PEA PROCESSING

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India's diverse climate ensures availability of all varieties of fresh fruits and vegetables. It ranks second in fruits and vegetables production in the world, after China. As per Indian Horticulture Database, India produced 162.89 million MT of vegetables during 2013-14, Out of which, *Pisum sativum* (commonly known as peas) is one of the major vegetable crop contributes approximately 2.5% (3.86 million MT) share of the total vegetable production and 4.6% of the total vegetable producing area in India (NHB, 2014). According to FAO statistics, the worldwide green pea production in 2012 was about 18.5 million tons. Green pea acreage ranks fourth among the vegetables. The main producers of this product are respectively China, India, the United States, France, and Egypt (FAO, 2012). Peas are highly nutritive and contain high content of digestible protein (7.2 g/ 100g), carbohydrate (15.8 g), Vitamin-C (9 mg), phosphorus (139 mg), minerals and also is low in fat, high in fiber, and has no cholesterol so that it has been used in the human diet for a long time. The fruit is a typical pod containing four to nine seeds. The length of pods is 5 to 9 cm and shape is inflated, but they are available only during winter season. Green peas are available for around 5 months during winter season only. The immature/green peas are used as a vegetable, fresh, frozen or canned; varieties of the species typically called field peas are grown to produce dry peas like the split pea shelled from the matured pod. They are used for making vegetables, as additives in certain vegetables and for making several snack preparations. But the shelf-life of green peas is not more than 3-4 days.

In Indian context Uttar Pradesh, Bihar, Jharkhand, Punjab, Haryana, Madhya Pradesh and Himachal Pradesh are the major pea producing states where peas are grown and farmers mostly sold it in local mandies at very low price of 10-15 Rs/kg depending upon the quality. Peas are highly perishable, fresh unshelled peas may be kept for two weeks at 0°C with 90-95 % RH whereas processed peas *i.e* shelled frozen peas can be stored at -23 to -18°C for one year when packed in gas tight packaging or it can also be dried for selling it as dry pea or mutter. Due to its high moisture content, it cannot be stored well for a long period of time and must be subjected to

some method of preservation such as, freezing, canning, cold storage or drying in order to make it available for later consumption (Chauhan and Srivastava, 2009).

Two uses of the pea crop with associated requirements will be considered. The first is the conventional view of the pea as a whole food (e.g. as dried/canned/frozen/processed peas) and the second is a more radical approach, with the peas undergoing further processing to provide a range of ingredients (i.e. protein, starch, fibre) for use by the food manufacturer.

PEAS AS A WHOLE FOOD:

- Dried peas
- Frozen peas
- Canned peas

❖ **Dried green Peas**

Drying is one of the oldest methods and most traditional methods. By reducing the moisture up to a certain level in fruits and vegetables, the microbiological spoilage and deteriorative chemical reactions are greatly minimized. In addition to preservation, drying also lowers the cost of storage, packaging and transportation by reducing weight and volume of the final product (Doymaz and Kocayigit, 2011). Drying can be an appropriate method for preserving green peas. In view of their demand round the year, they can be preserved with the help of drying/dehydration process and sold during off-season. It is also possible to produce powder which has got good market prospects. Dried green peas are desirable due to their longer shelf life, convenience for transport and handling, and also for the lower cost of all processes such as packaging, storage, and transportation due to the reduced weight and volume of the final dried product. To fulfill the demand of dried green peas the traditional methods like sun drying are available (Waruthaithanasan, 2000). For industrial production of dried peas the process flow chart is given below in fig no. 1

Fresh, sound and green pea pods are thoroughly washed in water and then pea seeds are separated and cleaned with the help of pea podder. Then they are pricked as pricking facilitates quick and uniform drying of peas. Then they are blanched and sulphited to retain colour, taste and texture in the final product. Blanched peas are then dried in a drier wherein moisture is reduced to 7-8%. Drying time is around 3 hours. Finally dried peas are graded and packed. On an average, the process and weight loss is 75%.

