



READING MANUAL FOR NUTMEG PROCESSING UNDER PMFME SCHEME



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CHAPTER 1

INTRODUCTION

Nutmeg is a twin spice which is cultivated in 23 ('000 Hectares) in India with an annual production of 15 ('000 MT). Nutmeg provides two separate spices viz., the nutmeg seed and its dried aril known as the mace. Apart from which the fleshy outer rind of nutmeg is also having health benefits and several value added products are prepared from it. Nutmeg is a tree aromatic spice having utilized in medicinal preparations as well as for culinary purposes. Nutmeg is native plant of Indonesian Moluccas islands, belonging to the family of Myristicaceae. The major nutmeg producing states in India are Kerala (14.19 '000 MT), Karnataka (0.20 '000 MT), Maharashtra (0.01 '000 MT) and Andaman & Nicobar Islands with market value of rupees 44572 lakhs.

1.1 VARIETIES AND CULTIVATION

The main variety of nutmeg is IISR Viswashree released by Indian Institute of Spices Research (IISR) which yields around 1000 fruits from the eighth year of planting while a regular nutmeg tree reaches peak harvesting period only after 20 years of planting. Other known varieties are konkan sugundhu and konkan swad developed by Konkan Krishi Vidyapeeth. Nutmeg is cultivated in sandy loam, clay and red laterite soils in warm, humid conditions which receives an annual rainfall of 150 cm. However, water lodging and extremely dry climatic conditions are suitable for its cultivation.

1.2 NUTRITIONAL AND THERAPEUTIC PROPERTIES OF NUTMEG

The nutmeg seed and mace contains several bioactive compounds like myristicin which makes it antioxidant and antimicrobial in nature. Nutmeg oil is used for reducing rheumatic and muscular pains. The concoctions made from honey and nutmeg is a home remedy for gastric issues like indigestion and nausea. Thus nutmeg acts as a detoxifying agent in the body. Studies have also showed the application of mace in the cosmetic industry as skin whitening agent as the lignin in mace could inhibit the melanin biosynthesis. Antimicrobials like myristic acid and trimyristin have been extracted from nutmeg seeds. Nutmeg is found to helpful in controlling the elevated post-prandial glucose levels in diabetic patients.

1.3 NUTRIENT COMPOSITION OF NUTMEG

Variety	Nutrients (per 100 g)					
	Carbohydrate	Protein	Fat	Calcium	Iron	Phosphorus
Nutmeg rind	11.2 g	1.0 g	0.4 g	40.0 mg	2.0 mg	10.0 mg
Nutmeg seeds	27.64 g	6.30 g	36.52 g	148.0 mg	2.33 mg	207.0 mg
Mace	47.8 g	6.50 g	24.4 g	180 mg	12.3 mg	100 mg



Figure 1: products and by-products from nutmeg

CHAPTER 2

PROCESSING OF NUTMEG

2.1 HARVESTING AND CURING

The nutmeg tree produce fruits throughout the year and peak season for harvest is from December to June. The fruits ripen in about six to eight months and are harvested when its rind splits open using a bill hook. A fresh fruit will weigh around 60 g while its seed weighs 6-7 g and mace weighs around 3-5 g. Once harvested the nutmegs will be dried till it loses 25% of its weight. On removal from its fleshy rind, seeds and mace (detached from the seed shell) will be dried separately. If climatic conditions doesn't facilitate open sun drying as the harvesting season falls in monsoon season hot air or tray driers could be utilized. Other disadvantages of sun drying in nutmegs were reported to be non-uniform drying of the seeds and bleaching of the mace colour, thus yielding final product with poor appearance and quality.

2.2 CURING PROCESS IN MECHANICAL DRYING

In case of artificial drying; solar dryers, tray dryers and hot air ovens are utilized. The mace will be pre-treated in hot water at 75 °C for 2-5 minutes for retaining the red colour. Then the blanched mace will be oven dried at 55-60 °C for about three to four hours, thus obtaining a final moisture level of 8-10 percent. The seeds are either sun dried for 4 to 8 weeks or oven dried at 40-50 °C for five to six hours, till the kernel rattles and then it will be break opened carefully using a wooden mallet without damaging the kernel.

2.3 POINTS TO BE CONSIDERED WHILE HARVESTING & DRYING

Always prefer freshly harvested nutmeg fruits than fallen fruits from the orchards.

Blanching of nutmeg seeds with mace in hot water containing 100 ppm of chlorine or 1000 ppm of alum is recommended to avoid mould growth on mace.

After harvesting, immediate drying of mace are recommended to avoid microbial contamination.

Drying temperature should be maintained at 40-50 °C in seeds to avoid lose of essential oil and oleoresin content.

