera* spp.

Source: IIFM (2007)

Accordingly a generic set of standards encompassing specific requirement/condition of NTFP management have been attempted to develop broad framework of forest certification of NTFPs in India (Table 3). These generic standards then could form the basis for a specific NTFP species or products certification standard applicable at the local/regional level.

Status of certification of Non-Timber Forest Products (NTFP)

Certification procedure for NTFP is still in its nascent state. Some of the agencies like Network for Certification and Conservation for Forests (NCCF) have Notified Certification Body for NCCF FM a third party auditing and certification party for Certification in India:

1. Chhattisgarh Certification Society, India for Forestry & Agriculture (CGCERT)
2. GICIA India Private Limited

Procedure for certification (CGCERT)

(I) Application Procedure

1. Applicant shall first contact directly through e-mail/ postal letter to CGCERT and request for application form for the required scope of certification.

2. CGCERT shall send / provide the requested application form to the applicant within fifteen days of the receipt of request. The application form consists of application for scope of certification, annual plan format and last three years history format.
3. The applicant will have to submit his/ her application form within three month of the issue of the application. CGCERT shall acknowledge the receipt of the application form. During screening, if it is found that the application is incomplete, the applicant shall be requested to provide necessary and missing documents for registration.
4. After receipt of the application, the administrative department of CGCERT shall screen and check the completeness of the application.
5. If the application is found appropriate, then CGCERT shall assign a registration number to the operator in a prescribed format & a fee estimate and a contract form between CGCERT & the Operator shall be sent to the operator.
6. Applicant will have to deposite 100% of the certification fees either in Cash or by Demand Draft in favor of CEO CGCERT, Raipur within 30 days of the signed contract to CGCERT in which they agree to comply with the NPOP standards, allow inspecton and provide updated information to CGCERT.

(II) Inspection Fee for Additional Visits

If an additional inspection visit is necessary because complete information has not been provided by the applicant at the time of the announced inspection or, due to conditional certification or otherwise the applicant will have to pay the fee in advance as mentioned in fee structure for the specific items.

(III) Unannounced Inspection Visit Fee

There is no fee to applicants for unannounced inspection visits to monitor compliance with the CGCERT's and NPOP Standards. However the operator will have to arrange boarding and lodging for Inspectors during inspection.

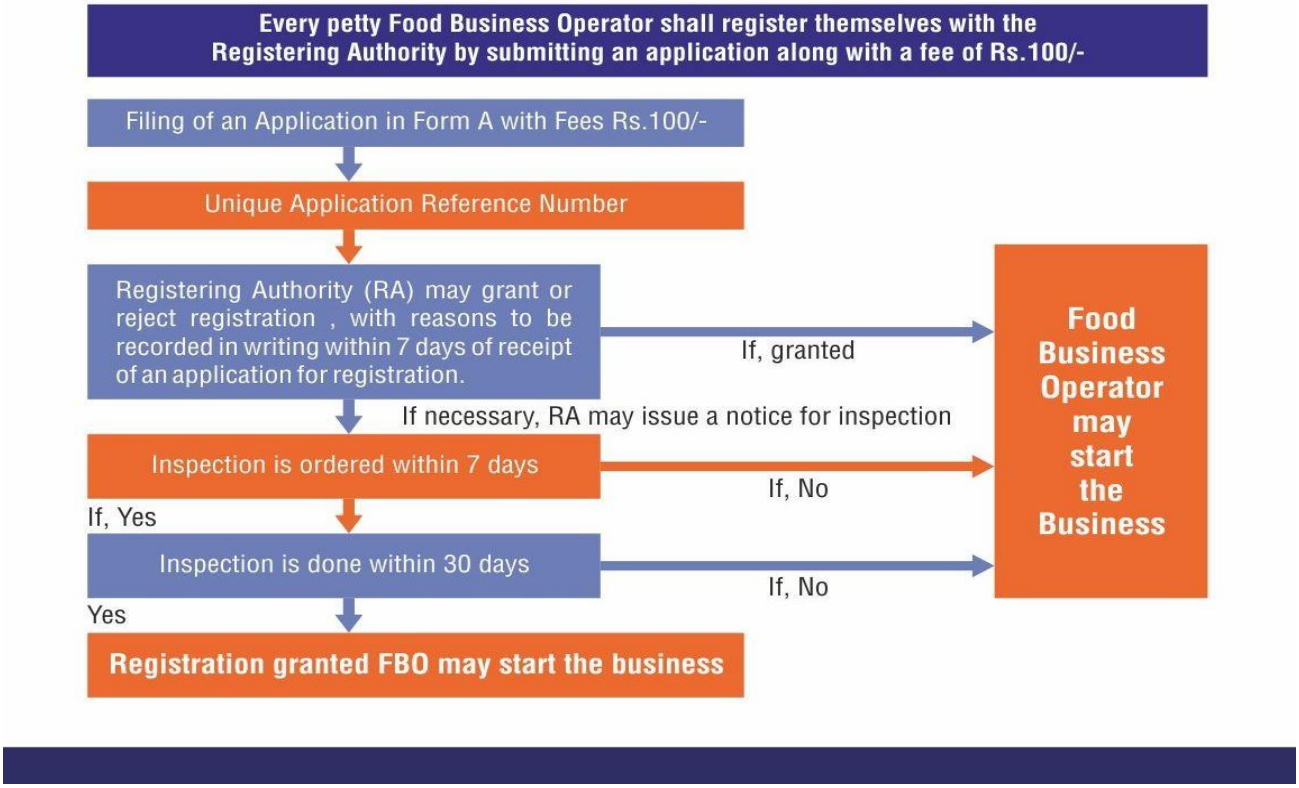
(IV) Refund of fee:

1. Registration fee will not be refunded.
2. If an applicant withdraws his/her application for certification prior to more than fifteen days of the proposed date of inspection, the applicant shall be refunded the deposited fee after deducting the 10% amount.
3. If the applicant withdraws application of certification prior to less than fifteen days and more than three days of the proposed date of inspection, he/she will be refunded the deposited fee after deducting 25% amount.

