



PM Formalisation of Micro Food Processing Enterprises Scheme

Processing of Frozen Peas



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CHAPTER 1

INTRODUCTION

1.1 Introduction

Green peas are a tasty and very nutritious vegetable that should be a part of almost everyone's diet. They're a great source of protein, vitamins, minerals, and soluble fiber. They are also very versatile. Peas can be cooked and prepared in many different ways and can add flavor and interest to many dishes. Another advantage of peas is that they are often



inexpensive to buy. In addition to being a component of a meal, green peas can be used to make other foods, including soups, puddings, and porridges. They also make a great addition to items such as salads, stews, pies, pasta, and omelets.

Field pea (*Pisum sativum*) is one of the world's main pulse crops, grown over an area of 5.9 million hectares and Production approximately 11.7 million tons. The pea, after dry bean and chickpea, is the third most important pulse crop worldwide. In India field pea is grown over an area of 11.50 lakh ha with a production of about 10.36 lakh tons during period (2012-2015). Uttar Pradesh is the largest pea producing state and It alone produces about 49 % of pea produced in India.

Other states such as Madhya Pradesh and Jharkhand, Himachal Pradesh, Punjab, West Bengal, Haryana, Bihar, Uttarakhand, Jammu and Kashmir, Odisha, portions of Rajasthan, and Maharashtra grow peas on a large scale. it is grown in Karnataka and in the hilly regions like Ooty and Kodaikanal also. The green pea growing area is 0.543 million ha in Madhya Pradesh, and production was 5430 tons. The mature seeds are used as whole or separated into dal and are used in different ways.

Only about 5 percent of the peas sold worldwide are fresh. The rest are sold either frozen or canned or dry. Frozen peas are convenient and easy-to-use, without the hassle of shelling, and can be stored as fresh, and also they're not that much more expensive than fresh peas.

1.2. Major component of pea

S. No.	Constituent	Concentration (%)
➤	Protein (% N x 6.25)	21.2–32.9
➤	Starch	36.9–49.0
➤	Resistant starch	2.1–6.3
➤	Amylose	20.7–33.7
➤	Total dietary fibre	14–26
➤	Insoluble fibre	10–15
➤	Soluble fibre	2–9
➤	Soluble sugars	5.3–8.7
➤	Total lipid	1.2–2.4
➤	Ash	2.3–3.4

Values are expressed on a moisture-free basis except for amylose, which is expressed on a starch basis (W. J. Dahl et al. British Journal of Nutrition, 108, S3–S100)



1.3. Frozen foods

Freeze-drying is a relatively recent method of preserving food. It involves freezing the food, then removing almost all the moisture in a vacuum chamber, and finally sealing the food in an airtight container. Freeze-dried foods can be easily transported at normal temperatures, stored for a long period of time, and consumed with a minimum of preparation. Freeze-dried food has many advantages. Because as much as 98% of the water content has been removed, the food is extremely lightweight, which significantly reduces the cost of shipping? This also makes it popular with boaters and hikers who have to carry their food with them. Because it requires no refrigeration, shipping and storage costs are even further reduced. Freeze-dried food is also relatively contamination-free since the dehydration process makes it virtually impossible for yeast and potentially harmful bacteria to survive.



1.4. Importance of Frozen food

Frozen foods retain their vitamins and minerals and there is no change to the carbohydrate, protein, or fat content. In some cases, frozen foods have more vitamins and minerals compared to fresh because fresh foods lose vitamins and minerals over time while freezing preserves nutrients.

Frozen foods can be a convenient and affordable way to incorporate healthful foods from every food group, including whole grains, fruits, vegetables, protein, and dairy. In addition to a time-saving convenience, frozen foods can be a benefit for individuals with limited kitchen space or

utensils. Not only can frozen foods be more affordable in price, but they also can aid in reducing food waste.

1.5. Statistics

1.5.1 Global scenario

Increasing customer desire for convenience foods implicitly favors increasing demand for frozen items, as they require less time and effort than cooking from scratch. The processed food market is driven by the greater need for convenience due to the busy lifestyles of consumers. That, in particular, raises the market for frozen goods. Rising disposable income is also one of those reasons that have a major effect on the development of the frozen food industry as it increases the purchasing power of customers.



The size of the frozen food industry in 2019 was priced at \$291.8 billion and is expected to hit \$404.8 billion by 2027, with a CAGR of 4.2 percent between 2020 and 2027. Frozen food is described as food products that are frozen at low temperatures and are used for a long period of time. Different food products, including ready meals, vegetables & fruits, rice, meat & fish, fish, and soup, are part of the product market.

1.5.2 National scenario

Urban consumers in India have been increasing their consumption of frozen processed food. With more supermarkets opening, especially in cities, women are increasingly shopping in these outlets as they are more convenient, comfortable, and have the space to keep large refrigerators to store frozen processed food. The infrastructure in the cities is much more

developed therefore retailers are able to store frozen processed food without worrying about consistent and long power cuts. The convenience of frozen processed vegetables, meats, and ready meals has encouraged many women to increase the usage of these products as they reduce the preparation time. Peas are used in many vegetables and are demanded around the year by all the families and are also required in the catering industry. Fresh peas are available only during the winter season but are generally required in all seasons. Also, their harvest is limited to certain states. This gap between demand and supply is being managed by frozen peas available in the Indian market.



1.6 Value added products from pulses

Roasting of pulses or puffed legumes

Peas Puffed chickpea and peas are widely used in India as a snack. Pulses being cheaper source of plant protein than nuts, milk, cheese, meat and fish can be used in bakery products like pasta, bread, snacks etc.