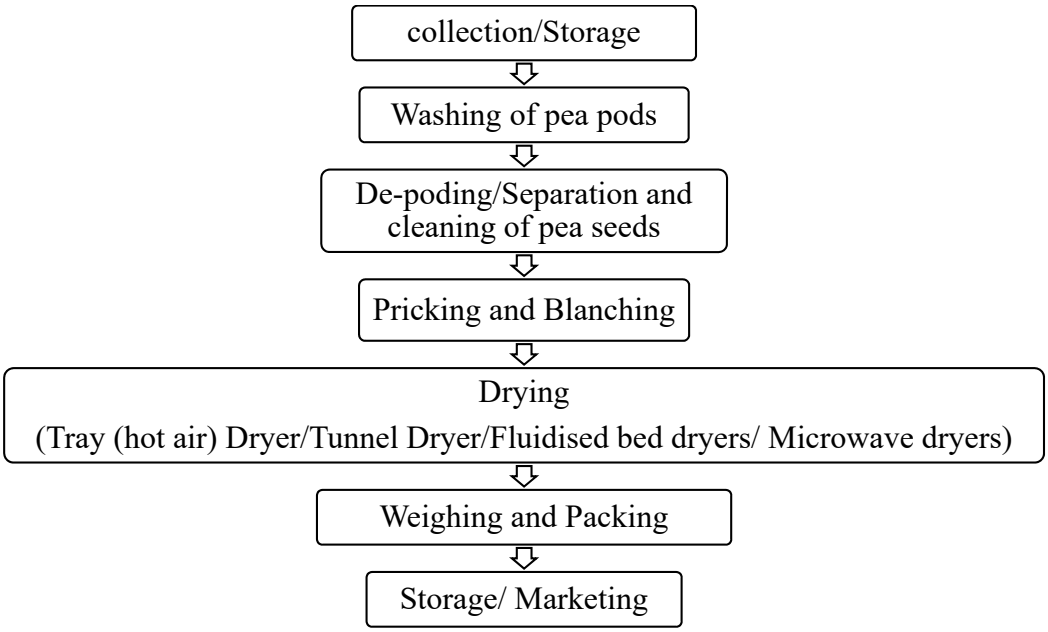


Fig. 1: Process flow chart for dried peas

Availability of technical know-how, Compliances and quality standards

CSIR-CFTRI, Mysore, has successfully developed the technical know-how. Compliance with FPO and PFA Act is mandatory. BIS has standardized quality parameters vide IS 4626:1968 and it is advisable to adhere to it.

❖ **Frozen pea: Process and Technology**

Freezing is an effective mean of preservation that maintains the quality of foods almost to fresh product. Although freezing is one of the easiest and least time-consuming methods, it is not as economical as canning; but it retains more nutrients in the food if properly done. Most vegetables retain their natural color, flavor, and texture better when frozen than if other methods of food preservation are used. Natural enzymes in foods cause changes in the above parameters, and freezing delays this activity, though it does not stop it. Thus, to prevent further enzyme activity, vegetables need to be blanched in boiling water or steamed for a brief period of time before freezing. Freezing does not destroy spoilage organisms, such as bacteria, molds, and yeasts; it merely retards their growth temporarily. Once the food is thawed, microorganisms may continue to grow. During the storage of frozen vegetables, moisture evaporation can render them dry and tough, with the development of off-flavors. To solve this problem, two options are available: provide high relative humidity throughout the storage period; and/or use moisture vapor-proof or resistant packaging.

Frozen peas is the food in “package” form, prepared from the succulent seed of the pea plant of the species *Pisum sativum L*. It is blanched, drained, and preserved by freezing in such a way that the range of temperature of maximum crystallization is passed quickly. The freezing process should not be regarded as complete until the product temperature has reached -18 ^{o}C (0^{o}F) or lower at the thermal center, after thermal stabilization. The process of freezing involves freezing the water in the cellular spaces of fruit tissue. As this water freezes it expands forming ice crystals that rupture cell walls resulting in softer texture once fruit is thawed. To reduce cellular damage chill and freeze fruit quickly so that the ice crystals formed are smaller.

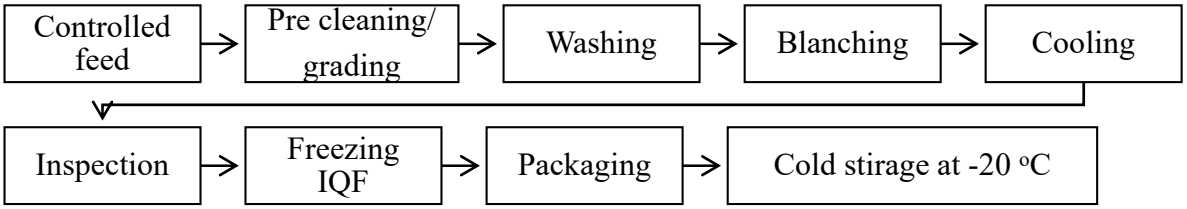
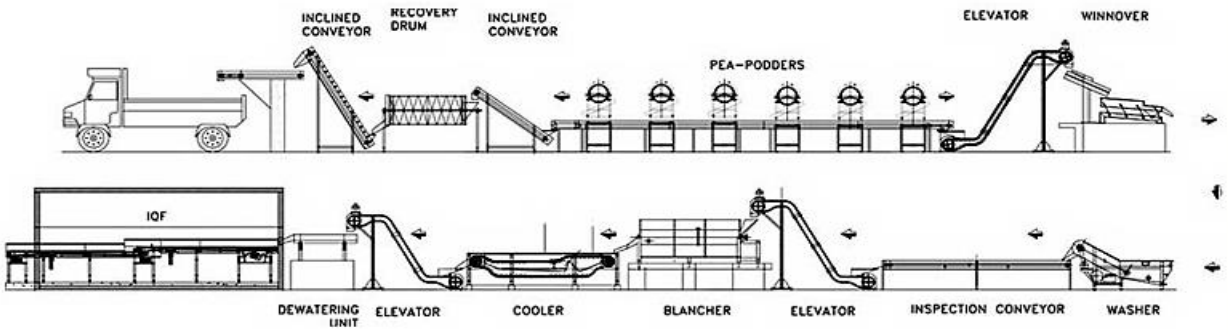