FSSAI registration and licensing procedure

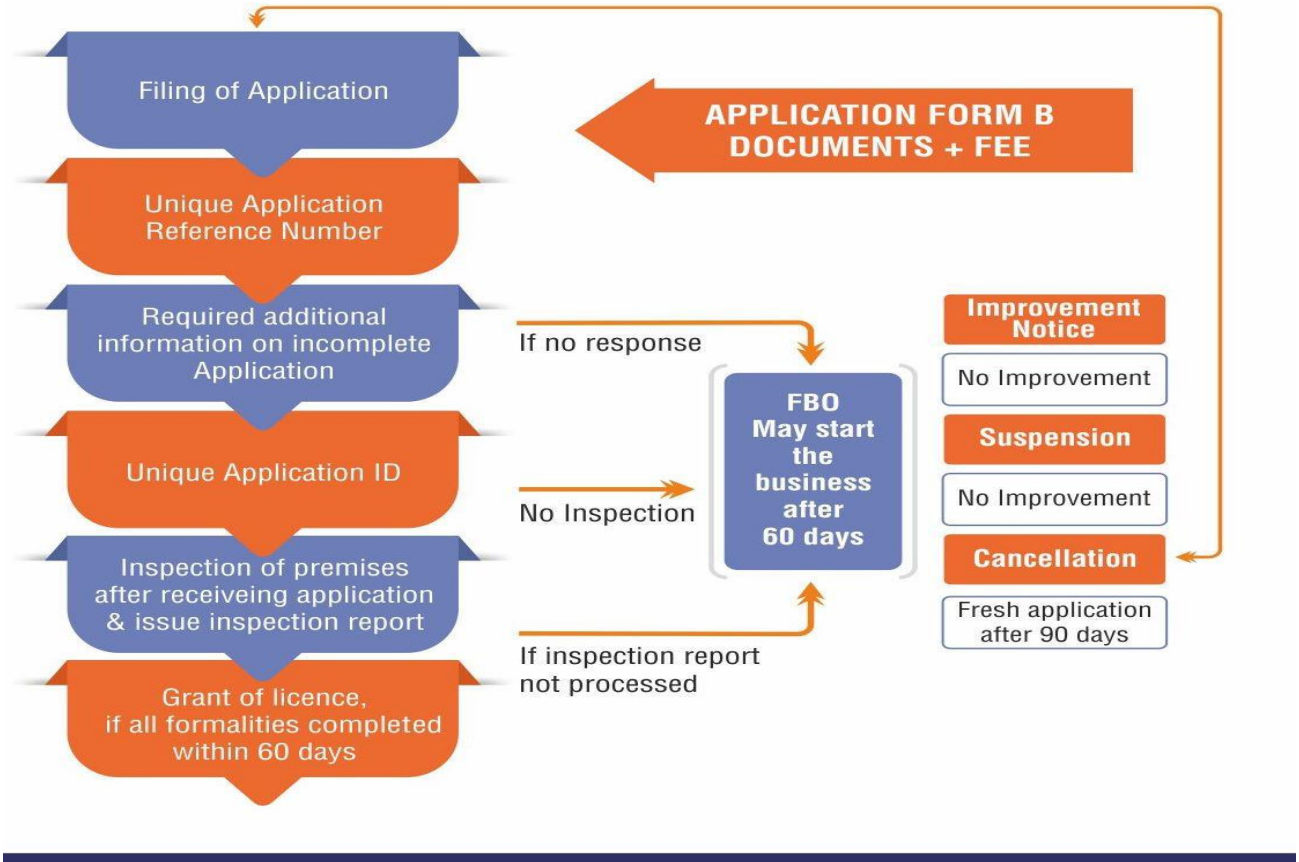
Registration

As per Section 31(1) & 31(2) of FSS Act, 2006 every Food Business Operator in the country is required to be licensed/registered under the Food Safety &Standards Authority of India. The licensing and registration procedure and requirements are regulated by Food Safety & Standards (Licensing and Registration of food Business) Regulations, 2011. Registration is meant for petty food manufacturers that includes petty retailer, hawker, itinerant vendor or a temporary stall holder or small or cottage scale industry having **annual turnover up to 12 lacs**. All food businesses having income more than this limit are required to take a license.



Licensing

As per Section 31(1) of FSS Act, 2006 every Food Business Operator in the country is required to be licensed under the Food Safety &Standards Authority of India. The licensing and registration procedure and requirements are regulated by Food Safety & Standards (Licensing and Registration of food Business) Regulations, 2011.



References

FSSAI- https://fssai.gov.in/cms/registration.php

FSSAI- https://fssai.gov.in/cms/licensing.php

Yadav, M., and Dugaya, D. (2013). Non-timber forest products certification in India: opportunities and challenges. Environment, Development and Sustainability, 15:567–586.

Yadav, M., Dugaya, D., Basera, K. et al. (2011). *Opportunities and Challenges for NWFP certification in India*. Paper presented at International Conference on Non Wood Forest Produce for sustained livelihood during December 17–19, 2011 at Bhopal, India.

Bhattacharyya, R., Asokan, A., Bhattacharya, P., Prasad, R., et al. (2009). The potential of certification for conservation and management of wild MAP resources. *Biodiversity and Conservation, 18*(13), 3441–3451.

IIFM. (2007). *Bhopal-India process as the basis for developing standards and integrated approach of forest certification*. C&I India Update (Vol. 6 No. 1, p. 9). Bhopal: Indian Institute of Forest Management. www.iifm.ac.in/sfmindia.

Chapter 7

Packaging of Minor Forest Produce

Dr. S Anandakumar
Indian Institute of Food Processing Technology

Introduction

Food packaging today has been an integral part of food production as almost all food is marketed as packaged. Food packaging has evolved as science and technology, is interdisciplinary in nature, since knowledge of polymer science, metals, glass, paper, properties of food and physics and engineering is applicable in food packaging, and it has evolved to give solutions to various hazards of food during packaging chain.

7.1 Packaging:

1. Packaging is an operation that ensures delivery of goods to the ultimate consumer in the best condition intended for their use.
2. Packaging is function of enclosing products in containers to perform one or more of the functions of containment, protection, preservation, communication, utility and performance.
3. Packaging is a coordinated system of preparing goods for transport, distribution, retailing and end use i.e. a means of ensuring delivery of product to the ultimate consumer in sound condition.

7.1.1 Levels of packaging:

1. Primary package: It is in direct contact with the product. For example, a product in can (canned food).
2. Secondary package: It contains number of primary packages. For example, a fibre board box containing several of cans.
3. Tertiary package: It is made up of number of secondary packages. For example, a stretch-wrapped pallet of fibre board boxes of canned food.
4. Quaternary package: It is used to facilitate handling (during transportation, shipping) of tertiary packages. For example, large container containing number of stretch-wrapped pallets of fibre board boxes of canned food.

7.1.2 Packaging chain (distribution chain):

Food production → Packaging operation (primary packaging, secondary packaging) → Palletizing and warehousing → Transportation for distribution and delivery to market (distributor → wholesaler → retailer) → Home or consumer → Product use/consumption

Hazards: Food during the time elapsed between production and ultimate consumption is exposed to various hazards (agents or conditions) which make the food unavailable for consumption or significantly affect the quality of food (by damage and any other harm).

7.1.3 Type, factors and effects of hazard:

1. Physical hazard
   - Operations: handling during warehousing, transportation, distribution
   - Actions: stacking, loading and unloading in/from transport vehicles, carrying

- Factors and effects: dropping, tearing, crushing by rope by tying, compression, stack impact (force) resulting in breakage, leakage, burst, bruising, distortion (deformation), crushing, spilling and ultimately loss of food

2. Mechanical hazard
   - Operations: handling during packing, warehousing, transportation, distribution
   - Actions: stacking, lifting, loading, unloading, transportation
   - Factors and effects: piercing, puncturing and tearing by hooks, straps, nails; dropping, bumping, bouncing, vibration (engine of truck, rail, aeroplane) and impact resulting in breakage, distortion, spilling and exposure to adverse climate leading ultimately to loss of food.
3. Biological hazard
   - Pests (rats, rodents, moths, etc) and microorganisms (molds, etc) are the causing factors
   - Operations: handling during warehousing, transportation, distribution
   - Effects: different types of spoilage, insect infestation and loss of food.
4. Climatic hazard
   - Operations: handling during warehousing, transportation, distribution
   - Factors: rain, sunlight, oxygen and other gases, high and low temperature, high and low humidity, high and low pressure, chemical pollutants like sulphites, chlorides and acids
   - Effects: extreme climatic conditions produce stress and results in stress crack and other kind of damage
5. Miscellaneous hazards
   - Caused by fire, floods, tampering, pilferage, foreign odours, corrosive chemicals, contamination by other commodities stored together

7.1.4 Functions of Packaging

The primary functions of packaging are:

- Containment: The package contains its content secured within itself.
- Protection: The package provides protection to the contained food from physical, mechanical, biological, climatic and miscellaneous hazards during warehousing, loading, unloading, transportation and distribution.
- Preservation: The package prevents spoilage of food by post-process contamination of microbiological agents, prevents microbial growth by not providing suitable conditions for growth, checks abiotic deterioration caused or accelerated by agents such as oxygen, humidity, light etc (lipid oxidation, oxidation of food constituents, maillard reaction, texture changes, etc).
- Information (communication): The package provides information to consumer about the product. The information includes the net weight, ingredients used, nutritional composition, price, ideal storage conditions, name and address of manufacturer, date of manufacture and batch number, minimum and maximum storage or shelf life etc.
- Convenience: Packaging provides convenience (comfort) in terms of carrying, storing and handling of foods.
- Sales promotion: An attractive package (attractive design, colour, graphics) is by itself an advertisement of the product and enhances product sales.

7.1.5 Desirable features of packaging:

- Product-package compatibility: The package serves all necessary purposes, no undesirable changes occur in food due to the reaction between the product and package
- Disposability and environment-friendly: Reuse and recycle as much as possible
- Machinability: Good performance in filling and closing in high speed machines
- Convenience to use in terms of opening, dispensing and re-closing

7.2 Packaging materials and their properties

Ancient use: leaves, bamboo, straw, leather, stoneware, clayware
Modern and main packaging materials: paper, plastics, metal, glass and laminates
Packaging materials to less use: wood, ceramics, fabrics of cotton lintre, jute, rubber

7.2.1 Paper and paperboard

Common packaging materials

Advantages:

- Billboards the product
- Can be used in combination with plastic to make aseptic packaging
- Microwavable
- Light in weight
- Can contain products with a variety of geometric shapes

Disadvantages:

- Less strong
- Offers few barrier properties

Table. 7.1 Main type of packaging papers, their properties and use:

Basic material	How made	Properties and use
Kraft paper	From sulphate pulp on soft woods	High strength, bleached, natural or coloured; may be wet-strengthened or made water-repellent. Used as heavy duty paper, used for manufacturing bags, multiwall sacks (e.g. grocery bags) and liners for corrugated board. Bleached varieties for food packaging where strength is required.
Sulphite paper	Generally made from mixture of soft wood and hard wood; usually bleached	Clean bright paper of excellent printing nature Used for making smaller bags, pouches, envelopes, waxed papers (*wax impregnated*, to improve wet resistance), labels and foil laminating etc.
Greaseproof paper	Made from heavily beaten pulp	It is resistant to oil and grease Used for baked goods, chicken roll, pizza

Glassine	Similar to grease-proof paper but supercalendered	It is resistant to oil and grease; it is odour barrier. Used for lining bags, boxes etc.
Vegetable parchment	Made by treatment of unsized paper with conc. sulphuric acid; later passed through bath of dil. Sulphuric acid and water, and then dried.	Non-toxic, high wet strength, grease and oil resistant Used for packaging of wet food and greasy food, e.g. butter, fats, fish

Mechanical pulp produces paper of relatively high bulk and low strength. Plastic coated paper, parchment, glassine, grease proof paper have grease resistance property in decreasing order.