- Soaking chickpea or peas in water for 15-20 minutes and draining of water
- Keeping the wet grains in a closed vessel for the moisture to equilibrate in the grain
- Puffing the wet grains in a hot iron vessel containing sand at 190-200 for 60-80 sec.
- The grains puff and the husk is split off

For efficient puffing, the temperature just before the explosion must be sufficient to create a high enough water vapor pressure without burning the pericarp and the temperature increase must be fast enough to build up the required pressure before the water evaporates. The moisture content of the kernel has a pronounced effect on popping behavior. The kernels, which are too dry, often pop up feebly.



Parching of pulses

Legumes such as Bengal gram and peas are parched to give highly acceptable products. Bengal gram is tied in a moist cloth and kept overnight before it is parched. Peas are soaked in water for 5 minutes dried partially in the sun for 15 minutes and then parched. Salt and turmeric powder are sometimes added to the steeping water or the grains smeared with the paste of the same before they are parched. Parching is done in a hot iron vessel containing sand at 190-200 for 60-80 seconds. Parching Bengal gram has been used in the treatment of protein-calorie malnutrition in children.



1.7. Scope of Frozen foods Industry

Vegetables accounted for about a 90.6 percent share in the global frozen fruits and vegetable segment in 2017. Frozen vegetables have an advantage over frozen fruits, like most vegetables, except leafy green vegetables such as spinach, which do not require thawing. This saves time, as the previously cooked vegetables can be eaten a few minutes after taking them out of the freezer.

Major frozen vegetables include exotic vegetables such as broccoli, legumes, spinach, sweetcorn, peas, beans, mixed vegetables, and others. Peas and spinach hold a larger share in the global frozen vegetables.

In order to increase the market share, companies are focusing on multinational campaigns and promotional strategies to increase awareness and consumption of processed frozen vegetables. This effort is anticipated to increase the market share of the frozen vegetables.



CHAPTER 2

PROCESSING OF FROZEN PEA

2.1 PEA

The crop is cultivated for its tender and immature pods for use as vegetable and mature dry pods for use as a pulse. Tender seeds are also used in soups. Canned, frozen and dehydrated peas are very common for use during off-season. Like any legume crop, pea is an integral component of sustainable agriculture due to its soil enriching and conditioning properties.

Nutritive value of pea

- Protein - 22.5%
- Calcium - 64 mg/100g
- Fat - 1.8%
- Iron - 4.8 mg/100g
- Carbohydrate - 62.1%
- Moisture - 11%

State-wise Recommended Varieties

State	Recommended varieties
Maharashtra	JP-885, Ambika, Indra (KPMR-400), Adarsh (IPF 99-25), IPFD 10-12
Gujarat	JP-885, IPFD 10-12, Indra, Prakash,
Punjab	Jay (KPMR-522), Pant pea-42, KFP-103 (Shikha), Uttra (HFP-8909), Aman(IPF5-19)
Haryana	Uttra (HFP-8909), DDR-27 (Pusa panna), Hariyal (HFP-9907 B), HFP-9426, Alankar, Jayanti (HFP-8712), Aman(IPF5-19)
Rajasthan	DMR-7 (Alankar), Pant Pea-42
M.P.	Prakash (IPFD 1-10), Vikas (IPFD -99-13)
U.P.	Swati (KFPD-24), Malviya Matar-15 (HUDP-15), Vikas, Sapna

	(KPMR-1441), IPF 4-9
Bihar	DDR-23 (Pusa Prabhat), V L Matar -42
C.G.	Shubhra (IM-9101), Vikas (IPFD -99-13), Paras
Uttarakhand	Pant Pea-14, Pant Pea-25, V L Matar -47
Jharkhand	PL Matar-42, V L Matar -42

Source: Seednet GOI, Min. of Agri. & FW, & ICAR-IIPR, Kanpur



2.1.1 Proper processing technologies for frozen pea are given below:

Sowing of pea

The peas are sown during the winter season. Depending on the variety and time, the seed is sown at a distance of 10 cm between the rows. When it is sown early the highest seed quantity is used because of the low germination percentage. Peas grow best in mild climates with enough humidity, ensuring that during flowering and ripening sufficient moisture is present. Preference is given to humus-rich and well drain soil. the pea crops do not require frequent irrigation and cannot stand with water lodging so drainage facilities are necessary for the cultivation of pea. The plant has the ability to absorb nitrogen from the air through Rhizobium bacteria, which live in symbiosis in the root

nodules on the roots of the plant. (The contract farming practices is important if the processing plant is on a large scale)

Harvesting: Since peas are only harvested from November to February in India, it is in the processing plants' interest that the pea supply is spread to a maximum over this period. To achieve this coverage, sowing is done according to a specific timetable, also called a seed scheme. Moreover, advantage can be taken off early and late varieties of peas. During ripening sugar is converted into starch, allowing the peas to become harder. In addition, the grain skin hardens. The ideal time for harvesting can therefore be determined using a tender meter. The round peas are at the time of harvest light green of color. Wrinkled peas both come in light green and dark green varieties. When the tender meter value is too high, too much sugar is converted to starch. After harvesting the peas must be processed as quickly as possible to prevent them from warming up. warming up might cause the peas to be affected by bacteria, which convert proteins into the toxic brown matter. Therefore, the temperature of the peas is well monitored.