PM FME – Processing of Nutmeg

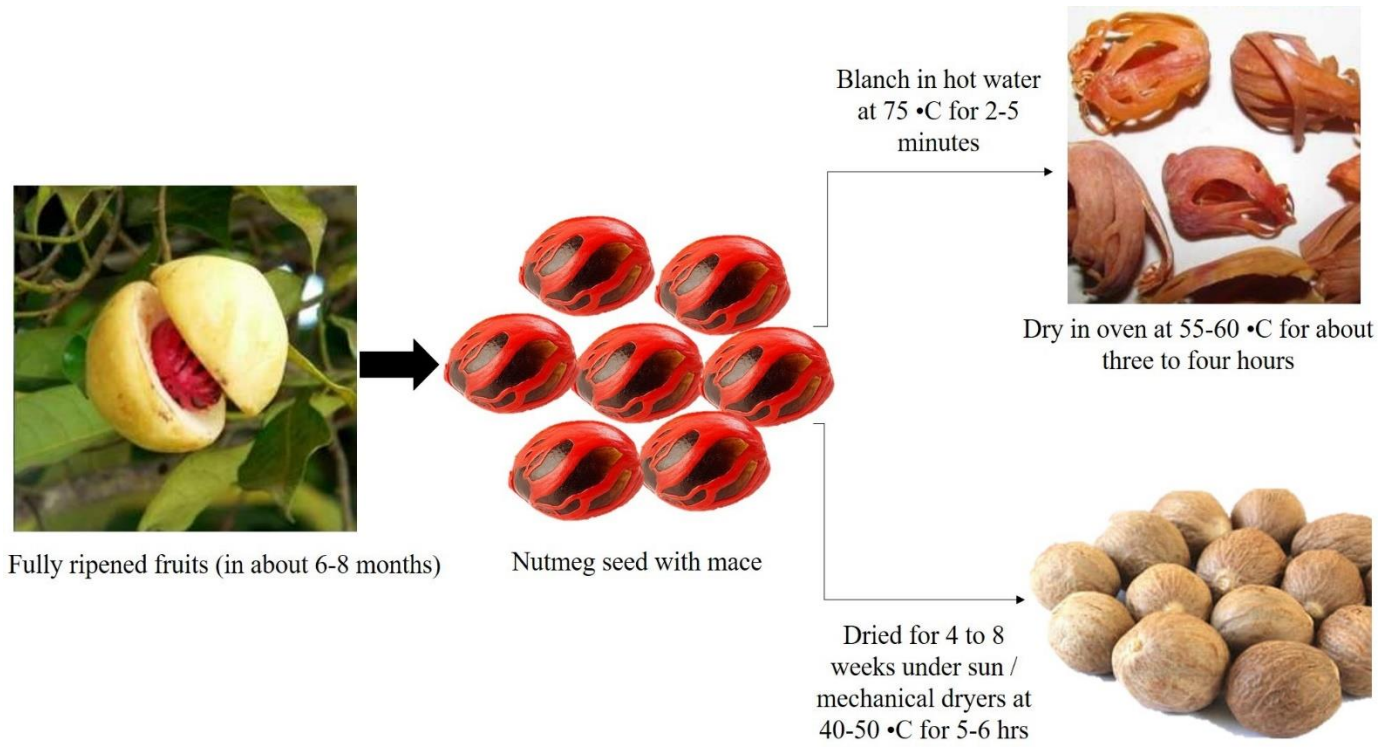


Figure 2: Curing of nutmeg seeds and mace



Figure 2: Nutmeg cracker and sorting meshes



Figure 3: Pulverizer with 40 kg/hr capacity

CHAPTER 3

FSSAI STANDARDS OF NUTMEG SEED, MACE AND ITS POWDERS

The nutmeg seed, mace and its powders should be free from mold and other insect infestations and its remains. The acceptable colour of dried nutmeg seeds are greyish brown unless it is treated with lime which may give a slight white colour. The powders also should be free from extraneous colour and flavoring substances. The other quality parameters prescribed by Food Safety and Standards Authority of India (FSSAI) for nutmeg and mace are as follows:

Quality parameters	Nutmeg seed (Jaiphal)	Nutmeg seed powder	Mace (Jaipatri)	Mace powder
Extraneous matter	Absent	----	Not > 0.5 % by wt.	----
Moisture	Not > 10 % by wt.	Not > 8% by wt.	Not > 10 % by wt.	Not > 10 % by wt.
Total ash on dry basis	Not > 3.0% by wt.	Not > 3.0 % by wt.	Not > 4.0% by wt.	Not > 3.0% by wt.
Ash insoluble in dilute HCl on dry basis	Not > 0.5 % by wt.	Not > 0.5 % by wt.	Not > 0.5 % by wt.	Not > 0.5 % by wt.
Volatile oil content on dry basis	Not < 6.5 % by v/w	Not < 6.0 % by v/w	Not < 7.5 % by v/w	Not < 5.0 % by v/w
Insect damaged matter	----		Not > 1.0 % by wt.	----
Nutmeg in mace	----		Not > 1.0 % by wt.	----
Crude fibre	----	Not > 10% by wt	----	Not > 10% by wt
Non-volatile ether extract	----	Not < 25.0 % by wt.	----	Not < 20 & not > 30 % by wt
Calcium content expressed as calcium oxide on dry basis	Not > 0.35 % by wt.	----	----	----