Paperboard

Paperboard (cheaper type) may also be made from straw and grass.

Type of paperboard:

(i) solid fibre board (ii) corrugated fibre board

Solid fibre board is composed of paperboard (usually chipboard) lined on one or both faces with kraft or similar paper. The total caliper of the board is 0.80 to 2.8 mm. Single ply, double ply and multi-ply (up to 8 plies). A single ply board has a single layer of paperboard, double ply board has two layers and so on. Structure of a 3-ply board: a 3-ply board is made up of liner (top layer), under liner and back liner (back layer). Structure of a multi-ply board: liner (top layer), under liner, middles, back liner (back layer or back). CFB has corrugating medium (flutes) between two layers of board for better compression impact resistance. The flutes bear compression (impact) and govern stiffness of the board. Greater flute height exhibits better property.

Table 7.2 Major types of paper board

Board type	Uses
Cream lined chipboard (liner of chemical, mechanical or mixed pulp, back as chipboard)	Board of lowest grade and price; Folding box
White lined chipboard (white pigment + binder/top layer of bleached chemical pulp/under liner of mechanical pulp /middles of mixed recycled fibres/back liner of selected recycled fibres)	Folding cartons for breakfast cereals (e.g. porridge, beaten rice, corn flakes)
White lined manila (triplex)	Cartons for cheese etc
Solid white board (board made entirely from sulphate pulp; waxed)	Strong board; carton and box for frozen and speciality foods, especially liquids
Duplex board (liner and back both made from new pulp, middles mixture of both)	As white lined chipboard
Liquid packaging board (construction similar to solid white board; extra coating or lamination for improved barrier properties)	For packaging of milk, cream, fruit juice, etc.

Chipboard is made from re-pulped 100% waste pulp. Quality of chipboard can be improved by various treatments, as a result different types of board are produced such as white lined chipboard and cream lined chipboard. Barrier properties (e.g. liquid, oil, gas barrier) of board can be improved by such treatments as coating and lamination (wax, glassine, plastic materials are used).


Kraft paper


Sulfite paper


Wax Paper


Greaseproof Paper


Parchment paper

7.2.2 Plastics

- Plastic word derived from Greek word *plastikos*
- The word *Plastics* is used to describe the vast range of materials based on macromolecular organic compounds
- The structures built by the repeated joining of small basic building blocks called monomers, the resulting compound being called a **polymer**

Type of plastics (selected) and description of properties:

1. **Low density polyethylene (LDPE)**
   - Accounts for the biggest proportion of plastics used in packaging
   - Versatility
   - Prepared in films, bottles, closures, dispensers
   - Coating on paper, aluminium foil
   - Relatively inert chemically, almost insoluble in all solvents at room temperature
   - Some softening and swelling can occur with chlorinated hydrocarbons
   - Low water vapour permeability
   - Excellent heat sealing property
   - High permeability to oxygen and other gases
2. **Linear low density polyethylene (LLDPE)**
   - Properties similar to LDPE
   - Stronger and tougher than LDPE
3. **High density polyethylene (HDPE)**
   - Harder than LDPE
   - Barrier properties superior to LDPE
   - gives higher rigidity to bottles than LDPE for same wall thickness
4. **Polypropylene (PP)**
   - Chemically similar to LDPE and HDPE
   - Harder than both
   - Excellent grease resistance
   - High stress crack resistance
   - Steam-sterilizable

   LDPE, LLDPE, HDPE, PP are called polyolefins (a family of plastics based on ethylene and propylene), olefin meaning “oil-forming” and constituting “thermoplastics” (melt on heating and stiffen on cooling)

5. **Ionomers (**a family of polymers in which there are ionic forces between the polymer chains, as well as the usual covalent bonds between the atoms in each chain)
   - Surlyn has properties similar to polyethylene,
   - TPX has good impact strength

6. **Polyvinyl chloride (PVC)**
   - Good gas barrier properties
   - Moderate barrier to water vapour
   - Resistant to weak or strong acid, and alkali
   - Excellent resistance to oil and grease

7. **Polyvinylidene chloride (PVDC)**
   - Outstanding property of low permeability to water vapour and gases
   - Used as shrinkable film (skin wrapping) for wrapping poultry, ham, cheese and other similar items to keep fresh

8. **Polyvinyl alcohol (PVA)**
   Soluble in water

9. **Ethylene vinyl acetate copolymer (EVA)**
   - Good flexibility
   - Used for making snap-on caps
   - Permeability to water vapour and gases is higher than LDPE
   - Good stress-crack resistance

10. **Polystyrene (PS)**
    - Colourless, transparent, hard, brittle
    - Fairly high tensile strength
    - Resistant to strong acids and alkalies; soluble in esters, aromatic hydrocarbons, higher alcohols, ketones, chlorinated hydrocarbons

11. **Polycarbonate (PC)**
    - High impact strength, high softening point
    - High clarity

12. **Cellulose acetate (CA)**
    - Sensitive to moisture and not dimensionally stable
    - Tensile strength and impact strength are comparable to PS

13. **Nylons**
    - Tough material, high tensile strength
    - Good resistance to abrasion
    - High softening point and resist steam sterilization
    - Slightly hygroscopic
    - Fairly high water vapour permeability
    - Good gas and odour barrier property and used in laminates for vacuum packaging
    - Excellent transparency

14. **Polyester/Polyethylene terephthalates (PET)**
    - High softening point
    - Used in boil-in-bag
    - Not easily heat-sealable

Table 7.3 Some important properties of plastics

Type of plastic	Sp. gr.	Softening point (°C)	Yield (m^2/Kg) 25 µ	Tensile str. (kg/cm^2)	WVTR (g/m^2/d/atm) at 90% Rh, 38 °C 25 µ	OTR (cc/m^2/d/atm) at 25 °C 25 µ
Low density polyethylene (LDPE)	0.92-0.94 (low)	85-87 (low)	42	80-240	14-18 (high)	7000-8000 (fairly high)
High density polyethylene (HDPE)	0.95-0.96 (higher)	120-130 (high)	41	220-350	5-7	1500-2000
Cast polypropylene (CPP)	0.91	150 (high)	44	300-400	7-9	2000-3000
Biaxially oriented polypropylene (BOPP)	0.91		44	500-550	4 (v. low)	2000-2500
Polyester (PET)	1.34-1.39	250	28	800-1700 (high)	21	50-90 (v. low)
Polyvinyl chloride (PVC)	1.3-1.6	82	28	460-560	30-40 (high)	300-400
Polyvinylidene chloride (PVDC)	1.5-1.7	80	24	500-850 (high)	2-4 (v. low)	5-25 (v. low)
Ionomer	0.94	68-76	42	350	20-30	7000-8000
Polystyrene (PS)	1.05	78-103	37	360-530	100-150 (v. high)	4000-5000
Polycarbonate (PC)	1.20	165 (high)	32	680-720	50-150	3000
Ethylene vinyl alcohol (EVOH or EVAl)	1.14-1.21		33	400-1600 (high)	20-50	0.5-20
Ethylene vinyl acetate (EVA)	0.93	95		155-280	20-50	10000 (high)
Cellulose Acetate	1.23-1.33	70	42		100-300	2000-3000
Nylon 11	1.04	216 (high)	34	700-1000	60-100	400

7.2.3 Metal packaging material

Advantages:

- High strength
- Offers the best barrier properties after glass
- Provides the tensile strength needed for operation across aerosol sprays
- Can be re-used as a container and offers "collectible" image/dual image

Disadvantages:

- Limits re-usability (sardines, nuts, cat food). Problem of corrosion.
- Can affect taste of food or beverage. Metallic taste
- Metal can not be microwaved unless special protective coating or layer is provided

Type of metal packaging material:
Tin, tin free steel, tinless steel, aluminized steel, aluminium, aluminium alloy, anodised aluminium, anodised and laquered aluminium

Tin
Advantages of tin:

1. Fabricated readily
2. Strong to withstand processing and handling
3. Easy to handle
4. Light weight
5. Can be handled on high speed machine

Type of steel plate: The type depends on the degree of workability, strength and corrosion resistance. The properties depend on the content of phosphorous (0.01-0.1%) and copper (0.02-0.6%). Phosphorous gives strength. Steel containing higher amount of copper are more corrosive.

