

# **PM Formalisation of Micro Food Processing Enterprises Scheme**

## **HANDBOOK OF PROCESSING OF PORK SAUSAGES**



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## CHAPTER 1

### INTRODUCTION

#### 1.1 ABOUT

Pigs are the most widely eaten animal in the world, accounting for about 36% of meat production worldwide. Pork, flesh of hogs, usually slaughtered between the ages of six months and one year. The most desirable pork is greyish pink in colour, firm and fine-grained, well-marbled, and covered with an outer layer of firm white fat. About 30 percent of the meat is consumed as cooked fresh meat; the remainder is cured or smoked for bacon and ham, used in sausage, and rendered to produce lard. Pork carcasses are graded according to the amount of edible meat they will yield. Pork is one of the most versatile of meats and is consumed around the world. Because it is proscribed by the dietary laws of Judaism and Islam, however, pork is virtually unknown in the cuisines of the Middle East and those of some local populations in Asia and Africa. The chief pork-consuming countries (on a per capita basis) are Germany, Denmark, Poland, and Austria. In China and Southeast Asia pork is commonly shredded or cubed and stir-fried with vegetables and spices. Pork-and-vegetable mixtures are also used to stuff a variety of small rolls, buns, and dumplings.



Pig as compared to other livestock species has a great potential to contribute to faster economic return to the farmers, because of certain inherent traits like high fecundity, better-feed conversion efficiency, early maturity and short generation interval. Pig farming also requires small investment on buildings and equipments. It has immense potential to ensure nutritional and economic security for the weaker sections of the society.

**Pig meat sector:** Among the various livestock species, piggery is the most potential source of meat production and more efficient feed converters after the broiler. Apart from providing meat, it is also a source of bristles and manure. Around 150 meat processing plants which are mainly processing pork and pork products like sausages, bacon and ham are functioning on small scale in the private sector in India. Here, 70% of the pig population is reared under traditional small holder, low-input demand driven production system, except for limited number of semi-commercial pig farms in Kerala, Punjab and Goa. The typical production system consists of a simple pigsty and feeding comprises locally available grains, vegetables and agricultural by-products along with kitchen waste. As per the reports there are 25,000 pig farmers in Telangana state with 10-500 animals in each. Punjab has around 400 pig farmers with an average farm size of 50-200 each. Pig producers' cooperative federations are coming up in some of the States. India has several indigenous and exotic pig breeds. The commonly used exotic pig breeds in India are Large white Yorkshire, Hampshire, Landrace, Large black and Duroc either pure or their crosses. Besides these exotic pig breeds, the indigenous pig breed, Ghungroo is also available in few states of NE. Thus, the present shortfall of pork in the country is about 0.60 million tonnes. Pork production and processing can be a profitable enterprise for nutritional security and meeting employment generation requirement of ever-increasing population. In the next ten years, it is predicted that the total consumption of meat in India will double from its present numbers. As per capita income of individuals rises, they tend to spend on improving their lifestyle and food consumption habits. Pork consumption is negligible in India, with the exception of the north-east while it is a major item elsewhere. In the European Union, 42.6 kg pork is consumed per person every year, while in the US, 29.7 kgs are consumed. Pork is a staple for Chinese, and so over 35 kg are consumed per person per year.

### Indigenous Breed of Pigs

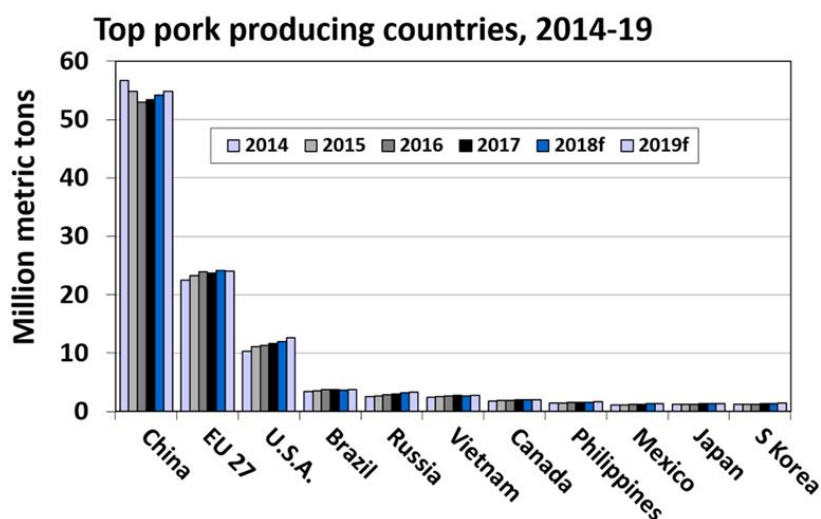
Sl.No	Name of the Breed	Home Tract
1.	Ghoongroo	West Bengal
2.	Zovawk	Mizoram
3.	Niang Megha	Meghalaya
4.	Tenyi Vo	Nagaland
5.	Agonda Goan	Goa

6.	Nicobari	Andaman & Nicobar
7.	Doom	Assam

(Source: NBAGR)

## 1.2 PORK PRODUCTION IN WORLD

In 2020, global pork production was led by China, which produced 34 million metric tons of pork in that year. The European Union and the United States held the second and third positions, respectively. That year, global pork production amounted to about 94.33 million metric tons. As China has experienced rapid economic growth, the demand for pork in the country has too increased. Although, the majority of pig farms in China are small scale operations, the introduction of factory farming methods with large scale production of swine is on the rise.