3.1 HACCP SKETCH FOR NUTMEG DRYING AND POWDERING

Critical control points	Potential hazards	Corrective measures
Raw material reception	Mould infested nutmegs, dirt adhering to the nutmegs and other biological as well as physical debris.	Washing the raw materials received under running water at lukewarm temperature and addition of disinfectants to the water.
Sorting and grading of raw materials	Mixing of different grades and inclusion of bad quality seeds and maces.	Physical inspection while sorting and grading to remove cut, injured and possible contaminants. Use of grading meshes to sort identical grades and seeds.
Drying of seeds and mace	Under drying will result in moisture retention and further quality deterioration through microbial infestation. Over drying will lead to removal of volatile compounds and the oil will also ooze out from seeds.	Drying should be carried out at 40 -50 °C for nutmeg seeds and 55-60 °C for mace.
Storage of powdered seeds and mace	Presence of moisture and improper storage will result in mould growth in the powder	The moisture should not be more than 10 % by weight of the powder and it should be packed in air tight polythene packages.
Quality control checks	Deviation in the quality parameters in samples from different batches	Quality parameters like presence of extraneous matter, moisture and volatile oils percentage as suggested by FSSAI needs to be analyzed in samples from each batch.
Documentation	Improper processing	All processing steps should be closely monitored any measures taken in the critical control points need to be documented.

CHAPTER 4

BY-PRODUCTS FROM NUTMEG RIND

4.1 NUTMEG RIND CANDY

Nutmeg candy is a traditional recipe of Indonesian islands where they call it as ‘manisan pala’. For the preparation of candy, the nutmeg rind is peeled and then steam blanched for 10 minutes. Further it was taken and cut into longitudinal slices and immersed in sugar syrup of 40 °brix (that means 100 ml of sugar syrup should contain 40g of sugar). To this solution of syrup mixed with nutmeg rind flakes, permissible preservatives like 150 ppm (0.15 g per kg of fruit) of potassium metabisulphite (KMS) or 500 ppm of (0.5 g per kg of fruit) calcium / potassium sorbate will be added. The nutmeg flakes immersed in sugar syrup solution will be kept overnight and further it will be boiled daily to increase the concentration of syrup by 5 °brix until the concentration reaches 70 °brix. Finally the nutmeg rind slices will be dipped in luke warm water for a minute to drain off the excess syrup and then the nutmeg slices will be oven dried at 60 °C for about six to eight hours. The final product could be packed in food grade polythene bags sealed air tight and could be stored for up to six months.