Type L: used for highly corrosive products
Type MR: moderately corrosive products
Type MC: used for making high strength tinplate

Process of tin coating:

1. Hot dipping: Steel plate is dipped in molten tin bath
2. Electrolytic coating: It is electrolysis process of coating where tin acts as anode and steel acts as cathode. The tin is deposited on the steel plate.

Tin coating thickness: 0.4 -2.5 um (2.8-17 gsm)

Electrolytic coating method gives thinner coating with the substance as low as 5.6 gsm when it is minimum of 22 gsm by hot dipping method (11 on each side).

Differential tin coating: it refers to the coating method with different amounts of tin deposit on the two sides of steel plate. Nomenclature, for example D 100/50.

Tin free steel: It is mild steel coated electrolytically with chromium (chromic acid). It is cheaper than tin. It may be lacqured to improve its performance.

Tinless steel: It is also called Black Plate. It is mild steel sheet coated with phosphate for facilitating lacquering. The coating is done by dipping in hot phosphate solution and the process is called bonderizing (bonderizinf produces good adherend surface for subsequent paint coating). After bonderizing, cleaning and drying the sheet is lacquered and baked.

Aluminized steel: The steel plate is coated with aluminium by hot dipping process or vapour coating (vapour deposition coating).

Alluminium: Light in weight, good gas and light barrier properties, non-corrosive for large number of food products, expensive

Aluminium alloy: It is Al-Mn alloy and contains 1% manganese as alloying agent. Manganese increases strength and corrosion resistance. Without manganese to have the same strength as tin the thickness of aluminium has to be 20% greater.

Lacquer and lacquering:
Lacquer (UK), enamel (US)

Lacquering is done to prevent corrosive reaction between the can and content.

Lacquer type based on resistance to corrosion:

1. AR lacquer (Acid Resistant lacquer): e.g. oleoresin lacquer, gold coloured
   Used for anthocyanin (water soluble red pigment) rich fruits like blue grapes, cherry, plums)
2. SR lacquer (Sulphur Resistant lacquer): e.g. Epoxy lacquer.
   Used for sulphur containing foods like meat, fish, poultry

Lacquer type based on composition and synthesis:

1. Natural lacquer: It is oleoresin lacquer and made of natural resin*, solvent, drying oil and drier. It is used for fruits containing anthocyanin.
   *Resin is an inflammable adhesive substance insoluble in water and secreted by most plants and exuding naturally or upon incision, esp. fir and pine.

2. Synthetic lacquer:

2.1 Phemolic lacquer: made of synthetic resin and solvent. It is made by the acid of alkaline condensation of a phenol with formaldehyde.

2.2 Vinyl lacquer: Made of synthetic resin and solvent. It is made by copolymerzation of vinyl chloride and vinyl acetate. It is used for beer and soft drinks cans which are not processed at high temperature.

2.3 Epoxy lacquer: It is made from eiphlorohydrin and bis-phenol (produced from phenol). It has fair resistance to sulphide staining.

2.4 Epoxy phenolic lacquer: It is made from polybutadienes and resins based on diphenolic acid. It is also called general purpose lacquer and used for high acid foods and condensed milk.

Table 7.4 General types of can coatings

Coating	Typical uses	Type
Fruit enamel	Dark coloured berries, cherries and other fruits requiring protection from metallic salts	Oleoresinous
C-enamel	Corn, peas and other sulphur-bearing products	Oleoresinous w. suspended zinc oxide
Citrus enamel	Citrus products and concentrates	Modified oleoresinous
Beverage can enamel	Vegetable juices; red fruit juices; highly corrosive fruits; non-carbonated beverages	Two-coated w. resinous base coat and vinyl top coat

7.2.4 Glass

The principal ingredient of glass is silica from sand, flint or quartz which is molten at very high temperature during fabrication of glass containers. Silica is combined with other raw materials to form glass. Very common soda glass contains apart from silica other minerals like CaO, Na_2O etc in small amounts.

Glass Bottle

Advantages:

- Offers tremendous barrier properties
- Chemical inertness. Reinforces consumer security.
- Conveys the "feel" of crystal, and creates a good impression. Good psychological attribute.

Disadvantages:

- Heavy in weight: weighs more than any other packaging material.
- Breakage problem: can break in filling, shipping, palletizing, storage or use.

Table 7.5 Packaging materials and package forms:

Packaging material	Package form
Paper and paperboard	Wrapping paper, bag, box, sachet, pouch, case, carton, fitments in board, body of composite container, fittings in case, multiwall sack, fibre drum, tray, tub
Metal	Can, crate, box, pallet, collapsible tube, closure, drum, metal strapping and banding, foil, laminate and label (aluminium)
Glass	Bottle, jar, tray, tube, ampoule, vial
Plastics (including cellulose and rubber)	Film, laminate and sheet, bag, pouch and sachet, sack (film and woven tape), bottle, jar, pot, tray, pot, blister and fitment, cushioning material and fitting, cap and closure, drum, crate, box, tub
Timber (including plywood)	Box, crate, cask and keg, case, drum, pallet, basket and punnet
Textile	Sack, bag

7.2.5 Retail pack

Three-piece can: It is open top sanitary (OTS) can, so called because the top side only is open while filling the can. It is made of three pieces of top side (lid), bottom side (lid) and body.

Can size nomenclature:
A2½, A1 Tall etc
A2½ (American system) → $4^{1}/16$" (dia) x $4^{11}/16$" (ht) → 401 (dia) x 411 (ht) (ISO diameter)

Can shapes: round, rectangular, oval, oblong, pullmon

Two-piece can: It has a body and a lid and so called two-piece can.

Two-piece can (type):

1. Drawn and wall ironed (DWI): The body blank is drawn into a cup and forced by means of a punch through a series of annular dies (rings). Each die is slightly smaller than the preceding one, thus elongating the wall by a stretching or ironing action. During ironing the wall thickness is reduced and the height correspondingly increased. For example, carbonated beverages.
2. Drawn and redrawn (DRD): This process is used to produce can of bigger height (taller can) and the can has higher height to diameter ratio. The process is similar to DWI, except that the height is increased by sequentially decreasing the diameter of container by drawing cups to smaller diameter.

Advantages of two-piece can:

1. Elimination of two seams reduces the possibility of leakage and removal of a potential source of lead contamination from solder.
2. Better aesthetic appeal presenting a smooth profile and streamline appearance.
3. Un-interrupted print decoration on the external surface.
4. Bottom of the can be designed and formed for better stack ability.
5. Less metal is used in its construction due to elimination of the overlap at the two seams.

Aluminium can

Type of aluminium can

1. **Built up can:** The can is made by the process similar to making normal 3-piece can. The lid can be replaced on can and the container is reuseable in household.
2. **Shallow formed can:** This is made by drawing process ("drawn can"), in which the body blank is blown with the stroke of "press". The maximum height is half the diameter of container. The shape is round or rectangular.
3. **Deep drawn can:** The maximum height is 1.2 times the diameter of container. The maximum practical diameter is 815 mm. This type of can is made by pressing.
4. **Impact extruded can:**
   In impact extrusion a disc of aluminium known as "slug" of about 2.5 to 6 mm thick is placed in specially shaped die. A container cylinder is formed inside a confining die from the cold slug, by a single stroke application of force through a punch (attached with a hydraulic press generating forces up to 250 psi) causing the metal to flow around the punch. Tall cans are formed by this process. The maximum height of can is 3 times the diameter. The practical diameter is 105 mm.

