MINISTRY OF FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

सत्यमेव जयते

READING MANUAL FOR BLACK PEPPER PROCESSING UNDER PMFME SCHEME

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CHAPTER 1

INTRODUCTION

Black pepper (*Piper nigrum* L.) known as the "King of spices", is the most important, most popular and most widely used spice in the world. Black pepper is the dried berries of the perennial evergreen climbing vine *Piper nigrum* (Family Piperaceae). Black pepper is a native of South West India, particularly the Western coastal regions of South Peninsular India (the Malabar Coast). It has extensive culinary uses for flavoring and preserving processed foods and has great medicinal value. Black pepper was the first oriental spice to be introduced into the Western world, and was well known among the Romans and Greeks. It is the third most added ingredient in food among the all range of spices. Processed products and derivatives of black pepper offer great promises for further improvement and exploration under food related small and medium scale agriculture industries development.

Pepper is traded all over the world with Western Europe, the United States, Japan and Korea being the biggest consumers. Vietnam, India, Indonesia, Malaysia, China, Brazil and Sri Lanka are the main pepper producing countries. India has the largest extent of area under pepper cultivation in the world (1, 95, 000 ha) followed by Indonesia (1, 16,000 ha). In India, black pepper is grown mainly in humid tropics such as Kerala, Karnataka in large extent and limited extent in Tamil Nadu, Maharashtra and other states.

1.1 MEDICINAL PROPERTIES

Pepper is an important source of vitamins A, C, E and K neutral and acidic phenolic compounds, which are important antioxidants for a variety of plant defence response. It contains major pungent alkaloid piperine (1-peperoyl pipericine) which is known to posses many interesting pharmacological actions.it is widely used in different traditional systems of medicine like ayurvedic and unani system of medicine. Pepper exhibits diverse pharmacological properties like anthelmintic, carminative, alterant, antiperiodic, diuretic, digestive, emmenagogue, rubefacient, stimulant, stomachic and used inthe treatment of fever, asthma, cough, dyspepsia, flatulence, arthritis. sore throat, skin diseases, snake and scorpion bites, dyspepsia, tremors, delirium, migraine, cholera, alopecia, rectal prolapse, gonorrhoea and paralysis of tongue.

1.2 CLIMATE AND SOIL

Pepper requires a warm and humid climate. Though an annual rainfall of 250 cm is ideal for the proper growth of the crop, it can also come up well in low rainfall areas, if the pattern and distribution of rainfall are conducive. About 70 mm of rainfall within a period of 20 days may be sufficient for triggering of flushing and flowering process in the plant, but once the process is set on, there should be continuous, rainfall until fruit development starts. Any dry spell, even for a few days, within this critical period will result in substantial reduction of yield. Very long spells of dry weather are unfavorable for the crop growth.

The plant tolerates a minimum temperature of 10°C and maximum of 40°C, the optimum being 20-30°C. It can be grown from sea level up to an altitude of 1200 m. Pepper prefers a light porous and well-drained soil rich in organic matter. Water stagnation in the soil, even for a very short period, is injurious for the plant. So, heavy textured soils in locations where drainage facilities are inadequate should be avoided.

1.3 VARIETIES AND CULTIVARS OF BLACK PEPPER

Most of the cultivars of black pepper are bisexual. Over 75 cultivars are found in India. Panniyur 1 and Karimunda are the most popular varieties. The other important cultivars are Kottanadan (in South Kerala), Narayakodi (in Central Kerala), Aimpiriyan (in Wayanad areas), Neelamundi (in Idukki areas), Kuthiravaly (in Calicut and Kumili region), Balankotta and Kalluvally (in Northern Kerala) and Malligesara and Udakkare (in Karnataka area). The major high yielding varieties available for cultivation in India are given in Table 1. (Fig 1)

Table 1. High yielding varieties of black pepper

No	Variety	Parentage	Peculiarities	Mean Yield (Kg dry pepper/ha)	Quality parameters (%)		
					Piperine	Oleoresin	Essential oil
Varieties from ICAR- Indian Institute of Spices Research, Kozhikode							
1	Subhakara	Selection from Karimunda	Suited to all pepper growing regions	2352.0	4.0	10.0	6.0
2	Sreekara	Selection from Karimunda	Suited to all pepper growing regions	2677.0	4.2	13.0	4.0
3	Panchami	Selection from Aimpiriyan	Late maturing	2828.0	4.7	12.5	3.4
4	Pournami	Selection from Ottaplackal	Tolerant to root knot nematode	2333.0	4.1	13.8	3.4
5	IISR Shakthi	Open pollinated progeny of Perambramundi	Tolerant to *Phytophthora* foot rot.	2253.0	3.3	10.2	3.7
6	IISR Thevam	Clonal Selection of Thevamundi	Tolerant to *Phytophthora* foot rot. Suited to high altitudes and plains	2481.0	1.7	8.20	3.1
7	IISR Malabar Excel	Hybrid (Cholamundi x Panniyur -1)	Suited to high altitudes and rich in oleoresin	1440.0	4.9	14.6	4.1
8	IISR Girimund	Hybrid (Narayakodi x	Suited to high	2880.0	2.2	9.70	3.4