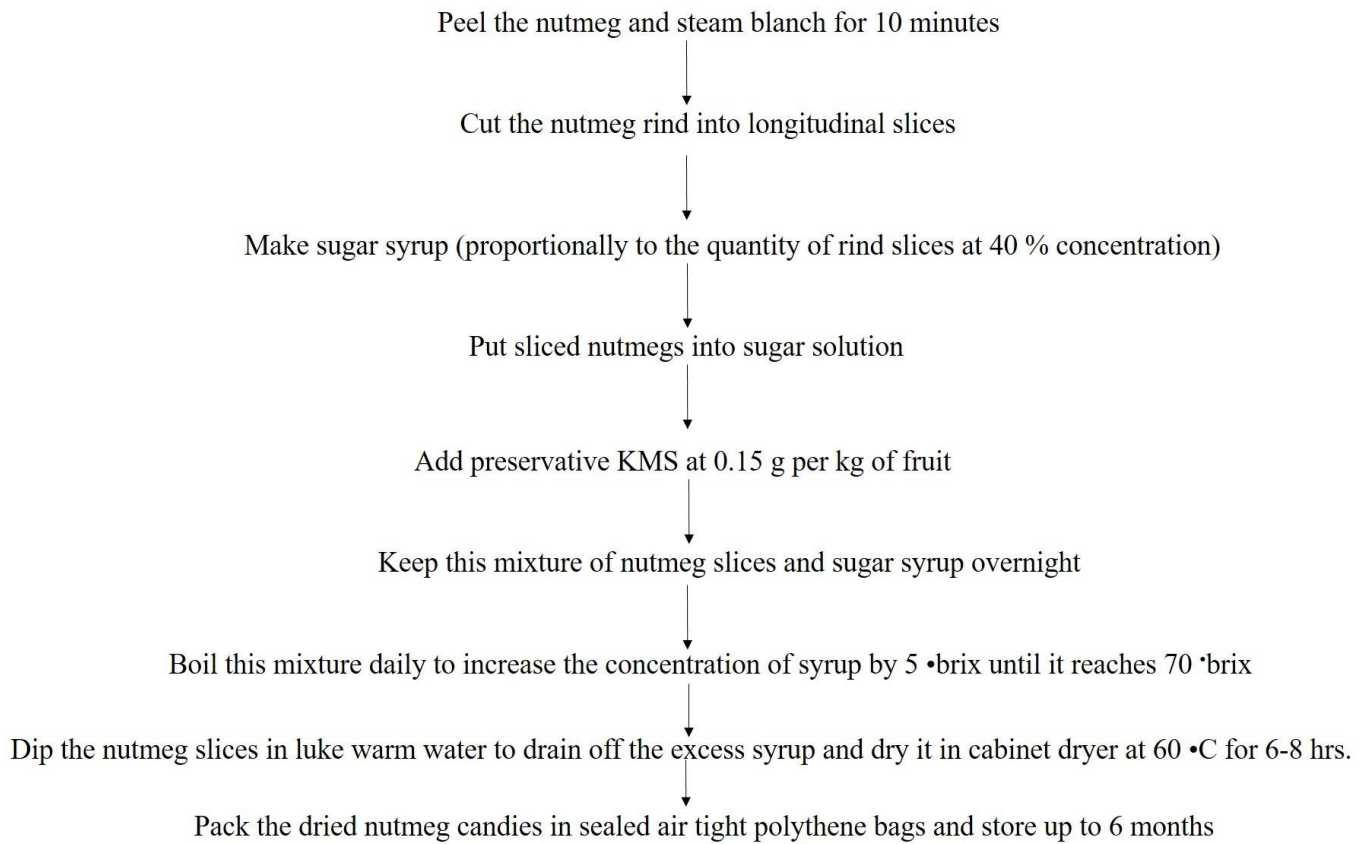
4.1.1 INGREDIENTS REQUIRED

Peeled nutmeg rind	: 1 kg
Sugar syrup	: enough quantity to completely immerse the rind slices at 40% concentration (40 g of sugar in 100 ml water)
Potassium metabisulphite	: 150 ppm



Figure 3: Nutmeg rind candy

4.1.2 FLOWCHART FOR MAKING NUTMEG RIND CANDY



4.1.3 EQUIPMENT REQUIRED FOR NUTMEG RIND CANDY PREPARATION



Hot air oven
Capacity: 12 stainless steel trays
Tray size (LBH): 45x45x2.5 cm
Price: 1,95,000/-



Sugar syrup preparation tank
Capacity : 200 lts.
Price: 60,000/-



Vegetable cutter
Price: 65,000/-

4.1.4 HACCP SKETCH FOR NUTMEG CANDY

Critical control points	Potential hazards	Corrective measures
Reception of raw materials	Dirt adhering to rind, cut or bruises on rind as source for further decay.	Physical inspection and removal of decayed rinds to avoid further contamination.
Washing and peeling	Cross contamination from water and equipment used for peeling	Always use luke warm water treated with disinfectants like alum. Also clean the equipments used in peeling with mild disinfectants.
Steam blanching	Under blanching will lead to undesirable enzymatic reactions in rinds. Blanching for a longer period will results in over cooked rind slices that will not hold shape in further processing.	Steam blanch the rind slices for only 10 minutes.
Syrup preparation	Dilute syrups will not aids in	Syrup concentration should be

	osmosis of rind pieces	maintained as prescribed in the process flow chart and it should be recorded using a refract meter
Drying of rind candies	Poor drying will result in soggy candies having lesser shelf life.	Optimal drying temperature (60 °C) and time (6-8 hrs) should be maintained.
Packaging	Improper packaging leads to insect infestation and mould growth	Rind candies should be stored in air tight cans with moisture barrier capacity.

4.2 NUTMEG RIND JAM

Fruits spreads like jam and jellies have a wide market in India with a market share of around \$ 211 million in 2016 and it is expected to grow further to \$ 527 million by 2022. As it is part of a convenience food that could be made using simple processing technology, it is gaining wide acceptance among the micro and small food enterprises. Nutmeg jam is prepared using nutmeg rind pulp and double its quantity of sugar along with preservatives like citric acid and sodium / potassium benzoates or potassium metabisulphite. The permissible limits of potassium metabisulphite is 40 ppm while addition of citric acid is based on good manufacturing practices (GMP). This mixture will be cooked until the total soluble solids (TSS) reaches 68 °brix which could be checked using a refractometer. In the absence of refractometer, the end point of jam preparation could also be analyzed using a sheet test in which a ladle full of hot jam is taken and allowed to drop, when it drops from the ladle it should fall in sheets. The keeping quality of a properly prepared and stored jam is six months.