Tube

Metal tube, plastic tube, laminated tube

Plastic tube:

Coloured PE (LDPE, MDPE, HDPE, L LDPE) granules are mixed and blended and extruded in continuous tubing; the tubing is cut to desired length; shoulder and nozzle are formed; after colour printing lacquering is done to give glossy finish; drying by UV light system

- Does not collapse but retains its shape and length on bending and squeezing
- Rust proof
- Strong seals (the seal does not open easily)

Laminated tube:

Plastic/al. foil/paper

Complete ply composition: LDPE with antistat (outermost layer)/LDPE/printing ink/pigmented white LDPE/paper/LDPE/ethylene acrylic acid copolymer/al. foil/EVA/LDPE (innermost layer)

Advantages

Far better barrier properties than plastic tube

Easily squeezable and eliminated waste

Resistant to cracking, creasing and denting
Superior appearance
Corrosion free

Tray, tub and cup:
Tray, a shallow container is made up of fibreboard (e.g. biscuits and snacks) and plastic (e.g. meat); may be portioned. Portioned tray suitable for assorted (classified) items e.g. biscuits Laminate is used to fabricate lid and body of tub, e.g. lid (PET/Al.foil/PP), body (PP/EVOH or PVDC/PP)
Plastic tray, tub (deep) and cup come under semi-rigid type moulded plastic containers.
Flexible type containers lack stand up rigidity.
Semi-rigid and rigid containers have advantage of speedy filling/packing

Wrap and closure
Wrap
Wrapping may be performed on individual item of product (confection, overwrap over a tray of food) or for unitizing purpose. Wrapping an individual product offers protection to the product whereas wrapping for unitization would mean making a bundle of the packages (or holding the load together) for easy handling, for example, stretch (film)-wrapping of a case of milk bottles or beer cans or strapping or netting of boxes piled up on a pallet (tertiary packaging). Unitizing thus saves labour costs, warehousing costs (space saving) and simplifies the handling thus increasing the efficiency of shipping and warehousing.

Shrink-wrapping:
1. Evacuation of air from bag followed by shrinking by immersion in hot water (e.g. PVDC) for odd shaped product e.g. dressed poultry, cheese
2. Collating of cans, cartons, bottles by exposing to hot air (e.g. LDPE)

Stretch-wrapping:
1. The film is stretched over/around the object e.g. a dressed poultry and then allowed to retract to its original dimensions.
2. Wrapping around the objects (unitizing) followed by heat sealing Plastic films: LDPE, EVA, PVC

7.2.6 Shipping containers/transportation containers/ containers for distribution (secondary package)

Box, case, crate, barrel, cask, drum, sack etc

Material of construction and package:
- Wood, fibreboard, plastic, metal, jute
- Wooden box, fibreboard box or case, wooden barrel or cask (wine, whiskey etc), plastic crate e.g. PP and HDPE (milk, beer, soft drinks etc), metal drum, plastic (PE, expanded PET) drum (fruits, fish etc)

7.2.7 Modified Atmosphere Packaging (MAP)

It is enclosure of food in a package in which the atmosphere (gaseous composition) surrounding the food is modified or altered to give optimum atmosphere for extension of shelf life (by 40-50%) and maintaining quality of food.

MAP is normally used in combination with low temperature

Type of MAP
1. Active MAP (active modification): It involves displacing the air with a controlled, desired mixture of gases (gas flushing).

Active packaging is also sometimes referred to as Active MAP, whereby an active substance is used to perform some active role. For example, an O_2 adsorber, e.g. ferrous carbonate is used to adsorb O_2.

Method:

1. Vacuumizing
2. Vacuumizing followed by gas flushing
3. Injecting gas without vacuumizing

Equipment:

1. Form-fill-seal
2. Chamber method (filling → vacuumizing → gas flushing → sealing)
3. Snorkel machine (continuous process, similar operation as chamber method)

2. Passive MAP (passive modification): an atmosphere high in CO_2 and low in O_2 occurs as a consequence of the food's respiration or the metabolism of microorganisms associated with the food over time.

The package film permeability is such that O_2 can enter the package to avoid anoxic condition and anaerobic respiration at the same time excess CO_2 can diffuse from the package (avoids injurious effect).

Controlled Atmosphere packaging CAP

In CAP, the atmosphere inside the package is continuously monitored and adjusted to maintain the optimum composition within quite close tolerances (so called controlled atmosphere)

In strict sense, CAP is enclosure of food in a gas impermeable package, the gaseous composition inside which with respect to CO_2, O_2, N_2, water vapour etc has been changed to increase the shelf life of food.

- Normally bulk packaging and storage
- Normally fruits and vegetables, and fresh produce

Vacuum packaging

Sometimes considered as active MAP method.

Package, normally retail package, evacuated mechanically (vacuum pump), and the food is held in air free atmosphere.

- package is skin-tight
- longer shelf life in oxygen free system
- Normally applied to meat, fish, poultry, cheese
- Suitable packaging materials: PVDC, EVOH (v. low GTR). Nylon may be used in laminate

Method: batch and continuous process

Vacuum packaging

Gas packaging

Package is first evacuated, and then filled with inert gases, CO_2 or N_2

- Package is devoid of O_2, provides protection to food against O_2, packaging of oxygen sensitive products, viz. milk powder
- Provides protection from compressive impact; packaging of fragile food, viz. potato wafer & chips;
- Production of pillow pouch
- Suitable packaging materials: PVDC, EVOH. Nylon may be used in laminate

Gas Packaging

Hypobaric storage

It is a storage system (structure) for the storage of food in an environment of precisely controlled air pressure, temperature and humidity. , and the rate at which air is changed is closely regulated. Air pressure (which is proportional to O_2 concentration) is the most important parameter, and it is closely monitored and regulated.

Edible film packaging: An edible film or coating is simply defined as a thin continuous layer of edible material formed on, [placed on, or between the foods, which can be eaten as a part of the whole food product. Selection of material for use in edible packaging is based on its properties to act as barrier to moisture and gases, mechanical strength, physical properties, and resistance to microbial growth. The types of materials used for edible packaging include lipids, protein and polysaccharides or a combination of any two or all of these. The most common form of coating fruits and vegetables is wax coating to retard respiration, dehydration and senescence. Edible films selected should meet the requirements such as physiochemical and microbial stability, good sensory qualities, high carrier and mechanical efficiencies, free to toxic and safe for health, simple technology, non polluting and low cost of material and process.

Aseptic packaging

It refers to filling food in package in contamination free (asepsis/sterile) condition.

- Most cases: filling pre-sterilized food in sterilized container under sterile environment
- Rare case: filing non-sterile product (yoghurt and similar products) in sterile container under aseptic condition

Method:

- Product sterilization by heat. Heat exchangers: tubular, plate, scrap film
- Sterilization of packaging materials by irradiation, heat (superheated steam, saturated steam or hot air) and chemicals (H_2O_2), in singles or combination
- Sterilization of packaging atmosphere by superheated steam

Advantages:

1. Application of HTST process - efficient heat transfer, superior product quality (nutritional, sensory)
2. Filling irrespective of container size
3. Product is shelf stable at normal temperature

Packaging materials:

- Packaging materials: metal, glass, plastic or laminate (PE/paper board/PE/foil/PE)
- Package type: carton, can, bottle, bag, pouch, sachet, cup

Filling in pouch, sachet and carton is by form-fill-seal system

7.2.8 Active packaging

Packaging is termed as active packaging when it performs an active role (inhibition of microbiological, biological, chemical reactions) besides providing an inert barrier to external environment. The effect is obtained by introducing materials having definite functions into the packaging or other special techniques. The active substances act by adsorption, absorption and reaction. It is that packaging technique that dynamically changes permeation properties or the concentration of different volatiles and gases in the package headspace during storage. AP is mostly applied to plastic packaging.

Oxygen scavenging

Oxygen scavengers/oxygen adsorbers: iron, oxygen scavenging enzymes, ascorbic acid, light activated scavenger, oxygen scavenging reaction system

CO_2 scavenging or scrubbing

1. Absorption of CO_2 in hydrated lime or activated carbon. Calcium hydroxide reacts with CO_2 under high humidity condition and produces $CaCO_3$.
2. The scavenger, CaO is packed in a porous envelope and put in a sachet containing hydrating agent like silica gel. Water is absorbed by the hydrating agent and CaO reacts with CO_2.

Ethylene scavenging

Ethylene, respiration product of ripening fruit, anaerobic respiration, has detrimental effect on fruits Yellowing

Ethylene scavenger e.g. $KMNO_4$

Humidification and humidity buffering

- Fruits and vegetables have high moisture content; leafy vegetables > 90%, and larger surface area, other vegetables and fruits 85-90%
- Transpiration →loss of moisture → weight loss, wilting, shriveling, shrinkage

Active packaging of fruits and vegetables

Packaging to control of moisture loss and maintain high Rh

- Active packaging: humidification and humidity regulation by use of humectants and like alcohol, propylene glycol, carbohydrate, etc. impregnated between the layers of water vapour permeating plastic films
- Humidity buffering (maintaining desired humidity without condensation or drying of packed goods)

1. Packaging in fibre board cartons with a LDPE liner (low WVTR) or waxed carton (protection from drying and wilting or shriveling)
2. Active packaging: 1. inclusion of microporous bag or pad of inorganic salts (antifogging agents) in the carton (prevention of condensation), 2. a multilayer is provided on the side of carton which absorbs moisture released by the packed produce and releases the moisture (water vapour) when the humidity is low.