	a	Neelamundi)	altitudes				
Varieties developed at Pepper Research Station, Panniyur, Kerala Agricultural University							
1	Panniyur 1	Hybrid (Uthirankotta x Cheriyakaniyakadan)	Most popular variety, world's first black pepper hybrid. Performs well in open condition	3850	5.30	11.80	3.50
2	Panniyur 2	Open pollinated progeny selection from Balankotta	Tolerates shaded condition, high piperine content	3313	6.60	10.90	3.40
3	Panniyur 3	Hybrid (Uthirankotta x Cheriyakaniyakadan)	Performs well in open condition, high oleoresin content	3269	5.20	12.70	3.12
4	Panniyur 4	Clonal selection from Kuthiravaly - II	Performs well in open condition, stable yielder, late maturing	2443	4.40	11.30	3.12
5	Panniyur 5	Open pollinated progeny selection from Perumkodi	Tolerates shaded condition, high oleoresin content	2248	5.50	12.33	3.80
6	Panniyur 6	Clonal selection from Karimunda III	Performs well in open condition, suited to all black pepper tracts	3359	4.94	8.27	1.33
7	Panniyur 7	Open pollinated progeny selection from Kalluvally IV	Performs well in open condition, suited to all black pepper tracts	2770	5.57	10.61	1.50
8	Panniyur 8	Panniyur 6 x Panniyur 5	Performs well in open condition, field	3000	5.68	12.17	1.17

			tolerant to *Phytophthora* foot rot and drought, high oleoresin				
9	Panniyur 9	Open pollinated progeny selection from Panniyur 3	Performs well in open condition and hilly tracts, field tolerant to *Phytophthora* foot rot , drought and cold stress, high piperine, oleoresin and essential oil	3150	6.11	12.71	5.00
Variety from College of Horticulture, Vellanikkara, Kerala Agricultural University							
1	Vijay	Hybrid (P2 x Neelamundi)	Large number of laterals and spikes/ unit area, production of laterals from lower nodes , field tolerant to *Phytophthora* foot rot , bold berries	3792	4.9	10.19	3.3
Variety from ICAR- Indian Institute of Horticulture Research, CHES, Chettali & IISR , Regional Station, Appangala, Karnataka							
1	Arka Coorg Excel	Seedling Selection	High yielding, with long spikes and bold berries	3267.0	2.1	6.9	1.6
Variety from ICAR- Central Plantation Crops Research Institute (Palode)							
1	PLD -2	Clonal selection from Kottanadan	Suited to Trivandrum and Kollam districts of Kerala	2475.0	3.3	15.5	3.5

1.4 VALUE ADDED PRODUCTS OF PEPPER

Black and white peppers are the two major primary products of *Piper nigrum* which are internationally traded. There are several other products which are also internationally traded but in small amounts (less than 2%), such as green pepper, pepper oil and oleoresin. Black pepper is the dried unripe berry, while white pepper is the mature berry from which the mesocarp has been removed. Black pepper is used as a direct spice and is also processed into pepper oleoresin and oil. White pepper is used mostly as a direct spice. Black pepper is used in a wide variety of foods, particularly meat products, while white pepper is used in light-colored sauces, mayonnaise, and cream soups when dark particles are undesirable. Varieties

of products can been made from pepper and can be broadly classified as; (I) Black pepper and white pepper based products (II) Green pepper based products (III) Pepper by- products.

1.5 HARVESTING AND POST HARVEST MANAGEMENT OF BLACK PEPPER

The harvesting season for black pepper in India is from December-February in plains and January-April in high ranges. For black pepper, it takes 7-8 months from flowering to full berry maturity. Hand picking is followed when one or two berries in the spike turn yellow to bright orange. The spikes are nipped of by hand and collected in bags. Harvested spikes are generally collected in clean gunny bags. Spikes which are fallen on to the ground may be collected separately, cleaned and then pooled to the general lot. The stage of maturity at which black pepper is harvested depends on the final value added product to be prepared. The level of maturity required at harvest for processing into different pepper products is given below.

Product Stage of maturity at harvest

Black pepper- Fully mature and 1-2 berries start turning yellow to red in each spike

Pepper powder- Fully mature with maximum starch

White pepper- Fully ripe

Canned pepper- 4-5 months

Dehydrated green pepper- 10-15 days before full maturity

Oleoresin and essential oil- 15-20 days before maturity

1.6 POST HARVEST PROCESSING

Post-harvest processing operations followed for black pepper involves threshing, blanching, drying, cleaning, grading and packaging. During processing care should be taken to maintain the quality at each step of operation. The harvested spikes are heaped in a pile overnight to initiate browning before threshing. This operation facilitates easy detachment of berries from spikes during threshing.