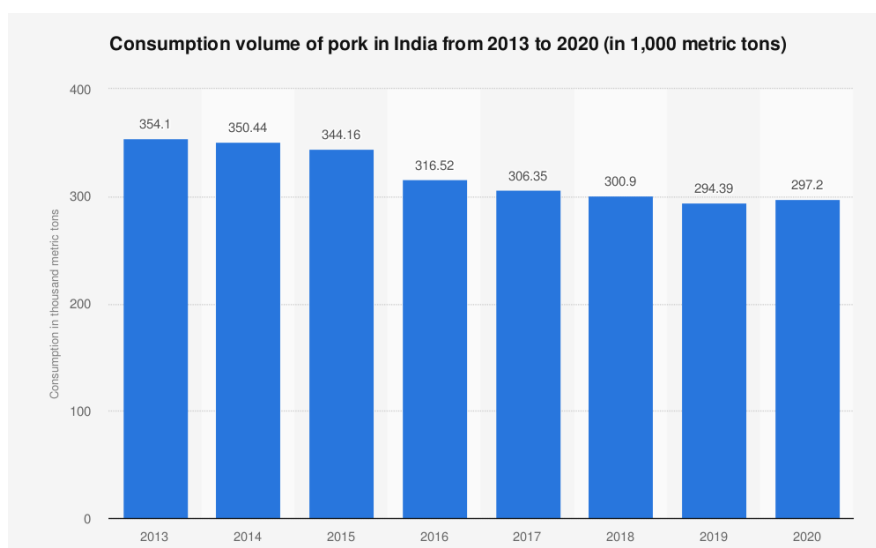
Source: USDA/FAS October 2018

## 1.3 PORK PRODUCTION IN INDIA

India has produced 360043 tonnes of Pig Meat in the year 2019. (Source: FAOSTAT)

Pork production in India is limited, representing only 9% of the country's animal protein sources. Production is concentrated mainly in the north-eastern corner of the country and consists primarily of backyard and informal sector producers. In 2019, Assam, at over two million, had the highest population of pigs in India. According to 19th Livestock Census of India (2012), the total swine population, while small, has grown consistently over the past 50 years. However, in the most recent decade, the population has declined to approximately 10

million head from a high of 14 million in 2003, as indicated by the 17th Livestock Census of India.



(Source: OECD)

## Export

**Major areas for Swine/pig Meat production:** Uttar Pradesh, Bihar, and Maharashtra.

**Major Export Destinations (2019-20):** Bhutan, Vietnam Soc Rep, Myanmar, Nepal.

(Source: APEDA)

## Import

The market for imported pork products in India is limited to the Hotel, Restaurant and Institutional sector (HRI), as well as other niche and specialty markets. Indian pork imports consist almost entirely of processed products. A small portion of these imports include imports of high-quality frozen pork meat. In recent years, the major suppliers of pork to India have been Belgium, Sri Lanka, Spain, Italy, and the Netherlands. (Source: FAS)

## 1.4 HEALTH BENEFITS OF PORK

### 1. Maintenance of muscle mass

Like most animal foods, pork is an excellent source of high-quality protein. With age, maintaining muscle mass is an important health consideration. Eating pork — or other

protein-rich foods — is an excellent way to ensure sufficient dietary intake of high-quality protein that may help preserve muscle mass.

## 2. Improved exercise performance

Meat consumption is not only beneficial for maintaining muscle mass but may also improve muscle function and physical performance. Aside from being rich in high-quality protein, pork contains a variety of healthy nutrients that are beneficial for your muscles. These include taurine, creatine, and beta-alanine. As a result, eating pork — or other rich sources of beta-alanine — may be beneficial for those who want to maximize their physical performance. Vitamins and minerals

## 3. Rich source of many vitamins and minerals, including:

- **Thiamine.** Unlike other types of red meat, such as beef and lamb, pork is particularly rich in thiamine, one of the B vitamins that plays an essential role in various bodily functions.
- **Selenium.** Pork is rich in selenium. The best sources of this essential mineral are animal-derived foods, such as meat, seafood, eggs, and dairy products.
- **Zinc.** An important mineral, abundant in pork, zinc is essential for a healthy brain and immune system.
- **Vitamin B12.** Almost exclusively found in foods of animal origin, vitamin B12 is important for blood formation and brain function. Deficiency in this vitamin may cause anaemia and damage to neurons.
- **Vitamin B6.** A group of several related vitamins, vitamin B6 is important for the formation of red blood cells.
- **Niacin.** One of the B vitamins, niacin or vitamin B3, serves a variety of functions in your body and is important for growth and metabolism.
- **Phosphorus.** Abundant and common in most foods, phosphorus is usually a large component of people's diets. It's essential for body growth and maintenance.

- **Iron.** Pork contains less iron than lamb or beef. However, the absorption of meat iron (heme-iron) from your digestive tract is very efficient, and pork can be considered an outstanding source of iron.

Pork contains good amounts of many other vitamins and minerals.

### Nutritional Content

Pork-Sausage/Patties Frozen /Cooked		
Sl. No.	Nutrient	Amount(/100g)
1	Calories	256 kcal
2	Protein	19 g
3	Fat	20 g
4	Iron	6 mg
5	Sodium	540 mg
6	Potassium	239 mg

(Source: USDA)

## 1.5 PORK SAUSAGES

Sausages are comminuted meat products that are usually spiced or seasoned to obtain various flavour intensities and profiles. The word *sausage* is derived from the Latin word *salsus* meaning *preserved*, or literally, *salted*. The development of sausages was initially driven primarily by economic factors mainly to utilize low quality meats such as trimmings, head and shoulder meat, and edible by-products. Convenience and variety sausages were developed in many parts of the world dependent on the climate of the region and the availability of various spices.





Based on the product characteristics and the specific processing method used, sausages can be classified into four major groups:

- a. Fresh sausages:** Fresh sausages are made from selected cuts of fresh meat (not cooked) and are salted but not cured with nitrite. They may be kept in refrigerator for maximum of 3-4 days and should be thoroughly cooked before serving. Examples of fresh sausages include breakfast sausage, fresh pork sausage, bratwurst etc.



- b. Uncooked smoked sausages:** These cured or fresh sausages that are smoked but not cooked prior to being sold. They must be refrigerated and stable for one week. Uncooked smoked sausages should be cooked thoroughly before they are served. Examples are smoked pork sausage, mettwurst and smoked country-style sausages etc.



- c. Cooked sausages:** Cooked sausages constitutes major chunk of sausages produced around the world. They are usually made from fresh meats that are cured during processing, fully cooked and smoked. Cooked sausages should be refrigerated until they are consumed. Since they are fully cooked, these sausages are ready to eat. Examples of cooked sausages are frankfurters, bologna, beerwurst, etc.



- d. Fermented Sausages:** Fermented sausages can be divided into dry and semi-dry groups based on the processing procedure and product characteristics. The dry and semi-dry sausages are made from fresh meats that are cured during processing and may or may not be smoked. Carefully controlled bacterial fermentation produces a lower pH (4.7-5.3), which aids in preservation and produces the tangy flavours associated with fermented meat products. Fermentation process occurs through inoculation of lactic acid bacteria (LAB) which produce lactic acid through glycolysis.