Cleaning: To determine the detergent effect of the washer, the percentage of unwanted parts is determined. This percentage is also included in the price of the raw material. Often, coarse dirt is first removed with shake and drum sieves and a blower. Because peas are quite vulnerable, a flotation washer is used. The peas are fed into the machine through a funnel. In the first part of the flotation washer, the remaining coarse and heavy dirt particles are removed. The stream that is formed at the bottom of the washer is so strong that only the heavier parts sink. In the second part of the washer, bark, leaves, and pea peels are sorted because they are lighter than the soaked peas and therefore float to the surface of the water. Using a strong flow of water, the now soggy and sunken peas are pressed to a vibrating sieve screen. Here, any remaining pea peels are loosened and the remaining sand is washed away.



Sorting: With a conveyor belt or water, the peas are transported to the sorting machine. Here, the peas are sorted. Sorting is important because a pea's size determines its further processing, the difference in filling weight, starch content, and price. The peas sorter consists of 3 to 5 rotating clover leaf-shaped, perforated drums with a diameter of about 2 meters that are placed on top of each. With water, the peas are led to the upper drum which has perforations of 8 mm. The sieved peas are collected in a gutter and transported with water to a drum with perforations of 7 mm.



Blanching: After sorting, the peas are blanched. Depending on their size/ sorting classification, the peas are heated up to 75 to 80°C for 2 to 4 minutes. After that, the peas are immediately washed with cold water, preventing the growth of thermophilic microorganisms. In addition, this step removes any starch from the peas, making sure that

there will not be any turbid water. Blanching removes any cell moisture from lightly crushed peas, which may otherwise cause flavor inconsistencies when coming in contact with oxygen.



Freezing: After the blanching the peas are taken to the cooling section where the temperature of the peas reduced, after the cooling steps, the peas are frozen on a conveyor belt freezer using cold air (-35°C), which is blown over the belt. In this way, the peas are frozen in a short period of time (IQF, individually quick frozen). The peas can be stored in bulk and later packaged using a flow packer.



Detection of Metal: This process is also carried out with the grading or sorting simultaneously. It is necessary to identify any other particles of metal or items that may have been collected during harvesting or processing. peas are passed through a metal

detector, it is highly recommended as metals could be highly injurious during consumption.

Packaging: The packaging is the most essential operation after processing it is also convenient for handling and marketing. The peas can be packed in different packaging materials are packed in several types and sizes of packaging on the basis of the nature of the market. 0.25 -1 kg or 2 kg volume packaging is commonly used for the local market. On the packaging labels, data such as weight, country of origin, cost, and date of expiry should be mention properly.



Storage: After packaging the storage temperature of frozen peas needs to maintain till consumption the standard temperature of frozen peas is -18°C . When peas are stored in cans and bottle the peas should be stored dry at a temperature of about 10 to 15°C . Usually the cans and jars are labelled only after leaving the temporary storage.



Filling in cans: Peas can be filled in canned with an internal protective lacquer layer or glass pots after the blanching process. When using glass pots with a ventilating lid a partial vacuum is created after sterilization and cooling. A non-ventilating lid may also be used, whereby the vacuum is created through steam injection. The product falls through a filling opening in the package, after which a hot covering liquid is added. This covering liquid consists of a 1% saline solution with a small amount of sugar.



Sterilization: The cans are then sterilized in an autoclave. In addition, cans can also be sterilized in a continuous sterilizer. The cans are sterilized with steam. To prevent leaking of the covering liquid during sterilization and cooling, pressure regulation for the glass

jars with ventilating covers is required. Depending on the filling volume, sterilization must be done at 121°C (half-liter) for 16 minutes or at 121°C (liter) for 18 minutes. After this step, the containers in the sterilizer are cooled down to a core temperature of about 35°C.

2.2 Current trends in frozen pea Processing

Indians generally prefer green and fresh vegetables but they are available only during seasons. Some of their shelf life is not more than 3-4 days. But dehydration technique preserves them for a few months and the original taste, flavor, and color are also retained. Green peas are very popular and they are used along with other vegetables in many vegetarian and continental dishes. Many fast food and snack items also include green peas. Thus apart from household demand, there is a continuous demand from restaurants, dhabas, caterers, and canteens. A small scale unit with lower overheads can offer competitive prices. Marketing would play a critical role. Likewise, the promoters should have adequate financial resources as the finished goods stock of around 5-6 months shall have to be stored.

2.2.1 General Principals on Fruit and vegetable Processing

Fruits are highly perishable items which needs processing to make it durable. Fruit processing is any deliberate change in a fruit that occurs before it's available for us to eat. Processing methods extend the shelf life of fruits.

Fruit processing has three major aims:

1. To make fruit safe (microbiologically & chemically).
2. To provide good quality products with good flavor, color, texture and taste.
3. To make convenient fruits products

As time passes spoilage increases rapidly. Fruit processing involves many steps.

Cleaning and washing

First, the fruits should be cleaned thoroughly to remove any adhering dirt or pesticide residues. This cleaning process usually involves washing the product with running water.

- **Sorting**

To achieve a uniformly sized product, fruits and vegetables are sorted immediately after cleaning according to their size, shape, weight or color. Sorting by size is especially important if the products are to be dried or heated, because their size will determine how much time will be needed for these processes.



Peeling

Many types of fruits have to be peeled in order to be preserved. This can easily be done with a stainless steel knife. It is extremely important that the knife be made of stainless steel because this will prevent the discoloration of the plant tissues.

Cutting

Cutting is important in order to get uniform pieces for heating, drying and packing. Fruits are usually cut into cubes, thin slices, rings or shreds. The cutting utensils have to be sharp and clean to prevent micro-organisms from entering the food.