Fig 2: Process flow of individual quick freezing (IQF)

Technology: The technology of IQF involves three sub sections:

- **Processing equipments** involves Pea Podder, cross collection conveyor for peas, waste collection conveyor, bucket elevator, Winnower, washer, Inspection Conveyor, Pea blancher, After cooler, dewatering conveyor, grain recovery system and potato dicer etc.
- **Freezing equipment** is with Polyethylene product belting. High efficiency SS coils, air foil fans. It consists of Conveyor System, Defrost system, freezer enclosure, Belt washer, electrical control panel, Dual Defrost Mechanism and refrigeration machine etc.,
- **Auxiliary Equipment** consists of Boiler, Reverse Osmosis plant, Laboratory Equipment, Fire Fighting equipment, ETP, Electrical infrastructure and accessories etc

Line diagram for Freezing (IQF) process



Canned peas: Canning process

Canning refers heating food stuff in hermetically sealed containers for a specific time at specific temperature to eliminate microbial pathogens that endanger public health and micro-organisms as well as enzymes that deteriorate food during storage. The canning of fruits and vegetables is carried out in the season when they are available in plenty. The canned products are then sold in the off season for getting better returns and to assure availability of fruits and vegetables throughout the year at reasonable prices Vegetables must be canned in a pressure canner for the correct time and pressure (PSI) to ensure their safety. If not canned correctly, these low acid foods may contain the deadly botulism toxin. The important unit operations in canning are discussed below and process flow chart depicted in Figure No 3.

Blanching: Blanching (scalding vegetables in boiling water or live steam for a short time) is done to inactivate the enzymatic activity, which can cause loss of flavor, color and texture. Blanching also cleanses the surface of dirt and organisms, brightens the color and helps retard loss of vitamins. It also wilts or softens vegetables and makes them easier to pack. Blanching time is crucial and varies with the vegetable and size.

Syruping or brining: The cans are filled with hot brine (2-10%) for vegetables. The purpose of syruping or brining is to help in transfer of heat within the food pieces during processing. It also improves the taste of the canned product, fill up the inter-space between the fruit or vegetables in the can. The syrup or brine is added to the can at a temperature of 79-82 ºC, leaving 0.3-0.47cm head space either manually or in automatic machines. In automatic machines, the prepared syrup or brine is drawn into the cans through a horizontal pipe having a row of small holes. The cans travel on a continuous belt in an inclined position below the syrup or brine pipe and get filled, the overflowing excess syrup is pumped back into the syrup tank by a centrifugal pump.

Exhausting: Exhausting is a unit operation occluded gases/ air from the contents in the can is removed before sealing. Normally, exhausting is carried out by passing the cans through exhaust box until the temperature at the centre of the can reaches at least 79.0° C. The purpose of exhausting and creation of vacuum is to create an anaerobic environment in the can that would inhibit microbial spoilage. The removal of air from the contents also reduces the risk of corrosion and pin holing of the tin plate and discoloration of can contents.

Heat processing: The cans after sealing are immediately transferred to the heating retorts to achieve sterilization of contents. Heat processing consists of heating cans to a predetermined

time and temperature of heating to eliminate all possibilities of microbial spoilage. Over cooking should be avoided as it spoils the texture, flavour and appearance of the product. Generally all fruits and acid vegetables can be processed satisfactorily in boiling water (100 ºC) as the presence of acid retards the growth of bacteria and their spores. While non-acidic vegetables (except tomato and rhubarb) are processed at higher temperatures of about 115-121 ºC under steam pressure. It needs to be ensured that required temperature reach the centre of the can. The temperature at the centre of the can should be maintained for sufficiently long period to destroy spores of more heat resistant bacteria.