1.6.1 THRESHING

The berries are separated from the spikes either manually by trampling under feet or mechanically using threshers. Manually a laborer can trample 200 kg pepper per day. Threshers with capacities varying from 50 kg/hr to 2500 kg/hr are available which helps in quick threshing and gives clean product.

Cost-Rs.30,000/-
Efficciency-95%
Cost of operation-Rs.125/tonne
Capacity-320 kg/hr
Mechanical pepper Thresher

Hand operated pepper thresher
Cost-Rs.7500/-
Effecciency-96%
Cost of operation-175/tonne
Capacity-60 kg/hr

1.6.2 BLANCHING

Blanching the threshed berries in boiling water for one minute prior to sun drying hastens the browning process as well as the rate of drying. It also gives a uniform lustrous black colour to the finished product. This treatment reduces the microbial load on the berries, removes adhering dirt and dust and reduces the sun drying period to 3-4 days.

1.6.3 DRYING

The high moisture content of the Pepper has to be brought down to safer levels by proper drying. During drying, enzymatic browning takes place in the presence of atmospheric oxygen and finally turns the product black. Conventionally, sun drying is practiced in which the berries are spread on PVC sheets or bamboo mats in a clean and open drying floor for sun drying. During drying, berries are raked using a wooden rake to ensure uniform drying. Drying is continued for 3-5 days till the moisture content of berries get reduced to 10 per cent. The average dry recovery is 33-37% depending on the varieties and cultivars.

1.6.3.1 CONVENTIONAL SUN DRYING

Dried black pepper with moisture content more than 12% is prone to fungal attack. The fungal attack may produce mycotoxins and makes pepper unfit for human consumption. Mechanical driers developed by various agencies are also used for drying black pepper. Models of varying capacities operated either electrically or by burning agricultural wastes are available for drying of black pepper by maintaining temperature below 60°C. Different types of popular mechanical dryers available in pepper are solar dryer, wood fired dryer, Solar cabinet dryer with aspirator (CIAE), Astra Dryer (IISC Bangalore), Agricultural waste fired copra dryer (CPCRI) and Mechanical dryer (Regional Researcch Laboratory), Trivandrum.

Solar cabinet dryer (CIAE)

1.6.4 CLEANING AND GRADING

Cleaning and grading are basic operations that enhance the value of the produce and help to get higher returns. The dried berries may be cleaned to remove extraneous matter like spent spikes, pinheads, stones, soil particles etc. Cleaning on a small scale is achieved by winnowing and hand picking. Such units consist of a fan/ blower and a feeding assembly. The lighter fractions (dust, immature berries, pin heads and spent spikes) are removed using sieves. Large scale cleaning is done using electrically operated blowers which blow away lighter fractions. Inclined belt separator, spiral separator can be used for the removal of foreign impurities. Multiple sieve - cum air classified type of machine whereby the impurities

are easily removed is used for grading at the farmers and traders level such as pinheads. Grading is done based on the size of dried berries at this time. The major grades are

Tellicherry Garbled Special Extra Bold (TGSEB) (4.8 mm diameter)

Tellicherry Garbled Extra Bold (TGEB) (4.2 mm diameter)

Tellicherry Garbled (4.0 mm diameter)

Malabar Garbled (MG grades 1 and 2) -3.75 mm

Malabar Ungarbled (MUG grades 1 and 2) -3.75 mm

1.6.5 BLACK PEPPER SPIRAL SEPARATOR

Black pepper cleaner cum grader is used to achieve grading of pepper into three grades according to AGMARK specifications and separation of smaller and larger size impurities

Feed Hopper Capacity – 200 Kg per Hour

Efficiency - 88%

Black pepper cleaner cum grader

1.5.6 PACKAGING

Pepper is hygroscopic in nature and tends to absorb moisture resulting in mould attack and insect infestation. This leads to loss in aroma, caking and rancidity. Conventionally, dried pepper is stored in double lined gunny bags. Eco friendly packaging materials like jute gunny bags, paper bags *etc* can be utilized and use of polythene bags can be minimized. All the bags have to be labelled separately.

1.6.7 STORAGE

Before storage the moisture content should be brought down to 10 per cent. The graded produce is bulk packed separately in multi-layer paper bags or woven polypropylene bags provided with food grade liners or in jute bags. The bags are arranged one over the other on wooden pallets after laying polypropylene sheets on the floor. Air tight plastic barrels may be used to store the berries for longer periods. Stored berries may be checked once in six months for cigarette beetle (*Lasioderma serricone*) incidence. The room should have controlled ventilation and devices for control of humidity and temperature and properly fumigated before storage.

CHAPTER 2

BLACK PEPPER-BASED PRODUCTS

2.1 GROUND PEPPER

Ground pepper is obtained by grinding cleaned black pepper without addition of any foreign matter. Grinding is accomplished by employing equipment like hammer mill, pin mill or plate mill. The ground product is further sieved, and material is packed according to the particle size of powder. The overflow is sent back to the grinding zone for further size reduction.