Blanching

Blanching is a slight heat treatment, using hot water or steam that is applied mostly to fruits before canning or freezing. It is done by immersing fruits in water at a temperature of 90-95°C. The result is that fruits become soft and the enzymes are inactivated. Blanching is done before a product is dried in order to prevent unwanted color and odour changes and an excessive loss of vitamins.

2.3 Fruit and vegetable Preservation

Fruit preservation is the process of treating and handling food to stop or slow down fruit spoilage, loss of quality, edibility or nutritional value and thus allow for longer fruit storage. Preservation usually involves preventing the growth of bacteria, fungi (such as yeasts), and other micro-organisms as well as retarding the oxidation of fats which causes rancidity. Fruit preservation can also include processes which inhibit visual deterioration, such as the enzymatic browning reaction in apples after they are cut, which can occur after fruit cutting.

Many processes designed to preserve food will involve a number of fruit preservation methods. Preserving fruit by turning it into jam, for example, involves boiling (to reduce the fruit's moisture content and to kill bacteria, yeasts, etc.), sugaring (to prevent their re-growth) and sealing within an airtight jar (to prevent recontamination). Maintaining or creating nutritional value, texture and flavor is an important aspect of fruit preservation.

2.3.1. Preservation methods

Drying

Drying is one of the most ancient fruit preservation techniques, which reduces water activity sufficiently low to prevent bacterial growth. Drying is the partial removal of water from solid foods. It is one of the oldest methods of food preservation. It was traditionally carried out in the presence of sun.

Refrigeration

Refrigeration preserves fruit by slowing down the growth and reproduction of micro-organisms and the action of enzymes. Refrigerators should be set to below 4°C to control the growth of micro-organisms. This lowered temperature also reduces the respiration rate of fruits and retard the spoilage. Commercial and domestic refrigerators improved the shelf life of foods such as fresh fruits and salads to be stored safely for longer periods, particularly during warm weather.

Vacuum packing

Vacuum-packing stores food in a vacuum environment, usually in an air-tight bag or bottle. The vacuum environment strips bacteria of oxygen needed for survival, slowing spoiling. Vacuum-packing is commonly used for storing dried fruits to reduce loss of flavor during oxidation.

Freezing

Freezing is also one of the most commonly used processes commercially and domestically for preserving fruit including prepared fruit stuffs which would not have required freezing in their unprepared state. Lowering the temperature below the freezing point of the product stops microorganisms from growing and reduces the activity of enzymes. Fruits are heat treated (blanched) before freezing to eliminate enzymes. Home freezers are held at -10°C, commercial freezers are under -18°C. At this temperature, the growth of micro-organisms is almost stopped.

Pasteurization

Pasteurization is a process of heating a product at a specific temperature for a controlled period of time to destroy the most heat resistant vegetative pathogenic organism. The process is also applied for fruit juices and juice products.

Canning

Canning involves cooking food, sealing it in sterile cans or jars and boiling the containers to kill bacteria.

2.3.2. Importance of Sugar & Preservatives in Fruit Preservation

Sugar is used to preserve fruits, either in syrup with fruit such as apples, pears, peaches, apricots, plums or in crystallized form where the preserved material is cooked in sugar to the point of crystallization and the resultant product is then stored dry. This method is used for the skins of citrus fruit (candied peel) and ginger.

Preservative / food additives can be antimicrobial; which inhibit the growth of bacteria or fungi, including mold or antioxidant; such as oxygen absorbers, which inhibit the oxidation of fruit constituents. Common antimicrobial preservatives include calcium propionate, sodium nitrate, sodium nitrite; sulfites (sulfur dioxide, sodium bisulfate, potassium metabisulfite, etc) and antioxidants which include BHA (Butylated Hydroxy Anisole) and BHT (Butylated Hydroxy Toluene).

Storage

Always store the preserved food in a cool place, at a temperature below 20°C. Keep glass bottles and jars out of light. The storage area has to be dry and with a consistent temperature. Moisture will make tins rust.

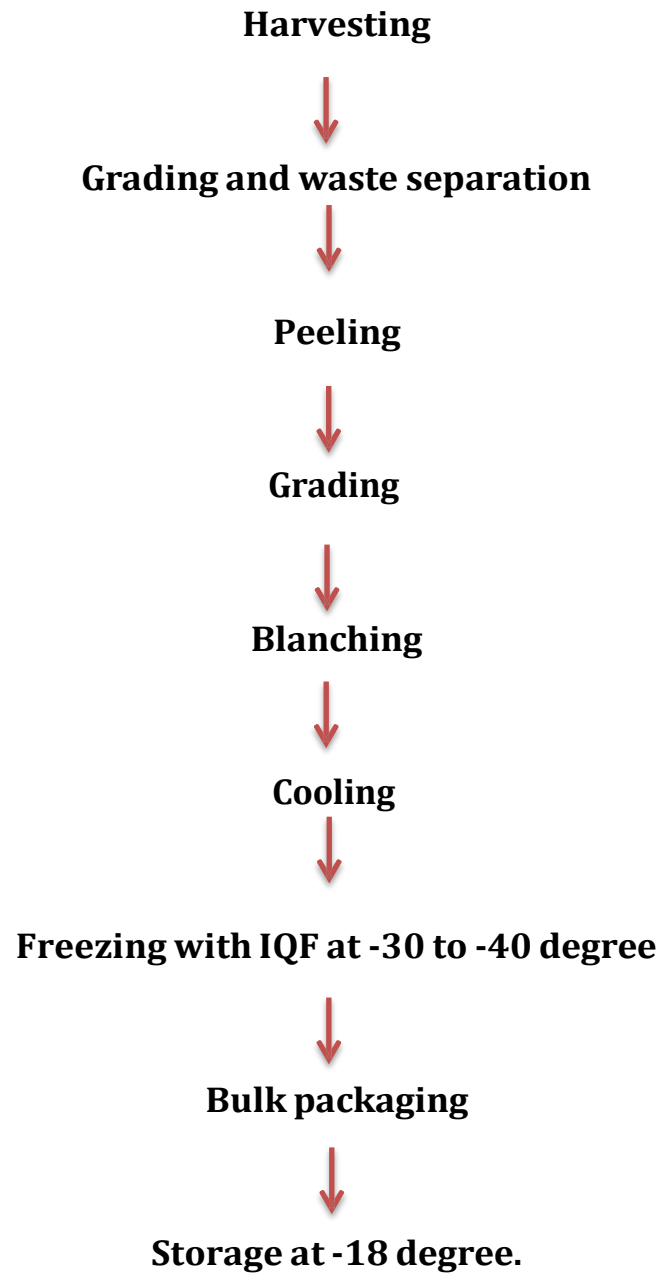
2.4 Raw material for frozen pea processing