Dry sausages require long drying periods (ranging from 21-90 days), whereas semi-dry sausages are often fermented and cooked in a smoke oven. Both sausages are ready to eat. Semi-dry sausages require refrigeration during storage whereas, dry sausages can be stored under room temperature. Of the different fermented meat products produced domestically, salami and pepperoni are two of the most popular items. Examples of dry and semi-dry sausages include summer sausage, thuringer, salami, pepperoni, mortadella etc

## CHAPTER 2

### PROCESSING OF PORK SAUSAGE

#### 2.1 INGREDIENTS USED

- **Frozen Pork** - any part such as pork butt, loin along with fat and skin.
- **Soy granules/flakes**- These are known as Binders and Extenders. These ingredients help may improve the binding characteristics, flavour, cook yield, slicing characteristics, and reduce the cost of the sausage formulation (i.e., extenders). The most commonly used ingredients of this type are non-fat dry milk, cereal flours, and soy protein products.
- **Ice/Water**- This is used in industrial processing of ground meats and sausages. It is added to most sausage formulations to rehydrate the non-fat dry milk and to replace the expected moisture loss during smoking and cooking. Approximately 10 percent added water typically is used in moist types of cooked sausage. A small amount of water (usually less than 3 percent) is added to fresh sausage to aid in stuffing, mixing, and processing.
- **Salt**- It is an essential ingredient for flavour and functionality in sausage. It aids in the water binding and emulsifying capacity of meat proteins. Salt is necessary for enhancing flavour, preserving the sausage from microbial spoilage, and extracting the soluble meat proteins. The extracted meat protein forms a film and coagulates during heating and binds the meat particles together providing a firmer texture for sausage. Most sausages contain 2–3 percent salt. Salt levels can be adjusted to taste.
- **Flavouring/ Spices mix**- Seasonings are normally parts of plants which flavours the sausage. These can be in the form of fresh, dried, whole, crushed, pureed, as paste, and as an extract. Commercial premixed seasonings are available for most sausage types. Natural spices, herbs and vegetable bulbs are the main groups of seasonings used.
- **Sodium Nitrate/Potassium Nitrate**: It has great benefit for the production of sausage with improved food safety with extended shelf life and excellent storage stability. Curing imparts unique colour, texture, and flavours that cannot be recreated by any other ingredient. These curing ingredients are required to achieve the characteristic flavour, colour, and stability of cured meat. Nitrate and nitrite are converted to nitric oxide by microorganisms and combine with the meat pigment (myoglobin) to give the characteristic pink cured-meat colour. However, more importantly, nitrite provides protection against the growth of botulism-producing microorganisms, acts to retard

rancidity, and stabilizes the flavour of cured meat. A maximum of 20 gm of sodium nitrate or potassium nitrate per 1 kg of chopped meat is allowed.

## **2.2 PROCESSING**

### **1. Meat Selection**

Meat for sausages is either pork, or a combination of pork with beef or poultry. All pork meat is well adapted for making sausages. The pork butt (sometimes called Boston butt) is a great all-around choice. It has an ideal fat to lean meat ratio for sausage making. The fat makes sausage tender and juicy. Pork fat is preferred for making sausages as it is hard, white and tastes the best. It exhibits different degrees of hardness depending from which animal part it comes from. Back fat, jowl fat, or butt fat (surface area) have a very hard texture and higher melting point. They are the best choice for making sausages products.

### **2. Grinding**

The selected pork part along with fat is ground through a plate with very small holes and if it is not partially frozen a smeared paste will be produced. The locking ring on a grinder head should be tight and the blades must be sharp, otherwise the meat will smear. Ideally, meat should always be chilled between 0-2°C for a clean cut. Since refrigerator temperatures are roughly 3-4° C, meat should be placed in a freezer for about 30 min just before grinding.

### **3. Mixing**

Minced meat along with other ingredients such as spices, flavourings etc are mixed to get a uniform paste. To prevent smearing and to keep the sausage texture looking great, the temperature of the sausage mix should be between 0-5° C. If this temperature increases, the sausage mix should be cooled down in a refrigerator before proceeding to the stuffing step. If the meat/fat mixture is not mixed adequately then the salt/myosin reaction will be minimal and the water holding capacity and the meat binding capacities will be reduced.

### **4. Stuffing and Link**

Before filling into casings, oxygen should be excluded from the mixture (by vacuum-filling devices) and the temperature of the mix should not exceed 2°C. Natural casing (made from the intestines of slaughter animals) as well as casings made from modified collagen or cellulose are most frequently used. Meat plants need a machine that will stuff, link and portion

sausages in one cycle. Sausages must be of the same length and weight otherwise it would be impossible to estimate costs and run the business. Such machines are very expensive and can stuff thousands of pounds of sausage in one hour. The piston is powered by hydraulic pressure and the machine is controlled with a foot or a knee. A longer shelf life of sausages is therefore achieved by vacuum filling.

**4.1 Casings:** Casings, also known as skins, used in sausage manufacturing to achieve their primary significance in portioning. They are broadly divided into two types, namely natural and artificial. Intestines of pigs or sheep are used in making natural casings. Most products made of natural casings come out with a curve after filling and cooking. Artificial casings are now made with collagen, cellulose and plastic materials to suit a wide range of applications. Through a series of mechanical and chemical actions, collagen is extracted from the connective tissue of animals and used for manufacturing casings. Apart from providing the required sausage shape, casings also increase product shelf life by providing high moisture and oxygen resistant properties with a seal strength and density. Casings therefore contribute in minimizing product weight loss during cooking.

**4.2 Preparing casing before use:** Casings are soaked for 30 min in cool water. They are flushed, scraped and cleaned with water and salt by hand or with machinery; today they are primarily machine cleaned.

## 5. Cooking/Steaming

Sausages, hams and other pieces of meat are considered raw products and must be cooked/Steam. It is recommended to cook/steam fresh pork to an internal temperature of 68° C for 20 min for maximum juiciness and flavour.

## 6. Smoking

The main reason for making smoked sausage is to add flavour. Oak chips, pecan, apple chips are used to added smoky flavour into the sausages. Sausage can either be cold smoked or hot smoked and these two processes are fundamentally different:

- Cold smoking takes place at temperatures below 30°C whereas hot smoking takes place between 60-80°C.