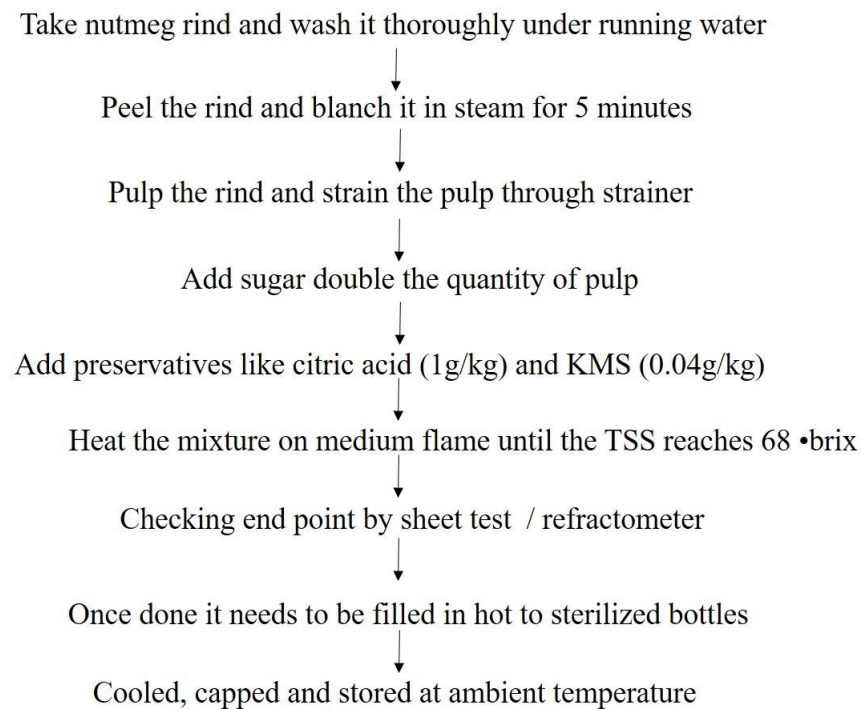
INGREDIENTS REQUIRED

Peeled nutmeg rind pulp	: 1 kg
Sugar	: 2 kg
Citric acid	: 1 g per kg of pulp
	: 40 ppm



Figure 3: Pictorial representation of sheet test for checking the end point in jam preparation

4.2.1 FLOWCHART FOR PREPARATION OF NUTMEG JAM



4.2.3 HACCP SKETCH FOR NUTMEG RIND JAM

Critical control points	Potential hazards	Corrective measures
Receiving raw materials viz., nutmeg rind, sugar, citric acid,	Rotten fruits will lead to cross-contamination and also quality deterioration of final	Physical inspection and sorting to remove damaged fruits. Good quality sugar
Potassium metabisulphite	product through microbial spoilage, sugar with impurity and unauthorized chemical preservatives.	should be used. The chemical preservatives used should be food grade.
Washing and blanching	Contaminated water can result in presence of <i>E coli</i> , <i>Staphylococcus</i> and other microbes in process chain.	Water used in processing plant should be tested for microbial quality and the fruits should be blanched to browning due to undesirable enzymatic reactions.
Pulping	Cross contamination from the pulper	Cleaning of the fruit pulper using mild disinfectants and water.
Processing of jam	proper consistency of jam. It might be too liquid or too solid	The end point of the jam preparation should be finalized using a refractometer. Or sheet test is advisable.
Bottling and storing	Cross contamination from bottles	Jam should be filled into sterilized bottles and should be stored in ambient temperature.

4.2.4 FSSAI STANDARDS FOR FRUIT JAM

Parameters	Permissible limits
Total soluble solids	Not < 65 %
Fruit content	Not < 45 %
Preservatives	Sulphur dioxide – 40 ppm Benzoic acid – 200 ppm Sorbic acid – 500 ppm
Microbial contamination	Mold count: not > 40 % of the field examined Yeast and spores: not > 125 per 1 /60 c.m.m