- For the processing of Frozen peas, the main raw material is fresh tender pea beans are required.

- Good packaging materials are required for the packaging of processed products.



2.4.1 Flow Chart of Frozen Pee Processing



2.4.2 FPO Specification:

Fruit Products Order -1955, promulgated under Section 3 of the Essential Commodities Act - 1955, aims at regulating sanitary and hygienic conditions in manufacture of fruit, vegetable products. It is mandatory for all manufacturers of fruit, vegetable products to obtain a license under this Order. To ensure good quality products, manufactured under hygienic conditions, the Fruit Product Order lays down the minimum requirements for:

1. Sanitary and hygienic conditions of premises, surrounding and personnel.
2. Water to be used for processing.
3. Machinery and equipment.
4. Product standards.



Besides this, maximum limits of preservatives, additives and contaminants have also been specified for various products. This order is implemented by Ministry of Food Processing Industries through the Directorate of Fruit & Vegetable Preservation at New Delhi. The Directorate has four regional offices located at Delhi. The Directorate has four regional offices located at Delhi, Mumbai, Calcutta and Chennai, as well as sub-offices at Lucknow and Guwahati. The officials of the Directorate undertake frequent inspections of the manufacturing units and draw random samples of products from the manufactures and markets which are

analyzed in the laboratories to test their conformity with the specifications laid under FPO.

The Central Fruit Advisory Committee comprising of the officials of concerned Government Departments, Technical experts, representatives of Central food Technology Research Institute, Bureau of Indian standards, Fruits and Vegetable Products and processing Industry, is responsible for recommending amendments in the Fruit Product Order, In view of the demands of the industry, and the liberalized economic scenario, major amendments were made in FPO during 1997.

FOOD LAWS:

- Prevention of Food Adulteration Act (Ministry of Health) The Act lays down specifications for various food products and is mandatory. The Ministry of Health in 1995 had constituted a Task Force under the chairmanship of Shri E.S. Venkataramaiah, Chief Justice of India (retired). The Task Force recommended that there should be emphasis on good manufacturing practices instead of detection of adulteration and prosecution. It also expresses concern about lack of laboratory equipments and quantified persons. In addition it also suggested that the name of PFA Act be changed to Food Safety Act.
- Agriculture Produce (Grading & Marking) Act (Ministry of Rural Development) This Act is commonly known as AGMARK and is voluntary. The Act lays down the specifications for various agricultural commodities including some processed foods.
- Laws being operated by Bureau of Indian Standards (BIS) BIS is the largest body for formulating standards for various food items. These standards are also voluntary.
- Essential Commodities Act- A number of quality control orders has been issued under Essential Commodities Act such as FPO, MMPO, Meat Product Order and Vegetable Oils Control Order. These orders are mandatory and primarily meant for regulating the hygienic conditions. They need to be clubbed under one order which may call Food Products Order.
- Harmonization of Food Laws- The review of multiple laws is necessary to have a uniform and logical approach for regulating the quality of food. The following action is being taken by various Ministries:-
 - The Ministry of Civil Supplies & Consumer Affairs has brought out a paper for consideration of Committee of Secretaries (COS). The paper recommends that BIS should

formulate standards for all food items in the country. This will be a major step towards harmonization of food laws and is still under consideration of COS for finalization.

➤ The Task Force constituted by the Prime Minister under the chairmanship of Shri Nulsi Wadia has submitted its report which is under the consideration of the Government. The Task Force had advocated promotion of food safety and quality. The Task Force has further made following suggestions:-

- Food Regulation Authority (FRA) is set up to formulate and update food standards for domestic and export market.
- FRA should replace the PFA to conform to international standards. The Task Force has given ten specific recommendations such as provision of storage simplicitor, simplification of sampling procedure, simplification of procedure for nominee, time limit for prosecution, standard methods of analysis to be prescribed, penalty should graded according to the gravity of offences and provision of adequate/infrastructure and laboratories.
- Harmonization of Indian standard with quality norms of Codex and WTO.