- Hot smoking cooks the sausage whereas cold smoking does not.
- The longer sausage is cold smoke, the deeper and richer the smoky flavour, this is not the case with hot smoking.

The sausages are generally smoked in a smokehouse in two phases: (a) steaming for 3–5 or more minutes to an internal temperature slightly above 50°C and (b) dry heating to an internal temperature of 64–65°C. Following this procedure quick chilling is advisable.

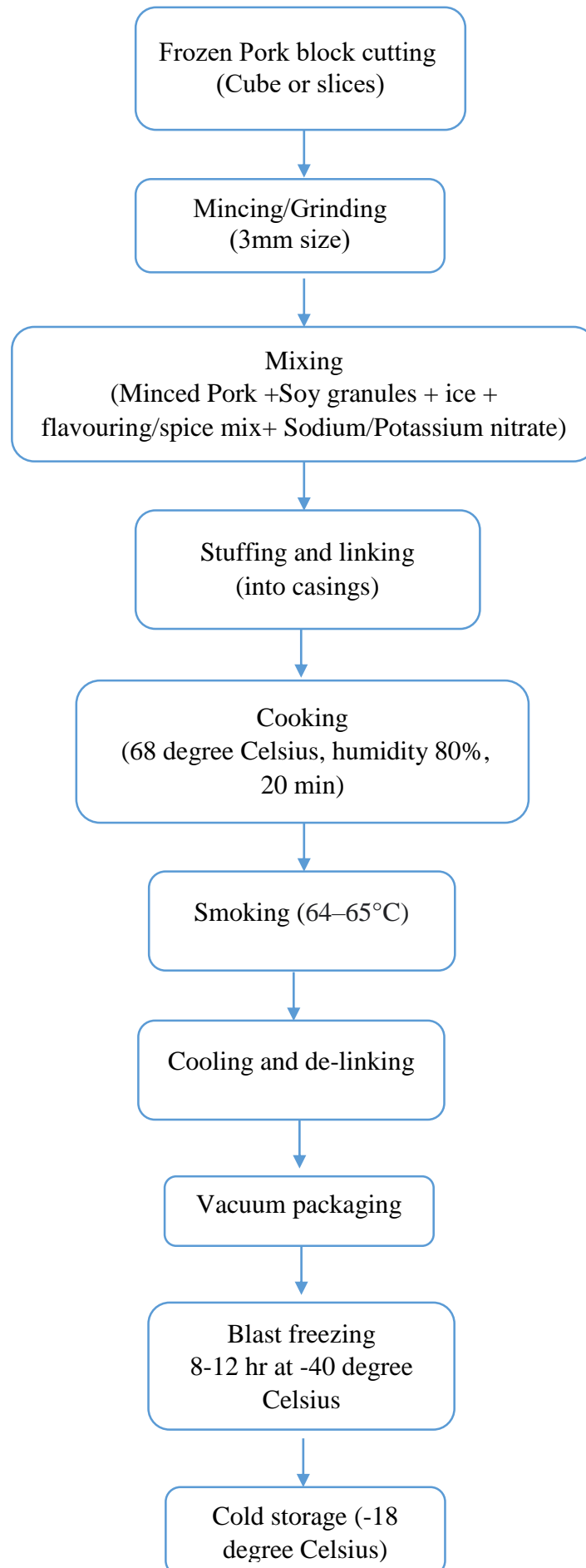
#### **7. Cooling and packaging:**

The sausage should be showered or soaked in water till reach an internal temperature of 10–15° C, then remove the casing and cooled for packaging. Cooling sausages with water offers the following advantages:

- Cleans the surface from grease.
- Extends product's shelf life.
- Decreases time of air cooling

The main purpose of packaging is to prevent meat and meat products from microbial contamination, physical and chemical changes. Packaging materials for sausages whether primary or secondary should be good enough to offer an acceptable visual and structural presentation of the product to the customer.

## 2.3 FLOW CHART



## 2.4 EQUIPMENTS AND MACHINERY USED

### 1. Thermometer

An accurate thermometer is necessary for ensuring that raw meat does not get warmer than 4°C during processing. It is also needed to measure the internal temperature of cooked sausages, which must be hot enough to kill any possible pathogens in the product. Most sausages are considered fully cooked when they reach an internal temperature of 70°C.



### 2. Meat Mincer with plates

The grinder consists of a screw auger, a four- or five-bladed knife, and plates with numerous holes to produce the desired texture of the sausage. A coarse grind is made with a plate with 1/4-, 3/8- or 1/2-inch holes; the fine grind is produced by 1/8 or 3/16-inch holes.



### 3. Bowl Chopper

It is used to produce finely ground, emulsified batter for sausages like bologna or hotdogs. The chopper warms the emulsified batter through friction to allow meat proteins to encapsulate microscopic fat particles. Temperature control is very important during this operation.





#### **4. Sausage Filling Machine**

It is ideal for filling sausages of various specifications and is suitable for filling in different kinds of casings such as animal, collagen, plastic casing.



#### **5. Industrial meat smoking machine**

This machine is made of stainless steel and it is electric. The sausages are hung on smoke rods and are carried inside the machine for steaming and smoking process. Wood chips are used to generate smoke for desirable flavours.



## 6. Vacuum Packaging Machine

A vacuum packaging machine puts product in a film bag, de-aerates the bag by decreased pressure in a vacuum chamber, and seals the bag. It prevents discoloring of product and heightens display effect.



## 7. Metal Detector Machine

Metal is one of the most commonly found contaminant materials in food. Metal can be introduced at all stages of processing of meat, as it is most commonly used in the construction of machinery, handling equipment and ancillary utensils. A metal detector for the food industry can help ensure the safety and integrity of a wide range of unpackaged, packaged or bulk goods, by identifying metal contaminants during processing or packaging.



## 8. Blast Freeze

This freezer storage is used to rapidly bring down the temperature of (usually) foodstuffs , meat products or fresh produce, freezing them very quickly.



## 9. Cold Storage

A cold storage room is a great place to store final product, as well as other products, as they prolong the life and help prevent spoilage of foods. Cold Rooms are a great idea as they will keep items much cooler than regular room temperature.