2.2 CRYO-GROUND PEPPER POWDER

Cryo-ground pepper is another product that can be made from cleaned black pepper. This is obtained by grinding the pepper below 100ºC using liquid nitrogen, which will prevent the oxidation of oil. A temperature controller maintains the desired product temperature by suitably adjusting the nitrogen inflow. This method overcomes the disadvantages of conventional grinding and helps in retaining more volatile oils. It also improves the fineness of the powder and preserves the natural composition of the powder to a great extent.

Flow chart for black pepper processing
Harvesting (Fully mature and 1-2 berries start turning yellow to red in each spike)
⇩ Threshing (Manually/mechanical threshers) ⇩
Blanching (Immersing in boiling water for 1 min)
Drying (Solar drying for 3-5 days till the moisture content of berries get reduced to 10%/mechanical dryer)
⇩ Cleaning (Winnowing, sieving, Inclined belt separator, spiral separator, cleaner cum grader) ⇩ Grinding

(in hammer mill, pin mill or plate mill without adding foreign matter)
⇩ Grading (based on size and bulk density) Ground pepper ⇩
Packaging (Double lined jute gunny bags, paper bags, polythene lined bags) ⇩
Storage (Multi layer paper bags or woven polypropylene bags provided with food grade liners or in jute bags arranged on wooden pallets

2.3 PEPPER OIL

The characteristic aroma of black pepper is due to the presence of volatile oil which ranges from 2-5% and can be recovered by steam or hot water distillation. Industrial process for the recovery of essential oil involves flaking of the black pepper using roller mills or grinding into coarse powder and distilling it in a stainless-steel extractor. The steam encounters the ground pepper particles and vaporizes the oil present in the pepper. On cooling, the oil is separated from water. It is observed that slightly immature pepper berries (15-20 days before maturity) are more suitable for oil extraction owing to higher oil content.

Flow chart for oil extraction
Sun drying
⇩ Cleaning
⇩ Flaking/Grinding (using roller mills)

⇩ Steam distillation (in huge stainless-steel extractors) ⇩
Condenser
⇩ Separator

2.4 PEPPER OLEORESIN

Oleoresin is the concentrated product of all the flavour components (aroma, taste, pungency) of black pepper and is obtained by solvent extraction of berries with solvents like hexane, ethanol, and acetone. It is used in flavoring meat products, as a preservative, coloring agent and in pharmaceutical industry. India dominates the global market for spice oleoresin, which is in big demand from processed food and fragrance industries that now mostly prefer natural coloring and flavoring agents to artificial ones as consumers become increasingly health conscious. For processing, pepper is flaked to a thickness of 1 to 1.5 mm and packed in stainless steel extractors for extraction with the organic solvent. Normally, solid to solvent ratio of 1:3 is employed and the oleoresin recovery ranges between 10-13%.

Flow chart of oleoresin extraction
Cleaning/Weighing ⇩
Flaking (Thickness of 1-1.5 mm)
⇩ Solvent extraction (using hexane,ethanol, acetone *etc* in huge stainless steel extractors)
⇩ Removal of solvent

2.5 MICRO-ENCAPSULATED SPICE FLAVOUR

Micro- -encapsulation is the technique by which the flavour component is entrapped in a suitable carrier and is ready for release as and when required. Encapsulation is achieved mostly by spray drying. In the production of spray dried spices, the essential oils and oleoresins are dispersed in the edible gum solution. Gum acacia or gelatin, spray dried and then blended with dry base such as salt or dextrose is most commonly used for encapsulation of volatile compounds of spices into food. As water evaporates from the spray dried particles, xthe gum forms a protective film around each particle of extractive components. The protective capsule prevents the spice extractive from evaporating and deterioration due to exposure to oxygen.

Flow chart for micro-encapsulation by spray drying method
Extraction of oil/oleoresin
⇩ Preparation of emulsion
⇩ Atomization of emulsion (using spray dryer)
⇩ Dehydration of atomized particles (40-100µm)

2.6 WHITE PEPPER

White pepper is the white inner corn obtained after removing the outer skin or pericarp of pepper berries. It is produced from fully red ripe berries by retting or by decorticating black pepper. Red ripe berries are detached from the stalk and packed in gunny bags. The bags are allowed to soak in slow running water for 7 days till the pericarp gets loosened enough to be rubbed and removed. Fermentation tanks are also widely used for the purpose wherein the water is changed every day for 7-10 days After removing the pericarp, the berries are washed in water and sun dried to reduce the moisture content to 10-12 per cent. The creamy white

product obtained is stored just as in the case of black pepper. Approximately 25 kg white pepper can be obtained from 100 kg ripe berries. White pepper is preferred over black pepper where dark coloured particles are undesirable such as in preparation of light coloured sauces, cream soups *etc*. It imparts modified natural flavour to food stuff.