2.4.3 Equipments involved

S. No.	Machine and Equipments
1.	Product Feeding Conveyor
2.	Continuous Online Washer
3.	Continuous Online Blancher
4.	Continues Online Pre-Cooler
5.	Sorting / manual inspection conveyor
6.	Product Elevator Conveyor
7.	Vibratory screen conveyor
8.	Linear IQF
9.	Metal detector
10.	Control Panel (common for all above Equipment's)
11.	Packaging Machine
12.	Storage facility



Product Feeding Conveyor: The main purpose of a conveyor system is to move beans from one location to another.



Continuous Online Washer: this machine is used washing peas beans and its peas seed.



Pea podder: Pea Podder is used for peeling the outer skin of pea pods.



Continuous Online Blancher: This machine is used for blanching operations to inactivate enzymatic activities and destroy microorganism



Sorting / manual inspection conveyor: The uses of this conveyor is the manually checking of other foreign particle, metals etc.



Product Elevator Conveyor: A vertical conveyor is an elevator type lift used to move peas from one floor to another. It is often referred to as a freight elevator.



Vibratory screen conveyor: Vibratory screens use a linear screening action to provide rapid and efficient separation of loose bulk material by size. Screens are also often used for dewatering and de-dusting applications in a range of industries.



Linear IQF: This is a technology known as the individually quick-frozen (IQF). IQF is a rapidly frozen technology that does not allow large ice crystals to form in vegetable cells.



Metal detector: it is used for detecting metals particle from the final product.



Control panel (For all the Equipments)



Packaging Machine: This machine is used for packaging frozen pea in various packaging capacity according to market demand.



Cold chamber: The final product (frozen Pea) required to store at ambient temperature (-18°C). This chamber is necessary for store the final product after packaging.



CHAPTER 3

PACKAGING OF FROZEN PEA

3.1 Purpose of packaging

To keep frozen foods safe, follow the cooking methods specified on the package. The safest way to thaw frozen foods is in the refrigerator. The prime purpose of packaging is to keep food from drying out and to preserve nutritive value, flavor, texture, and color. Labels on packages will say if the product is suitable for freezer storage. Good packaging material should have the following characteristics:



- Moisture/vapor-proof or at least moisture resistant.
- Made of food-grade material, i.e. designed to be used for food products.
- Durable and leakproof.
- Doesn't become brittle and crack at low temperatures.
- Resistant to oil, grease, or water.
- Protect foods from off-flavors and odors.
- Easy to fill and seal.
- Easy to mark and store.

3.1.1. Food spoilage

Food spoilage and deterioration is no accident. It is a naturally occurring process. To understand how to maintain the quality of food and prevent spoilage, we need to know what can cause it. Factors that affect food spoilage include:

- **Microorganisms:** Pathogenic microorganisms may grow in foods without any noticeable change in odor, appearance, or taste. Spoilage microorganisms, including some kinds of bacteria, yeasts, and molds, can grow well at temperatures as low as 40°F.
- **Enzymes:** Enzymes, substances naturally present in food, are responsible for the ripening process in fruits and vegetables. Enzymes are responsible for the texture, color, and flavor changes.
- **Air:** Oxidation, a chemical process that produces undesirable changes in color, flavor, and nutrient content, results when air reacts with food components. Vapor-proof packaging that keeps air out helps reduce oxidation problems.
- **Light:** Light exposure could result in color and vitamin loss. Light also may be responsible for the oxidation of fats.
- **Insects, Rodents, Parasites and Other Creatures:** These creatures require food to survive and damage food, making it more vulnerable to further deterioration.
- **Temperature:** Temperature affects storage time, and food deteriorates faster at higher temperatures. Recommended temperatures for storage areas are:
- **Time:** Microorganisms need time to grow and multiply. Other reactions, such as oxidation and enzyme action, also require time to develop. Purchase reasonable quantities, especially of perishable foods, to help avoid long-term storage.

3.1.2. Selection of Packaging Material

Factors to consider include product damage, fines, stickiness, bag opening size, re-closure among other things. In selection of packaging materials for the frozen pea following need to be considered:

3.1.3. Water Vapour Transmission Rate (WVTR)

Knowledge of WVTR of packaging materials and the effect of folding, creasing, crumpling of

	WVTR, g/m ² , 24 hr. 38°C & 90% RH.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	0.9	1.7	3.4	18
Met PET / LDPE (50μ)	0.5	0.6	0.7	0.6
2-sides PVDC coated PET	4.2	3.7	5.9	4.8
2-sides PVDC coated PET/LDPE	2.9	3.6	3.3	3.1

materials on papers and aluminum foil show considerable effect. However, thermoplastic materials are not much affected.

Effect of Folding and Crumpling on the WVTR of Frozen Pea

3.1.4. Gas Transmission Rate

Permeability to gases like oxygen decides the shelf-life of oxygen sensitive fruit items. The oxygen transmission rates (OTR) of some plastic materials and the effect of folding and crumpling.

Effect of Folding and Crumpling on the OTR

	Oxygen transmission rate, ml /m ² , 24 hr. Atm. at 25°C.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	< 1	5.5	16	59
Met PET / LDPE (50μ)	< 1	< 1	2	3.5
2-sides PVDC coated PET	6	6	8	7
2-sides PVDC coated PET/LDPE	7	7	9	11

Besides OTR, permeability to volatiles and flavours is important in candies packaging. Polyolefins have high values, whereas plastics such as polyester, nylons, ethylene vinyl alcohol (EVOH) have good barrier properties for transmission of volatiles. The odour permeability's (for volatiles used in candies) of some materials.