## **CHAPTER 3**

### **PACKAGING**

#### **3.1 PURPOSE OF PACKAGING**

The basic purpose of packaging is to protect meat and meat products from undesirable impacts on quality including microbiological and physio-chemical alterations. Packaging protects foodstuffs during processing, storage and distribution from:

- contamination by dirt (by contact with surfaces and hands)
- contamination by micro-organisms (bacteria, moulds, yeasts)
- contamination by parasites (mainly insects)
- contamination by toxic substances (chemicals)
- influences affecting colour, smell and taste (off-odour, light, oxygen)
- loss or uptake of moisture (evaporation or water absorption)

A range of synthetic materials suitable for meat packaging are available mainly in the form of plastic films or foils. Packaging films must have following qualities:

- flexible
- mechanical strength
- light weight
- odourless
- hygienic (clean and toxicologically harmless)
- easy recycling
- resistance to hot and cold temperatures
- resistance to oil and fats
- good barrier properties against gases
- sealing capability
- low-cost

#### **3.2 PACKAGING REQUIREMENTS FOR PORK SAUSAGE**

##### **1. Barrier against gases**

Good barrier properties against oxygen and evaporation are the most important features in order to ensure:

#### a) Exclusion of oxygen

Oxygen changes the red meat colour to grey or green and causes oxidation and rancidity of fats resulting in an undesirable off-flavour. The best protection will be achieved using oxygen-proof packaging films together with vacuum packaging of the product.

#### b) Prevention of evaporation of product moisture

Fresh meat or fresh sausages or freshly processed meat products have a comparably good amount of moisture content and will suffer considerable weight and quality losses by evaporation and drying during storage, if such products remain unpacked. The packaging material must therefore be sufficiently water-vapour-proof.

### 2. Barrier against light

The prolonged exposure to daylight or artificial light accelerates unattractive colour changes, oxidation and rancidity. Transparent packaging films normally allow attractive product presentation as the packaged product is visible. However, no protection against light impact. Therefore, for light sensitive products or products exposed to strong light, coloured or opaque films should be used. Films laminated with aluminium foil are very effective.

### 3. Sealing capability (Thermoplastic properties)

The films must be heat sealable, i.e., under slight pressure and with simultaneous high temperature application, they will melt or seal together along the heated area, resulting in hermetically closed plastic pouches or bags. Opaque and printed films are used as light barrier.

## 3.3 PACKAGING MATERIAL FOR PORK SAUSAGE

### PRIMARY PACKAGING

- Envelops and holds the product.
- Direct contact with the kebabs.



## **Types of packaging films which can be used for primary packaging**

For the various purposes in the meat industry packaging films can be divided into Single-layer films and Multi-layer films.

### **Single-layer films**

It is used for wrapping of meat pieces bone-in or boneless meat cuts or even entire carcasses as well as few processed meat products. These are self-adhesive, i.e., they cling together - “cling film”- in the overlapping areas. They provide good protection from external contamination and to some extent from evaporation but no protection from oxygen, as they are not hermetically closed or sealed packages. Foils with good self-adhesive properties are PE, PA, PVC and PP. To avoid evaporation, ice formation and freezer burn during freezer storage, at non-contact spots, suitable cold resistant films for freezer storage used are PA or PE.



### **Multi-layer films**

Multi-layer barrier film packaging saves the processed sausages from rotting by dust, parasitic organisms, bacteria and poisonous objects, from formulating odd smell, shade and flavour and from putting or adding up the water content. In general, the internal multi-layer meat packaging is carried out where the barrier material comes in quick contact with the meat.

Practically all the other films used for sausage packaging are designed as strong oxygen and water-vapour barriers. In order to fully achieve these requirements, films with good barrier properties for oxygen and water vapour respectively are combined.

For Instance, Layer1: Outside layer (mechanically strong, gas barrier to oxygen)

Layer 2: Middle layer (barrier to oxygen)

Layer 3: Inside layer = sealant layer (capable of being melted and welded under pressure to the sealant layer of the opposite sheet of the bag/pouch, serves also as barrier to water vapour).



### Combinations for Multiple layer films

A very efficient combination used is Polyamide (PA)/Polyethylene (PE). PA is relatively oxygen proof but permeable to some extent to water vapour. PE has the opposite properties; it is water vapour proof but permeable to oxygen. Moreover, the PE used as the inside layer has good thermoplastic properties and is therefore well suited for heat sealing. Sealant layers consist mostly of Polyethylene (PE) or Ionomer (I). Outside layers may be Polyamide (PA), Polyester (PET) or Polypropylene (PP). Barrier layers for oxygen are made of Polyvinylidenechloride (PVDC) or materials with similar properties.



### SECONDARY PACKAGING

- Used to group the primary packages
- Present outside the primary unit





### **TERTIARY PACKAGING**

- Used for handling of bulk during storage and transport.
- Carton palletized unit of secondary package. Package for any product is selected based on their characteristics and stability



### **3.4 PACKAGING TECHNIQUE**

Vacuum packaging (VP) along with refrigeration, have become increasingly popular preservation techniques to extend the shelf life of meat and meat products, which have brought major changes in storage, distribution, and marketing of raw and processed meat products.

Vacuum packaging (VP) is the packaging of a product in containers (rigid or flexible), from which air has been substantially removed before final sealing (Muller, 1990). Refrigerated processed meats like sausages, hot dogs and restructured ham products, and other sliced processed meats are traditionally vacuum-packed in plastic packages to minimize contact of the product with the oxygen and consequently prolong their shelf life.

### **VP materials**

Vacuum packages for retail meat products are generally low-oxygen packaging systems in which the meat is in a barrier styrene or PE films and the heat-shrinkable barrier films are vacuum sealed to conform to the shape of the product. Common materials for vacuum packaging include PA, EVA, EVOH and PET-PVdC. It should be noted that the reduced thickness at the corners of the package significantly affects the gas barrier properties of the vacuum package. Oliveira et al. (2006) suggested the use of EVOH in vacuum packaging because this material does not affect the gas barrier properties of the packaging corners. Currently, a typical VP material is usually a three-layered co-extrusion of EVA/PVdC/EVA with O<sub>2</sub> permeability of less than 15.5 ml m<sup>-2</sup> (24 h)<sup>-1</sup> at 1 atmosphere. A variation of the VP system is using composite films with outer barrier and inner air-permeable layers.

### **Vacuum Packaging Machine**

A vacuum packaging machine puts product in a film bag, de-aerates the bag by decreased pressure in a vacuum chamber, and seals the bag. It prevents discoloring of product and heightens display effect.