7.2.9 Total quality protection/Product package compatibility

It is desirable that no interaction between food and packaging material occurs which may harm the quality of food and pose health hazard to the consumers. Hence, total quality protection is a necessity.

The food-package interaction can result in:

- Unacceptable changes in food composition
- Unacceptable changes in organoleptic properties
- Toxic effects

Migration is a common process leading to food-package interaction. It refers to the process in that the monomers and other packaging material components move or transfer to food and vice versa by leaching or diffusion (evaporation).

Overall migration: Previously termed as global migration, it refers to the migration of sum of all mobile packaging material components, and measured per unit area under defined test conditions. All the migrants may not be known and may not be of toxicological interest.

Specific migration: It refers to the migration of a specific, individual and identifiable component. The terminologies are commonly and appropriately used in case of plastics

7.2.10 Case study 1: Packaging of Honey

Packaging of honey and honey containing products requires their own specific packaging materials. Storage containers for liquid or crystallized honey should be made either of glass or stainless steel or coated with food approved plastic, paint or beeswax to make air tight. For most retailing of pure honey, the preferred packaging material is glass followed by plastic or, for large quantities, metal container coated with materials appropriate for contact with acidic food. The container must be odorless, no exposed metal which will react with honey. The container must facilitate easy removal of honey. The label, container shape and material or other material should choose accordingly. Recycled glass bottles may be appropriate if they can be cleaned adequately and a cork type seal can be provided. Package choice should however also consider recyclability, disposability and environmentally friendly manufacturing of the packaging materials.

Honey is considered as a stable product, in the sense that it is not spoiled by the bacteria and fungi normally responsible for food spoilage. However, there are several factors such as microorganism, acidity, heat or sunlight which results in deterioration of honey. Fermentation remains the major threat to unprocessed honey, whether it is crystallized or liquid. Therefore storage conditions have to prevent fermentation through either low temperature storage or by preventing further adsorption of moisture. Change in PH (more moisture and low PH results) cause faster deterioration. Heat and sunlight can destroy the quality of honey. UV radiation destroys glucose oxidase. Considerably the aspect of preservation of product, maintaining its liquid or crystallized form is important. Only cold storage below 5 ^{o}C is suited to simultaneously prevent crystallization, melting of crystallized honey and fermentation. Such storage is however expensive. Storing liquid honey above 25 ^{o}C to prevent any crystallization can only be recommended if very quick sales are expected. A temperature of 20 ^{o}C was mentioned as a compromise for storage of liquid or crystallized honey. So, room should have temperature of near 20 ^{o}C and relative humidity of less than 65%. Storage of honey at more than 25 ^{o}C causes increasing quality less with time, due to progressively chemical and enzymatic

change. Also, proper storage and packaging together with quick marketing and consumption will reduce or eliminate the need for preservatives.

Honey	Wide mouth glass containers Acid-resistant lacquered tin containers Packaging material; HDPE, PP, PVC, LDPE

Metal drums

All metal drums, including new, reused and reconditioned drums, shall be coated or lined with a food grade lacquered coating. The coating must:

- provide a barrier between the metal surface of the drum and honey;
- be inert;
- not impart any flavour to honey;
- be resistant to delamination, flaking or peeling.

The lining coatings of any drum used for honey (ie, reconditioned or re-used) and the standards they comply with shall be known. A specification or letter confirming the suitability of the lining should be provided by the drum supplier

Reused or reconditioned drums

a. Drums that have been used to contain non-food materials (e.g. petroleum products and other chemicals) shall not be reused for honey.
b. Reused drums that have contained other foods such as sucrose, glucose, or orange juice shall be thoroughly washed and dried, in such a manner as to remove all residues of the food material, before it is used for honey. Only hot water and washing agents that have been approved as being safe for food use shall be used.

Inspection of drums

a. Drums shall be checked for damage, deterioration and contaminants prior to use to ensure that they are suitable for containing honey.
b. The internal surface of drums shall have no cracks, rust, delaminated coatings, and other defects or damage that may impact on the safety and suitability of honey. (For closed-head drums, it is common industry practice to use a torch to view the inside of the drum. A mirror should be used to check underneath the lid).
c. Badly dented drums shall not be used.
d. Drums that contain residues of fermented honey shall be washed and dried before reuse.

Storage and handling of drums

a. Empty and full drums shall be stored in a manner that prevents deterioration of the drums, and the entry of water and contaminants into the drums. (Empty and full drums should be stored off the ground e.g. use pallets).
b. Drums shall have properly fitted bungs that prevent the entry of moisture and other contaminants.
c. Drums shall be handled and transported in such a manner that prevents dents and other forms of damage.

Washing and drying of drums

a. drinking quality water shall be used for washing of drums.
b. Drums shall be completely dried after washing and before being sealed with a `bung. To facilitate drying, washed drums may be dried in hot boxes or rooms. Some processors use hot air guns to dry drums after washing.

Plastic packaging

Plastics for food contact use shall be food grade

Packaging materials must be adequately protected during transport to the premises and during storage, against dust, pest and other contaminants, and physical damage.

Glass jars

Metals lids must be coated or lined with a food grade material suitable for an acidic food such as honey.

Glass jars must be adequately protected during transport to the premises and during storage, against dust, pest and other contaminants, and physical damage. Glass jars should be stored in an inverted position.

Glass jars must be handled in manner that does not cause any breakage or other damage.

Broken glass must be removed and discarded immediately. A thorough check must be carried out to ensure that all broken pieces are removed.

Techniques Packaging shall be done under conditions that preclude the introduction of contamination into the product.

Preservation of finished product

Methods of preservation or treatment of the finished product shall be such as to kill any insects or mites remaining after processing and to result in protection against contamination, deterioration, or development of a public health hazard.

Storage and transport of finished products.

The finished products shall be stored and transported under such conditions as shall preclude the contamination with or development of pathogenic or toxicogenic microorganisms and protect against rodent and insect infestation and deterioration of the product or of the container.

The product shall be stored under suitable conditions of time, temperature, humidity, and atmosphere, to prevent significant deterioration. Where honey is stored under conditions in which they may become infested by insects and mites, appropriate methods of protection shall be used regularly.

Glass bottle with cork cap

Glass bottle with metal cap

PET bottle with plastic cap

Stand-up pouch

Wider mouth glass bottle with metal cap

Wider mouth glass bottle with plastic cap

Case study 2: Packaging of mushroom

Mushrooms have attracted much attention due to their excellent nutritional and sensory properties. However, they are highly perishable and rapidly lose their organoleptic characteristics. Many methods have been employed for mushroom storage, such as packaging, blanching, canning, or freeze drying. Among them, modified atmosphere packaging (MAP) has been widely employed for preserving fresh mushrooms. MAP provides an affordable packaging system that partly avoids enzymatic browning, fermentation and other biochemical processes by maintaining a controlled gas atmosphere. Several factors, including optimum CO2 and O2 partial pressures, permeability, package material, thickness, or product weight, must be considered in order to design a suitable modified atmosphere package for mushrooms. Thus, different strategies are available to preserve mushroom quality after harvest.

Case study 3: Packaging of tamarind

Tamarind Concentrate Tamarind Pulp	• Tin or glass containers • Pouches made from metallised polyester or laminate of metallized BOPP/ionomer • Metallized PET bags or BOPP ionomer bags • Closely woven bamboo baskets, lined with polyethylene or Palmyra mat • Jute bags, lined with polyethylene • LDPE coated raffia bags • Wooden boxes lined with Palmyra mats
Tamarind powder	• The printed flexible pouches are generally laminates of various compositions • Some of the commonly used laminates are: – Polyester/metallised polyester/LDPE – BOPP/LDPE – BOPP/metallised polyester/LDPE – Polyester/Al foil/LDPE

Tray pack

Flexible pouch with cap

Wrap package

Zipper flexible pouch

Case study 4: Packaging of Arecanut

Packaging Material: The areca nut is packed in gunny bags for marketing. The gunny bags are easily available in the market. Each bag has a capacity of packing 70kgs of areca nut.