Odour Transmission of Packaging Materials

Packaging Material	Thickness (μ)	Days to Aroma Leakage			
		Vanillin	Menthol	Piperonal	Camphor
BOPP / PE	17/50	6	2	1	13
PET / PE	12/50	2	16	5	< 30
PET / EVOH	12/15	< 30	< 30	30	< 30
OPP / EVOH / PE	18/15/50	30	< 30	27	< 30
PET / EVOH / PE	12/15/50	15	25	27	< 30

3.1.5. Tensile Strength & Elongation

Tensile Strength and Elongation properties of materials need to be studied as their running on high-speed machines should be suitable.

3.1.6. Tear Strength

For a fruit processed product, tear strength is of importance as low tear values are necessary and useful for opening packages by hands.

3.1.7. Heat Seal Strength

The performance of a finished package is determined by the effectiveness of the package seal i.e. the permeability to water vapor, gases and volatiles increase if the seal is not perfect. Thermoplastic films such as polyethylene give excellent heat seals.

3.1.8. Performance Properties

Apart from the above mentioned important properties, a material has to perform well on machines; therefore knowledge of physical properties like slip, stiffness, blocking resistance is also necessary.

Twist retention for twist wrap is also of importance. The initial function of packaging is to protect. However, the emotional role played by packaging is also of importance, especially when the confection is a gift. A sophisticated packaging using deluxe materials is often used as a way of expressing feelings.

Packaging must also be specialized for specific target groups. A different pack size is required for quick impulse buys at petrol stations and roadside shops than for the super markets selling predominantly family sized packs.

3.2 Different Types of Frozen Food packaging

Shrink Film For Frozen pea Packaging

A very high quantum of polymeric materials, besides cellulose and aluminium foil are used for packaging items. Paper board and metal containers are also used for certain applications. Although a variety of packaging materials are available, the ultimate choice of the wrapper depends upon the required shelf-life, performance on the wrapping machine and the cost which is purely based on the segment of the market targeted by the manufacturer. The most common choice of packaging medium is plastic (generally flexible) as it provides the required protection

and preservation, grease resistance, physical strength, machinability and printability. Plastics being lighter in weight are, therefore, the most preferred material for packaging of candies.

There are many changing trends in the packaging of candies. Plastic films and their laminates are increasingly replacing waxed papers due to better properties and aluminium foil laminates due to price and better flex crack property. Depending on the type of package i.e. twist wrap, pillow pack and vertical flow pack or roll pack, the plastic based packaging films used for candies are listed below.

➤ **Polyethylene (PE)**

It is considered to be the backbone of packaging films. Since one of the greatest threats to the integrity of candies products comes from moisture, polyethylene with its low water vapour transmission is of definite interest. Polyethylene films are fairly free of plasticizers and other additives and are quite extensively used as a part of lamination. Its ability to heat seal increases its value.

Low Density Polyethylene (LDPE) is an economical material with low WVTR, however, it has high permeabilities to flavours/volatiles, poor grease resistance and are limp. High-density polyethylene (HDPE) is stiffer, more translucent and has better barrier properties but needs higher temperature for sealing.

Later additions include high molecular weight high-density polyethylene (HM HDPE) and linear low-density polyethylene (LLDPE). HM HDPE is a paper like film with high physical strength and barrier properties, but is less transparent than ordinary polyethylene. HM HDPE is available in twist-wrap grades. Polyethylene films are also suitable for making bags and pouches. A copolymer of polyethylene and poly vinyl alcohol, and EVOH has outstanding gas barrier properties especially when dry.

➤ **Polypropylene**

Polypropylene films are undergoing a growth trend in the candies industry. They have better clarity than polyethylene and enjoy superior machine ability due to stiffness. Lack of good seal ability has been a problem; however, PVDC and vinyl coating have been used to overcome this problem. Some varieties of PP have been specially developed for twist-wrap applications as they have the ability to lock in position after twisting. Pearllised polypropylene with an opal finish and

attractive gloss is also used. Both as laminates and overwraps, PP film is now widely used for all types of candies packaging applications.

➤ **Poly Vinyl Chloride (PVC)**

PVC is a stiff and clear film having low gas transmission rate. PVC can be used as small wraps, bags and pouches. PVC when co-polymerised with polyvinylidene chloride is known as Saran. Since it is a costly material, it is only used as a coating to obtain barrier properties and heat sealability. PVC film is also used for twist wraps, as it has twist retention properties and is excellent on high-speed machines.

➤ **Polyesters (PET) and Polyamide (PA)**

Polyethylene terephthalate film has high tensile strength, gloss and stiffness as well as puncture resistance. It has moderate WVTR, but is a good barrier to volatiles and gases. To provide heat seal property, PET is normally laminated to other substrates. Nylons or polyamides are similar to PET, but have high WVTR.

➤ **Metallised Films**

When polymeric films are metallised there is an improvement in their barrier properties. Metallisation is also used for decorative purposes and aesthetics. The films, which are used for metallisation are PVC, PET, PP and polyamides. To safeguard the interest of the consumer the Standards of Weights & Measures (Packaged Commodities) Rules, have imposed a limit on the weight of the wrapper. Under this, it is essential that in the case of twist wrap and pillow wrap candies, where the weight of the individual pieces is less than 10 grams, the size of the wrapper and the type of wrapping material selected is such that it meets the limit on weight of wrapper, under the above rules.

3.3. Types of Packages used for pea

- **Shrink Film:** Shrink film is one of the most popular forms of frozen pea packaging. It is used on millions of packaging lines across the globe, including those of the largest food packaging companies in the world.