Improved CFTRI method: Fully mature but unripe berries are harvested and boiled in water for 10-15 minutes to soften the pericarp. After cooling, the skin is rubbed off either mechanically or manually, washed and sun dried to obtain white pepper. Since no retting operation is involved, the product will be free from any unpleasant odour. However, white pepper produced by this method gives pepper powder of light brown colour due to gelatinization of starch in contrast to pure white powder obtained by traditional method.

2.7 DECORTICATED BLACK PEPPER

This is a form of white pepper produced by mechanical decortication of the outer skin of black pepper. This is generally done when white pepper is in short supply. The appearance of decorticated kernel is inferior to traditionally prepared white pepper, but is satisfactory when ground. Also the milling operation requires considerable skill to avoid excessive volatile oil loss.

Flow chart for white pepper processing
Harvesting (Fully mature red ripe berries) ⇩
Threshing (Manually/mechanical threshers) ⇩
Packaging (Jute gunny bags) ⇩
Retting (Soaking in running water for 7-10 days/dipping in fermentation tanks)
⇩ Decorticating (Removal of loosened pericarp) ⇩
Washing (based on size and bulk density)

⇩
Drying (Moisture content reduced to 10-12%) ⇩
Storage (Multi layer paper bags or woven polypropylene bags provided with food grade liners or in jute bags arranged on wooden pallets

2.8 WHITE PEPPER POWDER

White pepper powder is processed in the same way as the black pepper powder, except the starting material is white pepper. White pepper powder can also be produced from black pepper by selective grinding followed by sieving. Before the pepper is subjected to grinding, it is conditioned by adjusting the moisture content.

Green pepper based products

2.9 DEHYDRATED GREEN PEPPER

In this method, slightly immature berries (10-15 days prior to full maturity) are harvested, cleaned and subjected to blanching (10-30 min) for inactivating the enzymes responsible for

browning reaction. Then the berries are cooled immediately and subjected to sulphiting in potassium metabisulphite solution to fix the green colour and dehydrated under controlled conditions wherein maximum retention of green colour is obtained. . The sulphited berries were then washed and dried in a cabinet dryer at 60-65 °C to get uniform green coloured berries. Good quality dehydrated green pepper should less than 8 % moisture content. Boiling time depends on the maturity of the berries. Dehydrated green pepper after reconstitution in water resembles freshly harvested green pepper. The advantage is that the season of availability can be extended and the berries could be stored for a year or more. Dry recovery comes to 20 per cent.

Flow chart for Dehydrated Green Pepper
Harvesting (Slightly immature berries)
⇩ Washing ⇩
Blanching (10-30 min)
⇩ Cooling
⇩ Sulphitation (potassium metabisulphite)
⇩ Mechanical Dehydration (60-65℃)

2.10 GREEN PEPPER IN BRINE/ BOTTLED GREEN PEPPER

Freshly harvested green berries (4-5 months old) or spikes are used for preparing pepper in brine. Harvest the immature spikes and clean it thoroughly. Light pepper and pinhead or broken berries are considered as extraneous matter. After proper cleaning and washing, berries are stored in brine solution of 17± 2% salt and 0.6 ± 0.02% citric acid. Stored pepper is washed three times in a period of 45 days at an interval of 20, 30 and 35 days, respectively followed by change of brine solution at each interval. The pepper is then packed in high density polyethylene (HDPE) food grade cans with sufficient quantity of freshly prepared brine solution of the same concentration. Major applications of green pepper in brine are in making sauces, meat processing industries and in food service sector.

. **Flow chart for Green Pepper in Brine/ Bottled green pepper**
Harvesting (4-5 months old) ⇩
Cleaning and washing ⇩
Storing in brine solution (17± 2% salt and 0.6 ± 0.02% citric acid) ⇩
Washing (an interval of 20, 30 and 35 days) ⇩
Packing (in bottles or HDPE in freshly prepared brine solution)

2.11 CANNED GREEN PEPPER

for this product 4-5 months old berries are to be harvested. The de-spiked and cleaned berries are immersed in water containing 20 ppm residual chlorine for about an hour. The berries are then immersed in 2 % hot brine containing 0.2 % citric acid, exhausted at 80 °c, sealed properly and processed in boiling water for 20 min. Canned pepper is then cooled immediately in a stream of running cold water. This product has the additional advantage over dehydrated green pepper in that it retains the natural colour, texture and flavour.