Polyethylene lined gunny bags used over plain gunny bags

Airtight bins/containers

Rigid, round tinplate containers, which are internally lacquered nuts that are packed with an inert gas like nitrogen for extended shelf-life. The containers are provided with ring pull type, easy open tops, fitted with re-closable plastic caps.

Flexible Plastics/pouches

Some of the typical structures are:

- BOPP / LDPE
- BOPP / Polyester / LDPE
- Metallised Polyester / LDPE
- BOPP / Metallised Polyester / LDPE
- Polyester / LDPE
- Polyester / Al foil / LDPE (The sealant layer could also be LLDPE or cast PP) In the European and American markets, the typical structures used for packaging of crisps and similar snack food are:
  - PVDC coated glassine
  - PVDC coated glassine / OPP

Vacuum Pouch

It offers extensive range of high barrier PA/EVOH-based 5 layer co-extruded barrier vacuum packing, gas flush and MAP Pouches polyethylene, polyamide, ethylene vinyl alcohol, and other materials such as packaging films, foils, trays, bags, and lids

Conclusion

The extension of fresh commodity and its products is an old challenge for industrial producers. In recent years, many innovative solutions and packaging materials have been explored, from active and intelligent packaging to edible coatings and nanomaterials, eventually coupled with MAP. High-barrier films and special packaging machines in order to displace atmospheric air from the headspace. Current research trend is emerging that couples the newest technological tools, such as active sachets, with the use of preservatives of natural origin, derived from spices and herbs. Proper packaging is an effective way to decrease post harvest losses and allow an extension of shelf life. Hence, adequate packaging method, coupled with interventions in formulation, can increase a product shelf life during storage.

Suggested literature:

1. F.A. Paine and H.Y. Paine. A handbook of Food Packaging. 2nd edition, Blackie Academic, 1992.
2. Gordon L Robertson. Food Packaging Principles and Practice. 2nd edition, CRC Press, 2006.
3. A.S. Athalye. Plastics in Packaging. Tata McGraw, 1992.
4. Frank A. Paine Packaging User's Handbook. Springer

Annexure

PM Formalisation of Micro Food Processing Enterprises Scheme (PM FME Scheme)

1. Background

1.1 The unorganized food processing sector comprising nearly 25 lakh units contributes to 74% of employment in food processing sector. Nearly 66% of these units are located in rural areas and about 80% of them are family-based enterprises supporting livelihood in rural household and minimizing their migration to urban areas. These units largely fall with in the category of micro enterprises.

1.2 These units face a number of challenges which limit their performance and growth. These challenges include lack of access to modern technology & equipment, training, access to institutional credit, lack of basic awareness on quality control of products, and lack of branding & marketing skills, etc. Therefore, the unorganised food processing sector contributes much less in terms of value addition and output despite its huge potential.

25 Lakh unorganised food processing units contribute to **74%** of employment in food processing sector

2. Objectives

2.1 Taking cognizance of the contribution of the unorganized micro food processing enterprises and the challenges that impede their performance, Ministry of Food Processing Industries (MoFPI) has launched "PM Formalisation of Micro Food Processing Enterprises Scheme (PM FME Scheme)" through a package support and services. The objectives under the scheme, inter alia, include:

(i) Capacity building of entrepreneurs through technical knowledge, skill training and hand holding support services;

(ii) Increased access to credit to existing micro food processing entrepreneurs for technology upgradation;

(iii) Support to Farmer Producer Organizations (FPOs), Self Help Groups (SHGs), Producers Cooperatives & Cooperative Societies along their entire value chain to enable microenterprises to avail common services.

(iv) Support for transition of existing enterprises into formal framework for registration under regulatory framework and compliance;

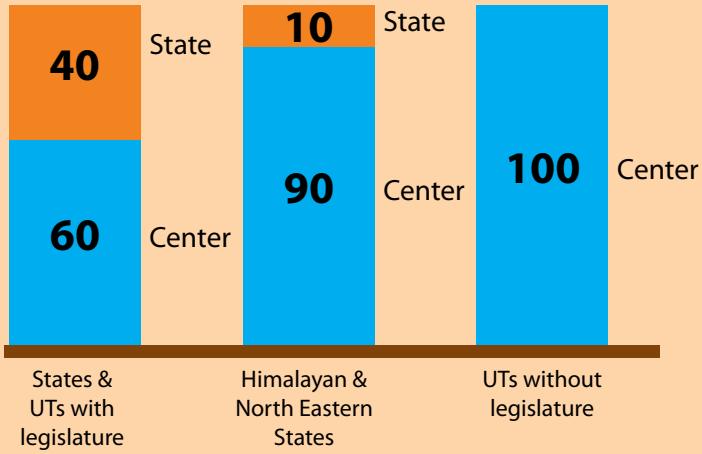
(v) Integration with organized supply chain by strengthening branding & marketing;

3. Coverage of States/ UTs and Funding Pattern

3.1 It is an All India Centrally Sponsored Scheme with an outlay of Rs. 10,000 crore for coverage of 2,00,000 enterprises over 5 years from 2020-21 to 2024-25. The expenditure under the scheme would be shared in 60:40 ratio between Central and State Governments, in 90:10 ratio with North Eastern and Himalayan States, 60:40 ratio with UTs with legislature and 100% by Center for other UTs.

3.2 Expenditure in the first year 2020-21, whether incurred by the Centre or the States would be borne 100% by the Central Government. The expenditure made for the first year would be adjusted in ratio given above in the funds being transferred to the States equally in the next four years.

Fund Sharing Pattern Between Center & State



3.3 Funds under the Scheme would be provided to the States based on the approved Project Implementation Plan (PIP).

4. One District-One Product Approach

4.1 The Scheme will adopt a One District One Product (ODOP) approach to reap benefit of scale in terms of procurement of inputs, availing common services and marketing of products. One District One Product approach would provide framework for value chain development and alignment of support infrastructure. There may be more than one cluster for one product in one district. A cluster may also extend beyond one district. The States would identify food product for a district, keeping in perspective the focus of the scheme on perishables. The ODOP could be a perishable agri-produce, cereal based product or a food product widely produced in a district and their allied sectors. Illustrative list of such products includes mango, potato, litchi, tomato, tapioca, kinnu, bhujia, petha, papad, pickle, millet based products, fisheries, poultry, meat as well as animal feed among others. With respect to support to existing individual micro units, preference would be given to those producing under ODOP approach. However, units producing other products would also be supported. In case of groups, predominately, those involved in products under ODOP approach would be supported. Support to groups processing other products in such districts would only be for those already processing those products and with adequate technical, financial and entrepreneurial strength. Support for common infrastructure and marketing & branding would only be for products under ODOP approach. In case of support for marketing & branding at State or regional level, same product of districts not having that product as ODOP could also be included.

4.2 The scheme would also support strengthening of backward and forward linkages, provision of common facilities, incubation centres, training, R&D, marketing & branding, provision of which would primarily be for ODOP products. Further, this approach would also complement and benefit from the existing promotional efforts of the Government such as development of Agriculture Crop Clusters under the Agriculture Export Policy, the cluster approaches of the Ministry of Agriculture and the Ministry of Rural Development through the National Rurban Mission.

5. Support to Food Processing Units

Support to food processing units would be provided for the following:

(i) Credit linked grant at 35% of the project cost with maximum grant up to Rs 10.0 lakh to existing unorganised food processing units for upgradation;

(ii) Credit linked grant at 35% of the project cost to SHGs/FPOs/cooperatives for capital expenditure with maximum limit as prescribed;

(iii) Seed capital @ Rs. 40,000/- per member to those engaged in food processing as a working capital;

(iv) Credit linked grant at 35% of the project cost for common infrastructure with maximum limit as prescribed;

(v) Support for marketing & branding up to 50% of the expenditure with maximum limit as prescribed.

6. Upgradation of Processing Units

6.1 Individual Category: Individual micro food processing units would be extended credit-linked capital subsidy @35% of the eligible project cost for expansion/ technology upgradation with a maximum ceiling of Rs.10 lakh per unit. The beneficiary contribution should be minimum 10% and the balance should be loan from a Bank.

6.1.1 Eligibility criteria:

(i) Individual / Partnership Firm with ownership right of the enterprise;

(ii) Existing micro food processing units in the survey or verified by the Resource Person;

(iii) The applicant should be above 18 years of age and should possess at least VIII standard pass educational qualification;

(iv) Only one person from one family is eligible for obtaining financial assistance. The "family" for this purpose would include self, spouse and children.