4.2.5 MAJOR EQUIPMENTS REQUIRED FOR JAM PREPARATION



Steam Jacketed kettle
Capacity: 50 ltrs
Price: 1,40,000.00



Pulper
Capacity: 40 kg/ hr
Price: 2.0 lakhs



Refractometer
Price: 3000.00

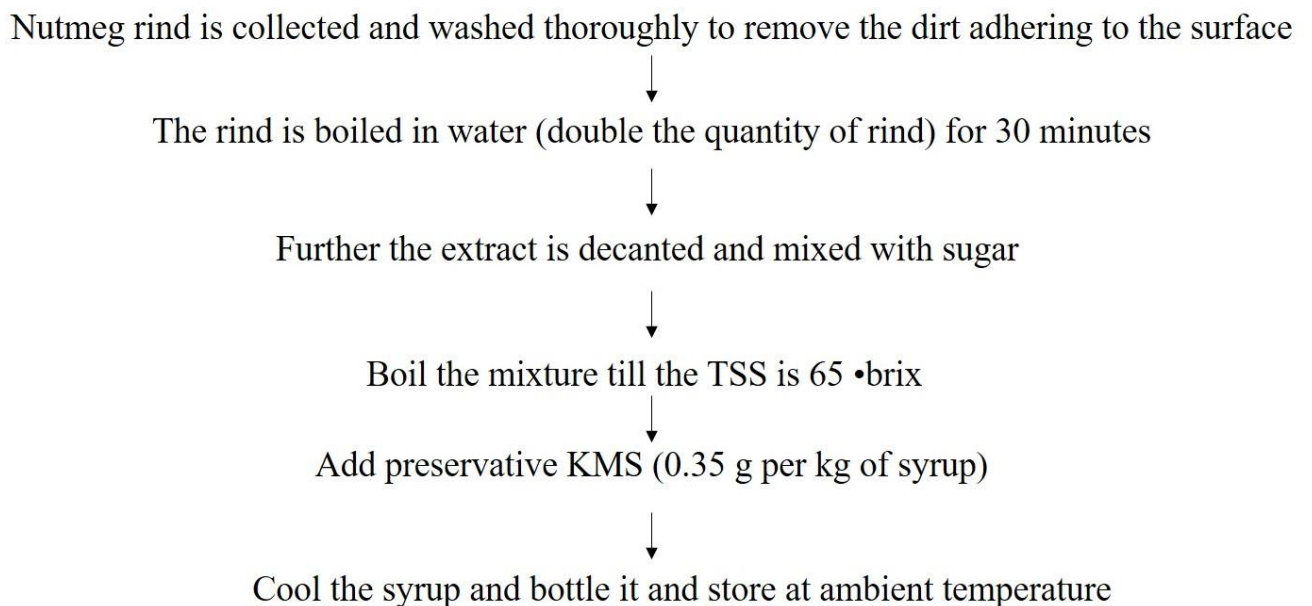
4.3 NUTMEG RIND SYRUP

Syrup is another means to preserve the fruits for longer shelf life. Fruit syrups are widely used in beverage and dessert preparation industries. Nutmeg rind syrup is prepared by boiling the unpeeled rind with double quantity of water for 30 minutes. The extract thus obtained will be mixed with sugar and boiled to reach the total soluble solids of 65 °brix. Further, after adding preservatives it could be stored in sterilized bottles and stored. The permissible limits for potassium metabisulphite in syrups as per FSSAI is 350 ppm.

INGREDIENTS REQUIRED

Unpeeled nutmeg rind pulp	: 1 kg
Sugar	: 0.6 kg per liter of extract
Water	: 2 liters
Potassium metabisulphite	: 0.35 g per kg of syrup

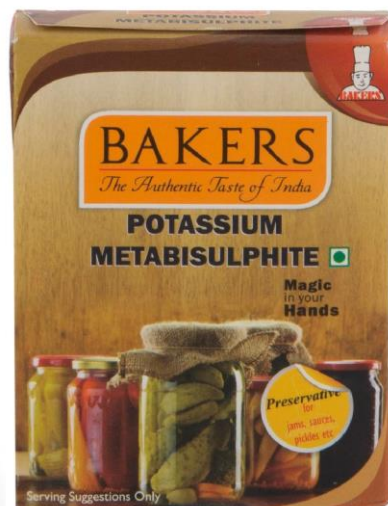
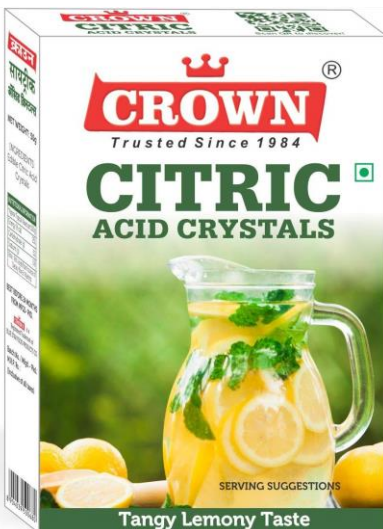
4.3.1 FLOWCHART FOR PREPARATION OF NUTMEG RIND SYRUP



4.3.2 HACCP SKETCH FOR NUTMEG RIND SYRUP

Critical control points	Potential hazards	Corrective measures
Reception of raw materials	Presence of microbes, physical debris accumulated on surface of fallen fruits.	Visual inspection to remove the decayed and damaged fruits.
Extraction of juice	Cross contamination from water, excessive disinfectants used in cleaning juice extractors etc.	Check the quality of water and use authorized mild disinfectants.
Filtration of juice	Contamination from micro filters used	The filters should be cleaned
Bottling	Cross contamination from bottles	Use sterilized bottles to store syrups
Storage	Damage to bottles and contamination	Final products should be stored at room temperature in properly packed stacks
Documentation	The steps in process and all corrective measures taken should be noted and documented for process recall.	