Flow chart for Canned Green Pepper
Harvesting (4-5 months old) ⇩
Cleaning and washing ⇩
Dipping in chlorine water (for 1 hour) ⇩
Immersing in 2% hot brine +0.2% citric acid solution ⇩
Exhaustion (80°C) ⇩
Sealing and processing in boiling water (20 min) ⇩
Cooling (immediately in running water)

2.12 FREEZE-DRIED GREEN PEPPER

India is one of the producers of freeze-dried black pepper. It is produced by vacuum drying at subfreezing temperatures ranging from −30 to −40 °C. Freeze-dried green pepper retains the natural form of the green pepper, and it is considered far superior to dehydrated green pepper for its better colour, flavour and essential oil and piperine content. Freeze-dried green pepper has 2 - 4 per cent moisture and is very light. On rehydration, it retains the original green colour and shape of the green pepper. It finds a wide application in instant soups and dry meals for its special characters and subtle flavour. It is also used in a cheese industry

2.13 FROZEN GREEN PEPPER

This is a relatively new and simple innovation for the diversification in pepper exports. Frozen green pepper is considered far superior to 'green pepper in brine' or 'dehydrated green pepper' owing to better retention of flavour, colour, texture and natural appearance. It is packed in poly pouches and hence the cost is much less compared to cans and containers. Though freezing is expensive, it is gaining popularity because of its superiority to other products.

HACCP protocol for pepper products

The product specific hazard analysis and critical control points (HACCP) worksheet for different spice products viz., garbled pepper, white pepper, dehydrated green pepper (DGP) and pepper in brine are shown in Table

Critical control points at various steps of pepper processing line

Product	CCP1	CCP2	CCP3	CCP4
	All 4 products*	All 4 products*	All 4 products*	Pepper in brine
Process Stage hazard	Reception Mycotoxin	Reception Chemical residue	Metal detection Metal	Brining Chemical Microbiological
Monitoring procedure	Vendor/Farmer selection, sample testing & analysis		Online inspection	
Pre requisite programme	Proper handling &storage	GAP	-	GMP,SSOP
Post occurrence control	No effective technique	-	Metal detector	No effective technique
Corrective action	Avoid entry to the processing line		Hold &review	Water quality testing

*Common for garbled pepper, white pepper, dehydrated green pepper & pepper in brine

2.14 PEPPER BY-PRODUCTS

2.14.1 GREEN PEPPER SAUCE

It is made from selected green pepper berries, which are first ground into puree and then blended

with vinegar, salt, sugar and other ingredients. It has natural flavour and is often used as a dip for chips or fries.

Ingredients

Ingredients	Amount (g)
Green pepper	300
Potato	750
Garlic	25
Shallots	75
Clove	10
Cinnamon	10
Sugar	300
Salt	25
Vinegar	100

Flow chart

Raw Material Collection (Immature green pepper berries)

Washing

Blanching

Pulping

Boiling chopped potatoes (20 min)

Preparation of pulp with onion and garlic

Blending green pepper pulp with potato pulp

Addition of other ingredients (salt, sugar, vinegar)

Preparation of spice bag

Boiling mixture gently until it turns creamy

Measuring the TSS

Addition of Sodium benzoate

Transfer to sterilized bottle

Store under room temperature

2.14.2 GREEN PEPPER PICKEL

Green pepper pickle is very popular in many states, notably in Kerala, Karnataka, Tamil Nadu, Gujarat, Maharashtra, *etc.* People relish it with rich meals as an appetizer. Recipes are almost the same as for domestic mango pickles. Green pepper is also prepared in 15–16 % acidified brine and in vinegar similar to other vegetables.

Ingredients

10 to 12 bunches fresh green pepper

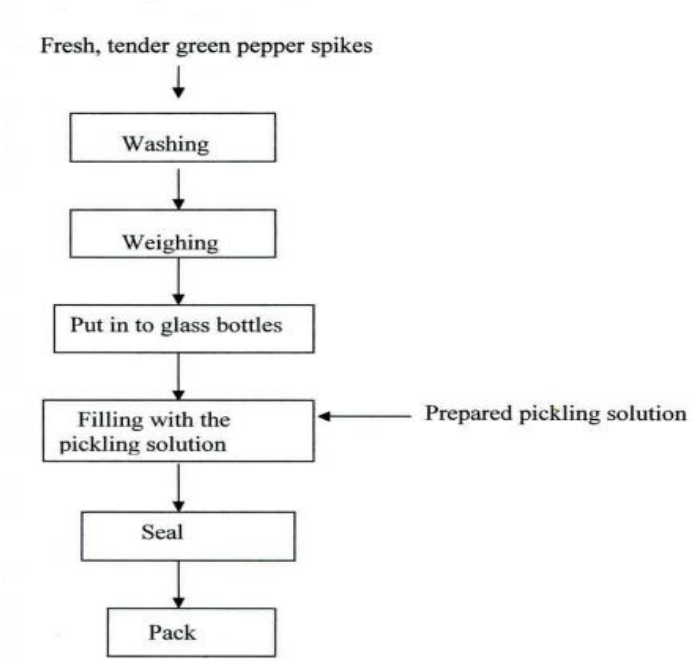
250 ml water

3/4 tsp turmeric powder

2 lemons

2 heaped tsps salt

Flow chart for green pepper pickle



2.14.3 MIXED GREEN PEPPER PICKEL

Green pepper berries are mixed with lime pickles, mango pickles, mixed cauliflower and carrot pickles, brinjal pickles and bitter gourd pickle with or without green chillies and sliced ginger (fresh). They are quite popular all over India. However, their preparation is very limited. These pickles can be preserved in good condition for 6–9 months in ambient environment.