6.1.2 Procedure for applying for upgradation:

6.1.2.1 Applications would be invited at the district level on an ongoing basis for units interested in availing the benefits under the Scheme. Existing food processing units desiring to seek assistance under the scheme should apply on the FME portal. Loan proposals would be recommended to the Banks after scrutiny. States would decide the appropriate level for short listing of the applications to be recommended to the Banks.

6.1.3 Procedure with Banks for Grant:

6.1.3.1 At the national level, a Nodal bank would be appointed for disbursement of subsidy to the banks and liaison with the banks extending loan to the beneficiaries. The bank sanctioning the loan would open a mirror account in the name of the beneficiary. Grant by the Central and State Government in 60:40 ratio would be deposited in this account of beneficiary in the lending bank branch by the State and Central Government. If after a period of three years from the disbursement

of last tranche of the loan, the beneficiary account is still standard and the unit is operational, this amount would be adjusted in the bank account of beneficiary. Release of grant for groups and common infrastructure would also be done in their bank account following the same principle.

6.2 Group Category: The Scheme would provide support in clusters to groups such as FPOs/ SHGs/ producer cooperatives along their entire value chain. SHGs / FPOs / Producer Cooperatives would be provided the following support:-

(i) Grant @35% with credit linkage for capital investment with maximum limit as prescribed;

(ii) Training support;

(iii) Support for marketing and branding for products under ODOP for developing common brand.

6.2.1 Eligibility Criteria:

(i) It should be engaged in processing of ODOP produce for at least three years;

(ii) In case of FPOs / cooperatives, they should have minimum turnover of Rs.1 crore and the cost of the project proposed should not be larger than the present turnover;

(iii) The SHG / cooperative / FPO should have sufficient internal resources to meet 10% of the project cost and margin money for working capital.

6.3. Seed Capital to SHG:

The scheme envisages provision of Seed Capital @ Rs. 40,000/- per member of SHG engaged in food processing for working capital and purchase of small tools. Seed capital as grant would be provided at the federation level of SHGs which, in turn, will be extended to members as loan through SHG.

6.3.2 Eligibility criteria:

6.3.2.1 For Seed Capital, only SHG members who are presently engaged in food processing would be eligible. The SHG member has to commit to utilize this amount for working capital as well as purchase of small tools and give a commitment in this regard to the SHG and SHG federation.

7. Creation of Common Infrastructure

7.1 FPOs/ SHGs/ Producer Cooperatives /State agencies or private enterprises would be supported for creation of common infrastructure including for common processing facility, incubation center, laboratory, warehouse, cold storage, etc. Eligibility of a project under this category would be decided based on benefit to farmers and industry at large, viability gap, absence of private investment, criticality to value chain, etc. Credit linked grant would be available @ 35% with maximum limit as prescribed.

8. Branding and Marketing Support

8.1 Marketing and branding support will be provided to FPOs/SHGs/Cooperatives or an SPV of micro food processing enterprises under the scheme following the cluster approach for developing common packaging & branding with provision for quality control, standardization and adhering to food safety parameters for consumer retail sale.

8.2 Support for Marketing and Branding requires a minimum volume which can be generated through active involvement of FPO/ SHG/ Cooperatives to bring large number of producers together. These organisations would be supported based on DPR prepared by them indicating essential details of the project. Support up to Rs.5 lakh would be available from State Nodal Agency for preparing DPR for proposals for branding & marketing.

8.3 Support for branding and marketing would be limited to 50% of the total expenditure with maximum limit as prescribed. Proposal from states or national level institutions or organizations or partner institutions for branding & marketing will be supported for vertical products at the national level. No support would be provided for opening retail outlets under the scheme.

8.4 Procedure for Applying for Support:

8.4.1 In case of SHGs/FPOs/cooperatives or SPV interested in applying for support for branding and marketing under the Scheme, DPR should be prepared and submitted to State Nodal Agency (SNA). SNA would appraise the proposal and with recommendation from the State Level Approval Committee (SLAC) seek approval from MOFPI. Thereafter, the proposal would be recommended to a Bank for sanction of loan. Same procedure should be followed for applying for support for creation of common infrastructure as well.

9. Capacity Building & Research

9.1 Training is a critical component in technical upgradation and formalization of micro food processing enterprises. All individuals & institutions members receiving grant would undergo training for upgradation of their skills. In addition, training support would also be provided to other existing individual units and groups producing ODOP product in the district, even if they are not being supported through

credit linked grant. Training support would also be provided for units that are part of support for Marketing & Branding or have potential to join such network.

9.2 National Institute for Food Technology Entrepreneurship and Management (NIFTEM) and Indian Institute of Food Processing Technology (IIFPT), two national level food processing technology institutions under MOFPI are given responsibility to spearhead capacity building and research. At the State level, they would partner with a State Level Technology Institution in food processing technology selected by the State Government for conducting capacity building and training.

9.3 Training to individual and group beneficiaries will focus on entrepreneurship development, essential functions of enterprise operations, book keeping, registration, FSSAI standards, Udyog Aadhar, GST Registration, general hygiene, packaging, marketing etc. Specific training designed on the model of ODOP and the vertical focus products will be undertaken nearer to the work place of the entrepreneurs. Existing infrastructure of Rural Self Employment Training Institutes (RSETI) and other institutions at the district level will be utilized for imparting training.

10. Partner Institutions

10.1 The scheme lays special focus on SCs/STs, women and aspirational districts and FPOs, SHGs and producer cooperatives. TRIFED, National SC Development Finance Corporation, NCDC, Small Farmer Agri-Business Consortium (SFAC) and National Rural Livelihood Mission under Ministry of Rural Development have been working in these areas. The above institutions may converge their activities by facilitating identification of units / clusters of STs, SCs, cooperatives, FPOs and SHGs respectively and feed this into state PIPs.

11. Implementation & Monitoring Mechanism

11.1 The Scheme will have the following management structure at the Central, State and District level for effective implementation and monitoring of the scheme:

11.2 Inter-Ministerial Empowered Committee (IMEC): IMEC at the Central level, will be chaired by Minister for Food Processing Industries (MoFPI) for general superintendence, guidance and overall direction for implementation of the scheme, monitoring of progress and reviewing its performance. IMEC will approve scheme guidelines, Project Implementation Plan (PIP) of the State/ UTs under the scheme and various projects of capital investment by SHGs/FPOs/ cooperatives, common infrastructure facilities and proposals of marketing & branding for project size above Rs 10 lakh. A Project Executive Committee (PEC) will be constituted in MoFPI for undertaking administrative function and regular monitoring of the scheme at operational level. A National Programme Management Unit (NPMU) will be set up to assist MoFPI to provide secretarial, managerial and implementation support.

11.3 State Level: State Governments would appoint a Nodal Department and a State Nodal officer to oversee the implementation of the Scheme. The Scheme will be implemented by a State Nodal Agency (SNA) assisted by the State PMU. A State Level Approval Committee chaired by the Chief Secretary will oversee the implementation of the Scheme. The Committee will sanction expenditure up to Rs 10 lakh on various activities related to the implementation of the scheme. A District Level Committee (DLC) would be constituted under the Chairmanship of District Collector.

11.5 District Resources Persons (DRPs) would be appointed by SNA for providing handholding support to the beneficiaries. Handholding support would be for preparation of DPR, taking bank loan, support for obtaining necessary registration and licences including food standards of FSSAI, Udyog Aadhar, GST etc.

12. Studies & Reports

12.1 State Governments should undertake the following studies:

(i) Base-Line Assessments: A baseline study should be undertaken to identifying ODOP. This study should get concluded by 31 July, 2020 in each State. For this study, Rs. 2.5 – 10.0 lakh would be provided to the States.

(ii) State Level Upgradation Plan(SLUP): Once decision is taken on the ODOP, detailed studies should be carried out in the States detailing the number of units undertaking processing of that product in the district, farm level of operations, total volume and value of produce, technology, farm gate level processing, storage, warehousing, etc. This study should be concluded by 31 December, 2020. The amount provided for the above study would be Rs. 25.0 – 75.0 lakh to States.

13. Detailed Guidelines

Detailed guidelines of the scheme may be view at Ministry's website mofpi.nic.in

IIFPT

Contact Us

Director

Indian Institute of Food Processing Technology

(Ministry of Food Processing Industries, Government of India)

Pudukkottai Road, Thanjavur - 613 005. Tamil Nadu Phone No.: +91-4362-228155, Fax No.: +91-4362-227971

Email: director@iifpt.edu.in ■ Web: www.iifpt.edu.in