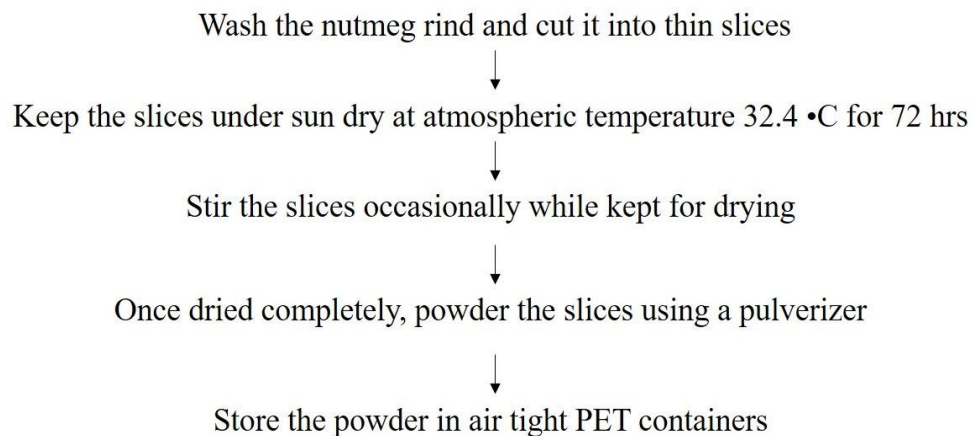
4.3.3 COMMONLY USED PRESERVATIVES



4.4 NUTMEG RIND POWDER

Nutmeg rind contains several minerals, vitamin C and antioxidant phenols, hence it could be utilized in powdered form as well. The powdered nutmeg rind could be incorporated into various products like cakes, cookies, muffins and also to some traditional breakfast preparations. Better quality nutmeg rind powder was obtained through sun drying process. Studies have shown that consumer acceptance was more for sun dried nutmeg rind powder when compared to cabinet dried powder.

4.4.1 FLOWCHART OF NUTMEG RIND POWDER



4.4.2 HACCP SKETCH FOR NUTMEG RIND POWDER

Critical Control Points	Potential hazards	Corrective measures
Reception of raw materials	Microbial contamination of rinds	Washing the rind in running water treated with mild disinfectants like alum or sodium hypochlorite
Sun Drying	Surface dust accumulation on the rinds, chances for cross contamination	The rind pieces kept for drying should be covered properly to avoid the dust.
Drying temperature	Improper drying	The rinds are dried under sun with intermittent stirring
Storing	Microbial attack	The powder should be packed in air tight containers to avoid microbial growth
Documentation	The steps in process and all corrective measures taken should be noted and documented for process recall.	

4.5 NUTMEG RIND WINE

Consumption of wine by mankind dates back to 350 BC. Preparation of wine was mainly done using grapes, however new researches are coming up the protocols for utilizing other native and indigenous fruits considering the fact that 4.6 – 15.9% of fruits are wasted annually in India due to its perishable nature. Thus fermentation is recommended as a way of preservation, which also ensures product diversification in the fruit products.

INGREDIENTS REQUIRED

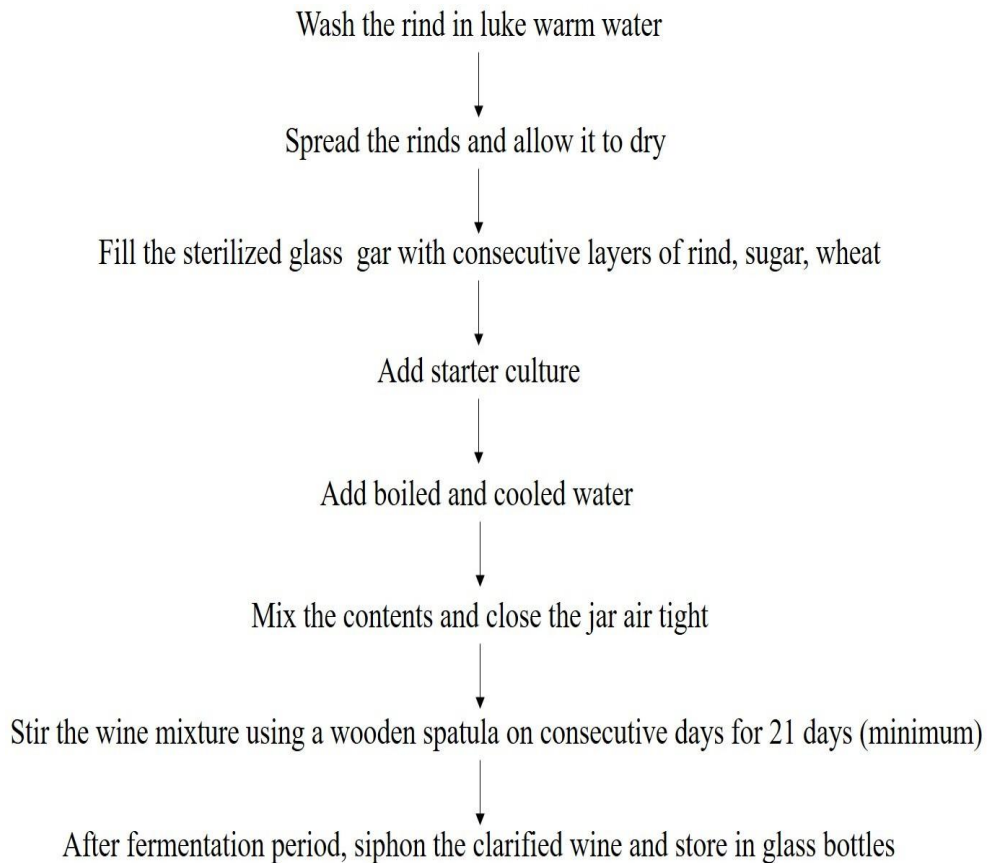
Nutmeg rind	: 1 kg
Sugar	: 1 kg
Water	: 1 kg
Whole wheat	: 10 g
Starter culture	: yeast (5g) + sugar (1 table spoon) mixed in luke warm water (20 ml)