Only by placing a product in bag on a belt, the machine automatically fulfills series of vacuum packaging processes from vacuum-packaging, sealing, cooling and discharging.

For meat processing industries, vacuum packaging machine wraps food with freshness intact. When the package is opened, the original taste and flavour is retained.

### **Metal Detector Machine**

In the food processing industry, metal is one of the most commonly found contaminant materials in food. A metal detector for the food industry can help ensure the safety and integrity of a wide range of unpackaged, packaged or bulk goods, by identifying metal contaminants during processing or packaging.

## CHAPTER 4

### FSSAI FOOD REGULATIONS AND STANDARDS

#### 4.1 Definition of Standards

According to FSSAI Standards (2.5.2 Meat and Meat Products) (Cured or Pickled and Cooked or Smoked Meat Products, or both) under Food Safety Standards and Additives 2011- Smoked meat means the product prepared by exposing the cured or cooked meat to smoke produced by hard wood for flavour and preservation. Alternatively, liquid smoke (oil-based, water soluble or dry powder) shall be applied to meat through dipping or drenching, atomising (spraying) or directly mixing with meat formulation.

#### Microbial Standards for Meat and Meat Products

Table: Microbiological Standards for Meat and Meat Products- Process Hygiene Criteria

Product Category	Aerobic Plate Count		Yeast and Mold Count		Escherichia coli		Staphylococcus aureus (Coagulase +ve)	
	Limits (cfu/g)		Limits (cfu/g)		Limits (cfu/g)		Limits (cfu/g)	
	m	M	m	M	m	M	m	M
Raw marinated/minced/comminuted meat	$5 \times 10^5$	$5 \times 10^6$	$1 \times 10^4$	$5 \times 10^4$	$1 \times 10^2$	$1 \times 10^3$	$1 \times 10^2$	$1 \times 10^3$
Cooked Meat Products	$1 \times 10^3$	$1 \times 10^4$	10	$1 \times 10^2$	10	$1 \times 10^2$	10	$1 \times 10^2$

Table: Microbiological Standards for Meat & Meat Products- Food Safety Criteria

Product Category	Salmonella\$	Listeria monocytogenes	Sulphite Clostridia Reducing		Clostridium Botulinum		Campylobacter Spp*	
	Limits (cfu/g)	Limits (cfu/g)	Limits (cfu/g)		Limits (cfu/g)		Limits (cfu/g)	
	m /M	m /M	m	M	m	M	m	M
Raw marinated/minced/comminuted meat	Absent	NA NA	NA	NA	NA	NA	NA	NA
Cooked Meat Products	Absent	Absent	1x10 <sup>2</sup>	1x10 <sup>3</sup>	NA	NA	Absent	

### Use of food additives in food products

Food products may contain additives as specified in these regulations and in the following Tables.

#### Edible casings (e.g. sausage casings)

Casings or tubing prepared from collagen, cellulose, or food-grade synthetic material or from natural sources that contain the sausage mix.

Meat and meat products including poultry				
Food Category System	Food Category Name	Food Additive	INS No	Recommended Maximum Level
8.4	Edible casings	Paprika oleoresin	160c(i)	GMP
		ASCORBYL ESTERS		5,000 mg/kg
		Brilliant blue FCF	133	100 mg/kg
		CAROTENOIDS		100 mg/kg
		Fast green FCF	143	100 mg/kg

		Grape skin extract	163 (ii)	5,000 mg/kg
		<b>HYDROXYBENZ OATES, PARA</b>		36 mg/kg
		<b>IRON OXIDES</b>		1,000 mg/kg
		<b>PHOSPHATES</b>		1,100 mg/kg
		<b>POLYSORBATES</b>		1,500 mg/kg

### Heat-treated processed comminuted meat and poultry products

Includes cooked (including cured and cooked, and dried and cooked), heat-treated (including sterilized) and canned comminuted products.

Meat and meat products including poultry				
Food Category System	Food Category Name	Food Additive	INS No	Recommended Maximum Level
8.3	Processed comminuted meat and poultry products	Brilliant blue FCF	133	100 mg/kg
		Butylatedhydroxyan isole (BHA)	320	200mg/kg
		Caramel III - ammonia caramel	150c	GMP
		Caramel IV - sulfite ammonia caramel	150d	GMP
		Erythrosine	127	30 mg/kg
		Grape skin extract	163(ii)	5,000 mg/kg
		<b>NITRITES</b>		80 mg/kg
		Paprika oleoresin	160c(i)	GMP
		<b>PHOSPHATES</b>		2,200 mg/kg
		<b>POLYSORBATES</b>		5,000 mg/kg
		<b>RIBOFLAVINS</b>		1,000 mg/kg
		Propyl gallate	310	200 mg/kg
		Propylene glycol alginate	405	3,000 mg/kg
		<b>SORBATES</b>		1,500 mg/kg
		Sodium diacetate	262(ii)	1,000 mg/kg
		<b>TOCOPHEROLS</b>		500 mg/kg
		Tertiary butylhydroquinone (TBHQ)	319	100 mg/kg

## 4.2 FOOD SAFETY AND STANDARDS (CONTAMINANTS, TOXINS AND RESIDUES) REGULATIONS, 2011

### CONTAMINANTS, TOXINS AND RESIDUES

#### METAL CONTAMINANTS

1. Chemicals described in monographs of the Indian Pharmacopoeia when used in foods, shall not contain metal contaminants beyond the limits specified in the appropriate monographs of the Indian Pharmacopoeia for the time being in force.
2. Notwithstanding anything contained in clause (1) above, no article of food specified in column (2) of the table below shall contain any metal specified in excess of the quantity specified in column (3) of the said table:

Name of metal contaminant	Article of food	Parts per Million (mg/kg or mg/L)
(1)	(2)	(3)
Lead	Named Animal fats (lard, rendered pork fat, premier jus ( <b>suet</b> ) and edible tallow)	0.1
	Meat of cattle, sheep and pig (also applies to fat from meat)	0.1
Arsenic	Named Animal fats (lard, rendered pork fat, premier jus ( <b>suet</b> ) and edible tallow)	0.1

#### Crop contaminants and naturally occurring toxic substances

1. No article of food specified in column (2) of the Table below shall contain any crop contaminant specified in the corresponding entry in column (1) thereof in excess of quantities specified in the corresponding entry in column (3) of the said Table:

Name of naturally occurring toxic substances (NOTS)	Article of food	Maximum limits (ppm)
(1)	(2)	(3)
Saffrole	Meat preparations and meat products, including poultry and game	10

## Residues

Restriction on the use of insecticides:

(1) The expression “insecticide” shall have the meaning assigned to it in the Insecticide Act, 1968 (46 of 1968).