CHAPTER 3

PACKAGING OF PEPPER

3.1 CHARACTERISTICS OF DRIED PEPPER

Pepper Black (Kalimirch) whole means the dried berries of Piper nigrum L., brown to black in colour with a wrinkled pericarp. The berries are generally picked before complete ripening and may be brown, grey or black in colour. It shall be free from mould, living and dead insects, insect fragments, rodent contamination. The product shall be free from added colour, mineral oil and any other harmful substances.

Moisture – Not more than 13.0 percent by weight

Should have a diameter of 3 mm-6mm and are of a brown, grey or black colour with awrinkled pericarp

Should be packed in clean, sound, sealed packages, made of a material which does not affect the product

3.2 FUNCTIONS OF PACKAGING

- ✓ Ability to protect content from spoilage and Spillage
- ✓ Prevent insect infestation and insect damage
- ✓ Economical, easily available, and easy disposal
- ✓ Confirm with food laws
- ✓ Offer Protection against environmental conditions- moisture barrier
- ✓ Offer protection against microorganisms- oxygen barrier
- ✓ Strength properties to withstand mechanical hazard during transportation and storage
- ✓ Have a good printability

3.3 COMMONLY USED PACKAGING MATERIALS FOR PEPPER

3.3.1 GLASS CONTAINERS

- ✓ Bottles/Jars are commonly used.
- ✓ The glass used for food packaging is soda-lime glass.
- ✓ Most bottles and jars are tailor-made specifically for one product or one manufacturer.
- ✓ Closures for glass containers are more standardized.
- ✓ Glass containers can be reused or recycled.
- ✓ Eliminates the risk of potentially harmful chemicals found in some plastics that can leach.

3.3.2 GLASS CLOSURE

Also known as Twist Off (T/O) caps, lug caps are compatible with containers whose threads are non-continuous.

Lugs on the interior of a lug cap, correspond with the non- continuous threads and close by a partial rotation.

3.3.3 FLEXIBLE PACKAGING

1. Polyester/metallised polyester/ LDPE
2. BOPP/LDPE
3. BOPP/metallised polyester/LDPE.
4. Polyester/AL foil LDPE

TYPES OF POUCHES

Centre seal formation

Three sides seal formation

Four sides seal formation

KRAFT PACKAGING

Has good strength, printability and appearance.

Other advantages are its low cost, wide availability and low weight.

Currently very popular material in food packaging.

Made by sulphate pulping process.

Poly amide or polyamine resin is used to coat or laminate to improve barrier properties.

PET BOTTLES

Clear, Shiny and transparent.

Unbreakable.

Good barrier properties.

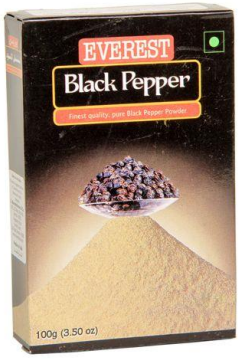
100 % recyclable.

Low permeability of moisture and air.

LINER CARTON BOX

Liner carton filling and packing machine also known as duplex box packing machine

Provides good protection and barrier properties.



3.4 PACKAGING MACHINERY

Induction Cap Sealer

Automatic FFS machine

Piston Filling Machine

CHAPTER 4

FSSAI REGULATORY REQUIREMENTS

5.1 FOR WHOLE BLACK PEPPER- It shall conform to the following standards: —

Light Berries – Not more than 5.0 percent by weight

Pinheads or broken berries – Not more than 4.0 percent by weight

Bulk Density (gm/liter) – Not less than 490 gm/liter by weight

Moisture – Not more than 13.0 percent by weight

Total ash on dry basis – Not more than 6.0 percent by weight

Non-volatile ether extract on dry basis – Not less than 6.0 percent by weight

Volatile oil content on dry basis – Not less than 2.0 percent by v/w

Peperine Content on dry basis – Not less than 4.0 percent by weight

Insect damaged matter (percent by weight) – Not more than 1.0 percent by weight

5.2 GROUND BLACK PEPPER:

The powder obtained by grinding dried berries without addition to any other matter. The powder shall have characteristic aromatic flavor, free from foreign odor, mustiness or rancidity. It shall be free from any extraneous matter. It shall conform to the following standards:

Moisture Not more than – 12.5 percent by weight

Total ash on dry basis – Not more than 6.0 percent by weight

Ash insoluble in dilute – Not more than 1.2 percent HCl on a dry basis by weight

Crude Fibre on dry – Not more than 17.5 percent basis by weight

Non-volatile ether – Not less than 6.0 percent by extract on dry basis weight

Volatile oil content on – Not less than 1.75 percent dry basis by v/w

Peperine Content on – Not less than 4.0 percent by dry basis weight

5.3 LIGHT BLACK PEPPER

means the dried berries of Piper nigrum L. dark brown to dark black in colour. It shall be well dried and free from mould, living and dead insects, insect fragments, rodent contamination. It shall conform to the following standards:

(i) Extraneous matter Not more than 1.0 percent by weight

(ii) Other Foreign edible seeds Not more than 2.0 percent by weight

Pinheads shall be wholly derived from the spikes of Piper nigrum L. They shall be reasonably

dry and free from insects. The colour shall be from dark brown to black. It shall be free from added colouring matter. It shall conform to the following standards:

Extraneous matter Not more than 1.0 percent by weight

FSSAI issues three types of licence based on nature of food business and turnover

Registration: For turnover less than 12 lakh.

State License: For turnover between 12 Lakh to 20 crores.

Central License: For turnover above 20 crore.

So as to establish any food business operation certain legal requirements have to be satisfied and hence taking Food Standards and Safety Authority of India (FSSAI) license or registration are mandatory to start any food enterprise.

5.4 BASIC FSSAI REGISTRATION

To be taken by businesses or startups having annual turnover below Rs.12 lakhs .

Documents Required

1. Authorized person address proof
2. Passport size photo
3. Business name and address
4. FSSAI declaration form
5. Nature of business details

State FSSAI License Registration- Businesses having annual turnover between Rs.12 lakhs to 20 crore can apply for FSSAI State license.

Documents Required

1. Rental Agreement of Business Premises.
2. ID Proof of the Concerned Person (Aadhaar Card / Driving License / Passport / Voter ID)
3. If any Government Registration Certificates (Company Incorporation Certificate / Firm Registration / Partnership Deed / Pan card / GST / Shop & Establishment / Trade License)
4. If the applicant is private limited company or partnership firm then they should provide MOA & AOA or Partnership deed copy
5. For applying State License any One of the following certificate is compulsory (Trade license, Shop & Establishment, Panchayath License, Corporation License , Municipality License)
6. Nature of Business.

7. FSSAI declaration form

Central FSSAI License Registration- Businesses having annual turnover above 20 crore can apply for FSSAI central license. Eligible food Business Operators like Importers, Manufacturers, operators in central government, Railways, airports, seaports, etc. need to take a Central FSSAI license from Food Standards and Safety Authority of India.

Documents Required

1. Rental Agreement of Business Premises.

2. ID Proof of the Concerned Person (Aadhaar Card / Driving License / Passport / Voter ID)

3. If any Government Registration Certificates (Company Incorporation Certificate / Firm Registration / Partnership Deed / Pan card / GST / Shop & Establishment / Trade License)

4. If the applicant is private limited company or partnership firm then they should provide MOA & AOA or Partnership deed copy.

5. IE Code (Import Export Code) Certificate (for the category of export and import IE code is compulsory)

6. Authority letter from the company letterhead to the concerned person stating that he is authorized to file FSSAI application.

7. List of food category desired to be manufactured (In case of manufacturers).

4.5 GENERAL LABELING REQUIREMENTS

1. Every pre-packaged food shall carry a label containing information about the product.

2. The particulars of declaration required under these Regulations to be specified on the label shall be in English or Hindi in Devanagari script. However, nothing herein contained shall prevent the use of any other language in addition to the language required under this regulation.

3. Pre-packaged food shall not be described or presented on any label or in any labeling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect;

4. Label shall be applied in such a manner that they will not become separated from the container;

5. Contents on the label shall be clear, prominent, indelible and readily legible by the consumer under normal conditions of purchase and use.

Specific restrictions on product labels-

(1) The label shall not contain any reference to the Act which can cause contradictions

(2) Labels not to use words "recommended by the medical profession"

(3) No claims concerning medicinal (preventative, alleviative or curative) effects shall be made.

(4) Labels not to contain false or misleading statements

FSSAI labelling requirements

Name, trade name or description

Name of ingredients used in the product in descending order of their composition by weight or volume

Name and complete address of manufacturer/packer, importer, country of origin of the imported food (if the food article is manufactured outside India, but packed in India)

Nutritional Information

Information Relating to Food Additives, Colors and Flavors

Instructions for Use

Veg or Non-Veg Symbol

Net weight, number or volume of contents

Distinctive batch, lot or code number

Month and year of manufacture and packaging

Month and year by which the product is best consumed

Maximum retail price.

CHAPTER 5

CONCLUSION

The worldwide demand for spices as nutraceuticals is showing an increasing trend. Processed products and derivatives of black pepper offer great promises for further improvement and exploration under food related small and medium scale agriculture industries development.

REFERENCES

Food Safety and Standards (Food Product Standards and Food Additives) Regulation, 2011 – https://fssai.gov.in/dam/jcr:99067191-c774-4c81-b9c8-708b9e72b770/Food_Additives_Regulations.pdf

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