4.5.1 HACCP SKETCH FOR NUTMEG RIND WINE

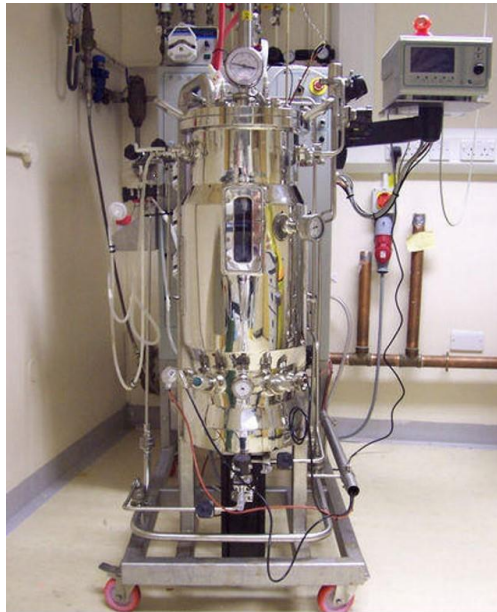
Critical control points	Potential hazards	Corrective measures
Raw material quality	Damaged and contaminated rinds	Physical inspection to remove decayed rind pieces
Water	Cross contamination from water	Analysis microbial quality of water. Use of boiled chilled water
Sugar	Dirt, debris and extraneous matter	Good quality sugar should be used, make contract with supplier that if the product delivered is of inferior quality it will be rejected.
Yeast	Without action	Fresh wine yeast need to be purchased
Fermentation		All equipment's used for wine

	Cross contamination	making should be sterilized to avoid cross contamination
Siphoning	Cross contamination	The siphoning tubes should also be cleaned microbial free to ensure good quality wine.
Bottling and storing	Spoilage of final product	The product should be filled in sterilized bottle.

4.5.2 FLOWCHART FOR PREPARATION OF NUTMEG RIND WINE



4.5.3 MAJOR EQUIPMENT REQUIRED



Wine fermenter
Price: 1.45 lakhs

4.5.4 COMMONLY USED PACKAGING MATERIALS FOR POWDERS & JAMS



Kraft Stand up pouches



LDPE Pouches



Glass bottles

CHAPTER 5

REGULATORY REQUIREMENTS

Any food business operations (FBOs) require registration or license from Food Safety Standards Authority of India (FSSAI). A food business operation with an annual turnover of 12 lakh or less should take **FSSAI registration** and if the annual turnover is >12 lakhs – 20 crores the FBOs need to take **FSSAI State Licensing** and **above 20 crores** should go for **central licensing**. The **registration fees is 100/-** for a year and **3000/- per year for licensing**. The **validity of the registration / license can be from 1 year to 5 years** as chosen by the food business operator. **Renewal of registration / licensing should be done 30 days prior** the expiry of the current registration or license. Any application filed after this period for renewal will have to bear fine of rupees 100/-.

THE DOCUMENTS REQUIRED TO APPLY FOR REGISTRATION:

- Proof of premise
- Identity proof of the manufacturer
- No objection certificate from Municipality / Panchayat
- Health fitness certificate by physician declaring the fitness of workers in the FBO
- Document declaring the safety of the water (with respect to both microbial and mineral contamination) utilized in the Plant.

These documents should be uploaded in the FoSCoS – FSSAI website (<https://foscos.fssai.gov.in/>) for obtaining registration or licensing.

DOCUMENTS REQUIRED FOR LICENSING:

- Blueprint of the plant with marked dimensions of each processing area.
- List of manufacturer(s) with full address
- Details of the equipment utilized with specifications, capacity and power consumption
- Data of water analysis (bacteriological and chemical) from govt. authorized water testing laboratories.
- Photograph of unit
- Government authorized identity proof along with photo of the manufacturer/ proprietor / partner / director of the FBO.
- Proof of possession of food plant premises (sale deed/ rent agreement/ electricity bill)

In case of partnership business the partnership deed/ memorandum & articles of association towards the constitution of the firm/ self-declaration of proprietorship.

Form IX: nomination of persons by a company along with the board resolution.

GENERAL HYGIENIC REQUIREMENTS

- The location of the food establishment should be away from pollution and other such industrial areas where there are chances for fumes, excessive soot etc. to avoid cross-contamination.
- There should be compartmentalization for raw material storage, pre-processing section, primary and secondary processing sections. The final product should be stored away raw materials.
- Floors and ceilings should be cleaned, paintings of walls should be water proof, easy to clean, and also flaking of plaster should be avoided.
- Rodent and insect control measures need to be taken.
- Proper waste disposal measures, segregation of biodegradable and non-degradable waste should be done.
- The drainage flow should be opposite to the manufacturing line.
- The windows and ventilations should be screened.

CHAPTER 5

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