(2) Subject to the provisions of clause (3), no insecticides shall be used directly on articles of food: Provided that nothing in this regulation shall apply to the fumigants which are registered and recommended for use as such on articles of food by the Registration Committee, constituted under section 5 of the Insecticides Act, 1968 (46 of 1968).

Food	Name of the Insecticide	Maximum Residue Limit (MRL) in mg/kg
<b>Meat and Meat products</b>	Acephate (expressed as mixture of Methamidophos and acephate).	0.05
	Acetamiprid	0.05
	Chlorantraniliprole	0.2
	Chlorothalonil	0.02
	Bitertanol	0.05
	Chlothianidin (Chlothianidin and its metabolites Thiazolymethylguanidine (TMG), Thiazolymethylurea (TZMU), Methylnitroguanidine (MNG) TMG)	0.02
		0.05



	Deltamethrin (Decamethrin)	
	Difenoconazole	0.2
	Dimethoate	0.05
	Mancozeb	0.1
	Ethofenprox (Etofenprox)	0.5
	Fenpropathrin	0.02
	Fipronil	0.01
	Flusilazole	1
	Glyphosate	0.05
	Imidacloprid	0.1
	Indoxacarb	2
	Kresoxim Methyl	0.05
	Methomyl	0.02
	Oxydemeton-Methyl	0.05
	Penconazole	0.05
	Profenofos	0.05
	Propiconazole	0.01
	Spinosad	2
	Tebuconazole	0.05
	Thiacloprid	0.1
	Thiodicarb	0.02
	Thiamethoxam	0.02
	Triadimefon	0.02* * Maximum Residue Limit fixed at Limit of Quantification (LOQ)
<b>Meat and Poultry</b>		0.1 (carcass fat basis)

	Sum of benomyl and carbendazim expressed as carbendazim	
	Carbendazim	0.1(Carcass fat basis)
	Carbofuran (sum of carbofuran and 3-hydroxy carbofuran expressed as carbofuran)	0.10 (carcass fat basis)
	Chlorpyrifos	0.1
	Cypermethrin (sum of isomers) (Fat soluble residue)	2
	Edifenphos	0.02 (carcass fat basis)
	Fenvalerate (Fat soluble residue)	1.0 (carcass fat basis)
	Phenthoate	0.05 (carcass fat basis)
	Phorate (sum of Phorate, its oxygen analogue and their sulphoxides and sulphones, expressed as phorate)	0.02* (carcass fat basis)

## ANTIBIOTIC AND OTHER PHARMA-COLOGICALLY ACTIVE SUBSTANCES

Following antibiotics and veterinary drugs are not permitted to be used at any stage of processing of meat and meat products, poultry and eggs, sea foods including shrimps, prawns or any variety of fish and fishery products. The Extraneous Maximum Residue Limit of 0.001 mg/kg will be applicable except for Chloramphenicol for which it shall be 0.0003 mg/kg (0.3 ug/kg).

### 1. Nitrofurans including-

- (i) Furaltadone
- (ii) Furazolidone
- (iii) Nitrofurantoin
- (iv) Nitrofurazone

### 2. Chloramphenicol

### 3. Sulphamethoxazole

### 4. *Aristolochia* spp and preparations thereof

### 5. Chloroform

6. Chlorpromazine
7. Colchicine
8. Dapsone.
9. Dimetridazole
10. Metronidazole
11. Ronidazole
12. Ipronidazole and other nitromidazoles
13. Clenbuterol
14. Diethylstilbestrol
15. Glycopeptides
16. Stilbenes and other steroids
17. Crystal Violet
18. Malachite Green
19. Carbadox

The antibiotics and veterinary drugs specified shall not exceed the tolerance limit specified in for the article of food of the Table below, namely: -

S. No.	Name of the antibiotics and veterinary drugs	Tolerance limit (mg/Kg) in Pig's			
		Muscle	Fat	Kidney	Liver
1	Colistin	0.15	0.15	0.15	0.2
2	Dihydrostreptomycin Streptomycin	0.6	0.6	1	0.6
3	Chlortetracycline/Oxytetracycline/Tetracycline	0.2	-	1.2	0.6
4	Flumequine	0.5	1	3	0.5
5	Lincomycin	0.2	0.1	1.5	0.5
6	Neomycin	0.5	0.5	10	0.5
7	Spectinomycin	0.5	2	5	2
8	Ceftiofur	1	2	6	2
9	Danofloxacin	0.1	0.1	0.2	0.05
10	Tilmicosin	0.1	0.1	1	1.5
11	Tylosin	0.1	0.1	0.1	0.1

12	Doramectin	0.005	0.15	0.03	0.1
13	Ivermectin	-	0.02	-	0.015
14	Levamisole	0.01	0.01	0.01	0.1
15	Febantel/Fenbendazole/Oxyfendazole	0.1	0.1	0.1	0.5
16	Thiabendazole	0.1	0.1	0.1	0.1

### 4.3 FOOD SAFETY AND STANDARDS (PACKAGING AND LABELLING) REGULATIONS, 2011

#### FSSAI 2.1: Packaging 2.1.1: General Requirements

1. A utensil or container made of the following materials or metals, when used in the preparation, packaging and storing of food shall be deemed to render it unfit for human consumption:— (a) containers which are rusty; (b) enamelled containers which have become chipped and rusty; (c) copper or brass containers which are not properly tinned (d) containers made of aluminium not conforming in chemical composition to IS:20 specification for Cast Aluminium & Aluminium Alloy for utensils or IS:21 specification for Wrought Aluminium and Aluminium Alloy for utensils.