- **Cardboard Packaging:** Chipboard commonly thought to be cardboard is ubiquitous in the packaging of a frozen pea. Boxes made from chipboard are often used for packaging pies, veggies, pizza, cakes, and various other types of frozen food products. Chipboard boxes are sturdy, durable, and easy to shrink wrap.
- **IQF Polyethylene:** IQF stands for “individually quick frozen,” an action that freezes food extremely fast, so there is little to no damage to the cell structure of the frozen food. IQF polyethylene wrapped food moves through a blast freezer around 40 degrees under zero Fahrenheit.
- **Wax Coated Cardboard:** Wax coated cardboard is yet another highly popular form of frozen food packaging. Specifically for frozen foods of which the container itself is to be heated. Now a days various wax coated cardboard are used for pea packaging.
- **Glass:** Glass containers made from specific food-grade glass formulations are used for packaging for peas and other frozen products applications; particularly in Asian countries.it is specifically made to save for future use in glass containers.
- **Flexible Bags:** Flexible bags are a type of flexible packaging supply made for packaging food. When dealing with frozen foods, the most common flexible bags used are pouches made from food-grade plastics, foils, or other food-safe materials.

3.3.1 Quality considerations during packing

Quality control of packed products is the last time the fruit is checked before reaching the customer. Documented checking of the packages entails:

- Weight of the package;
- Weight of the fruit;
- Arrangement of the fruit (in glove boxes);
- Uniformity of the fruit;
- Damage to the fruit;

- Defects; and
- Moisture content.

The surrounding area is also checked:

- Cleanliness of the conveyer belts;
- Calibration of the scales (automatic or manual);
- Writing on the packages;
- Satisfactory working of the metal detector (installed on every retail packing line);
- Repackaging installations and marking; and
- Qualification for international standards such as ISO and HACCP

3.4 Future Trends

The demand for plastic bags for the packaging of frozen food is the latest trend in the global frozen food packaging market. The availability of plastic bags in different shapes and sizes and the benefits offered by them, such as the ability to tolerate high temperatures, is fuelling the demand for plastic bags for the packaging of frozen food.

The market of frozen food packaging was valued at \$ 41.53 million in 2019 and is projected to reach a value of \$ 56.2 million by 2025, at a CAGR of 5.18% over the forecast period of 2020-2025



CHAPTER 4

FOOD SAFETY REGULATIONS AND STANDARDS OF FROZEN PEA

4.1 Frozen Vegetables (2.3.38)

1. Frozen Vegetables means the product frozen in blocks or individually quick frozen and offered for direct consumption, if required. Frozen vegetables are prepared from sound, clean vegetables of suitable maturity, free from insect or fungal, which are washed, sufficiently blanched to inactivate enzymes and are subjected to a freezing process in appropriate equipment. Freezing operation shall not be regarded as complete unless and until the product temperature has reached (minus) - 18°C at the thermal center after thermal stabilization. It may be prepared in any style appropriate for the respective vegetable in normal culinary preparation. It may contain salt, nutritive sweeteners, milk solids, spices and condiments and any other ingredient suitable to the product.

2. It shall have normal colour characteristic of the individual Vegetable. It shall have taste & flavour characteristic of the kind & variety of the vegetable used & shall be free from sand, grit & other foreign matter.

3. The product shall test negative for peroxidase. The product shall conform to the microbiological requirements

given below :

Frozen fruits and vegetables products Total plate count not more than 40,000 / gm

4.2 Food Safety

Part I - General Hygienic and Sanitary practices to be followed by Petty Food Business Operators applying for Registration

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.

4.3 Labelling Standards

Labeling requirements for packaged food products as laid down in the Part VII of the Prevention of Food Adulteration (PFA) Rules, 1955, and the Standards of Weights and Measures (Packaged Commodities) Rules of 1977, require that the labels contain the following information:

1. Name, trade name or description
2. Name of ingredients used in the product in descending order of their composition by weight or volume

3. 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)
4. Nutritional Information
5. Information Relating to Food Additives, Colors and Flavors
6. Instructions for Use
7. Veg or Non-Veg Symbol
8. Net weight, number or volume of contents
9. Distinctive batch, lot or code number
10. Month and year of manufacture and packaging
11. Month and year by which the product is best consumed
12. Maximum retail price

4.3.1 Wherever applicable, the product label also must contain the following

The purpose of irradiation and license number in case of irradiated food. Extraneous addition of coloring material. Non-vegetarian food – any food which contains whole or part of any animal including birds, fresh water or marine animals, eggs or product of any animal origin as an ingredient, not including milk or milk products – must have a symbol of a brown color-filled circle inside a brown square outline prominently displayed on the package, contrasting against the background on the display label in close proximity to the name or brand name of the food.

Vegetarian food must have a similar symbol of green color-filled circle inside a square with a green outline prominently displayed.

All declarations may be: Printed in English or Hindi on a label securely affixed to the package, or Made on an additional wrapper containing the imported package, or Printed on the package itself, or May be made on a card or tape affixed firmly to the package and bearing the required information prior to customs clearance.

Exporters should review the Chapter 2 of the “FSS (Packaging and Labeling) Regulation 2011” and the Compendium of Food Safety and Standards (Packaging and Labeling) Regulation before designing labels for products to be exported to India. FSSAI revised the labeling Regulation and

a draft notification to that effect was published on April 11, 2018, inviting comments from WTO member countries and the comments received are under review and the publication date remains unknown.

According to the FSS Packaging and Labeling Regulation 2011, “prepackaged” or “pre packed food” including multi-piece packages, should carry mandatory information on the label.



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