2. Containers made of plastic materials should conform to the following Indian Standards Specification, used as appliances or receptacles for packing or storing whether partly or wholly, food articles namely: —

- (i) IS: 10146 (Specification for Polyethylene in contact with foodstuffs);
- (ii) IS: 10142 (Specification for Styrene Polymers in contact with foodstuffs);
- (iii) IS: 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs);
- (iv) IS: 10910 (Specification for Polypropylene in contact with foodstuffs);
- (v) IS: 11434 (Specification for Ionomer Resins in contact with foodstuffs);
- (vi) IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer.
- (vii) IS: 12252 - Specification for Poly alkylene terephthalates (PET).
- (viii) IS: 12247 - Specification for Nylon 6 Polymer;
- (ix) IS: 13601 - Ethylene Vinyl Acetate (EVA);
- (x) IS: 13576 - Ethylene Metha Acrylic Acid (EMAA);

(xi) Tin and plastic containers once used, shall not be re-used for packaging of edible oils and fats; Provided that utensils or containers made of copper though not properly tinned, may be used for the preparation of sugar confectionery or essential oils and mere use of such utensils or containers shall not be deemed to render sugar confectionery or essential oils unfit for human consumption.

### **Labelling Requirements**

All food products sold in India that are pre-packaged are required to comply with the Food Safety and Standards (Packaging and labelling) Regulations, 2011. The Food Safety and Standards Regulation, 2011 is a notification issued by the Food Safety and Standards Authority of India under the Ministry of Health and Family Welfare.

### **Applicability of Food Labelling Regulations**

The food labelling regulations require all “Pre-packaged” or “Pre-packed food” to comply with the labelling regulations in India. As per the rules, pre-packaged food means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.

### **General Labelling Requirements**

The following labelling requirements must be complied with by all pre-packaged food sold in India:

- The label must be in English or Hindi or Devnagri language. In addition to the above, the label can contain information in any other language, as required.
- The label must not contain information about the food that could be deemed to be false, misleading, deceptive or otherwise create an erroneous impression regarding the product.
- The label must be affixed to the container in such a manner that it would not easily be separated from the container.
- The contents or information presented in the label should be clear, prominent, indelible and readily legible by the consumer.
- If the container is covered by a wrapper, then the wrapper must contain necessary information or make the label of the product inside readily legible by not obscuring.

- The name of the food must be mentioned along with the trade name and description of the food contained. In case the food contains more than one ingredient, then a list of ingredients must be presented in descending order of their composition by weight or volume, as the case may be, at the time of its manufacture;

### **Nutritional Information**

- Nutritional Information or nutritional facts per 100 gm or 100ml or per serving of the product must be given on the label along with the following information:
- energy value in kcal;
- the amounts of protein, carbohydrate (specify the quantity of sugar) and fat in gram (g) or ml;
- the amount of any other nutrient for which a nutrition or health claim is made:

It is important to note that any “health claim” or “nutrition claim” or “risk reduction” claim made in the label will be thoroughly scrutinized by the FSSAI authorities. Hence, any such claim must be validated by test data. As per the rules, the following is the definition for “health claim”, “nutrition claim” and “risk reduction” claim:

- **“Health claims”** means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health and include nutrition claims which describe the physiological role of the nutrient in growth, development and normal functions of the body, other functional claims concerning specific beneficial effect of the consumption of food or its constituents, in the context of the total diet, on normal functions or biological activities of the body and such claims relate to a positive contribution to health or to the improvement of function or to modifying or preserving health, or disease, risk reduction claim relating to the consumption of a food or food constituents, in the context of the total diet, to the reduced risk of developing a disease or health-related condition;
- **“Nutrition claim”** means any representation which states, suggests or implies that a food has particular nutritional properties which are not limited to the energy value but include protein, fat carbohydrates, vitamins and minerals;
- **“Risk reduction”** in the context of health claims means significantly altering a major risk factor for a disease or health-related condition

### **Veg or Non-Veg Symbol**

All packaged food that is “Non-Vegetarian” must have a symbol that is a brown colour filled circle inside a square with a brown outline. If a food contains only egg as a non-vegetarian ingredient, then the manufacturer may provide a declaration that the product contains only egg and add the non-vegetarian symbol



**Non-Veg Symbol**

### **Information Relating to Food Additives, Colours and Flavours**

Food additives contained in the food product must be mentioned along with class titles along with the specific names or recognized international numerical identifications. Addition of colouring matter should be mentioned on the label along with certain statements like “CONTAINS PERMITTED NATURAL COLOUR(S)”, just beneath the list of the ingredients on the label. In case of addition of extraneous flavouring agent, then it should be mentioned in a statement like “CONTAINS ADDED FLAVOUR” just beneath the list of ingredients on the label.

### **Name and Complete Address of the Manufacturer**

The name and complete address of the manufacturer must be mentioned on every package of food. In the case of imported food, the package must contain the name and complete address of the importer in India.

### **Net Quantity**

All packaged food must carry the net quantity by weight or volume or number, as the case may be. The net quantity of the commodity contained in the package must exclude the weight of the wrappers and packaging materials.

### **Lot Number of Batch Identification**

A lot number or batch number or code number must be mentioned on all packaged food so that it can be traced while manufacturing and distribution. Only bread and milk including sterilised milk are not required to comply with this regulation.

### **Date of Manufacture or Packing**

The date, month and year in which the commodity is manufactured, packed or pre-packed must be mentioned on the label. In the case of food products having a shelf life of more than three months, then the month and the year of manufacture can be given with the “Best Before Date”. In case of products having a shelf life of fewer than three months, the date, month and year in which the commodity is manufactured or prepared or pre-packed must be mentioned on the label with best before date.

### **Country of Origin for Imported Food**

For imported food, the country of origin of the food should be declared on the label of the food. In case a food product undergoes processing in a second country which changes its nature, the country in which the processing is performed should be considered to be the country of origin for the purposes of labelling.

### **Instructions for Use**

Instructions for use, including reconstitution, should be included on the label, if necessary, to ensure correct utilization of the food.

## **4.4 SANITARY AND HYGIENIC REQUIREMENTS FOR FOOD, MANUFACTURER/PROCESSOR/HANDLER**

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.
2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.
3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.
4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.
5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects. No spraying shall be done during the conduct



of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises. Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free. The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.

6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.

7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.

8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).

9. All equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.

10. All equipments shall be placed well away from the walls to allow proper inspection.

11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.

12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.

13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.

14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.

15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.

16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.

17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.

18. The vehicles used to transport foods must be maintained in good repair and kept clean.
19. Foods while in transport in packaged form or in containers shall maintain the required temperature.
20. Insecticides / disinfectants shall be kept and stored separately and `away from food manufacturing / storing/ handling areas.



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