Type of food	**Head space**	**Dial-gauge Pressure in Canner**	**Weighted-gauge Pressure in Canner**
Green or Shelled and Fresh Peas	1 inch	40 minutes 11 PSI	40 minutes 15 PSI
Shelled and Dried Peas	1 inch	Pints – 75 min. 11 PSI Quarts – 90 min. 11 PSI	Pints – 75 minutes 15 PSI Quarts – 90 minutes 15 PSI

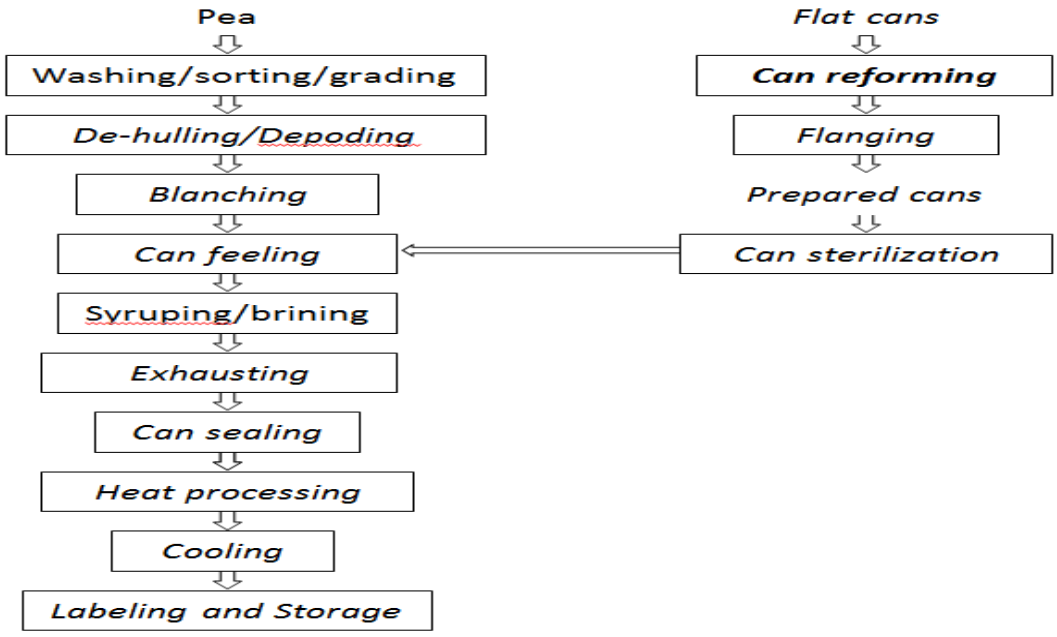


Fig 3: process flow chart for canning of peas

PEAS AS A SOURCE OF FOOD INGREDIENTS

Peas contain a variety of compounds which, if they could be separated, are of potential use to food manufacturers as ingredients of processed foods. Researchers have found that pea/legume flours can be used to fortify foods that have typically been fortified with wheat and other traditional flours. Depending on the variety and the way in which they are processed. Pea

flour is now used widely in the processed meat industry where heat and mechanical stability are important. It has also had excellent results in canned foods, cooked sausages, pâtés, and other items. Pea starch has become popular as a thickening agent in soups, sauces, and many other products. Until recently, the main limitation of the use of pea starch has been the relatively high cost of its isolation.

The technology used for soyabeans processing can also be applied, with some modifications to peas (Figure 4). The modifications for pea processing include omission of preliminary defatting stages and incorporation of screening and washing procedures to effect purification of the starch fraction. In this way, peas can be processed into four ingredients: protein isolate (or proteinate), starch, and two fibre fractions (derived from either hull or cell-wall material). There is, however, an alternative to this wet-processing procedure which is applicable to peas and other pulses because of their composition and internal organization. As storage protein is localized within discrete protein bodies which range in diameter up to approximately 3 μm (Weber and Neumann, 1980) and the starch is located in granules, generally of much larger size, theoretically, it should be possible to separate these components on the basis of size. It is this size differential that is exploited by the alternative technology of air classification.

Essentially the process involves the suspension of a finely ground flour in a current of air and separation of constituent particles (e.g. protein bodies and starch granules) on the basis of mass, density and shape by centrifugal and centripetal forces produced within the air classifier (Sosulski, 1983). Two fractions are collected, a fine (protein) fraction and a coarse (starch) fraction the cut-point for fractionation being adjustable by controls on the classifier (Wright ***et al,*** 1984). Normally the coarse fraction obtained after classification is remilled and subjected to a further classifying step to increase the overall yield of protein in the fine fraction. The two fine fractions are combined to give the protein concentrate (Figure 5). This is roughly equivalent to a soya concentrate, although its overall functionality should be superior as the protein is still in its native state inside the protein bodies and, unlike its soya analogue, has not been solubilized or subjected to denaturing solvents or heat during processing. The dry-processing operation yields fibre (hulls removed prior to milling), a protein concentrate and a starch fraction. Interest is growing in the air-classification process simply because it is a straightforward operation involving no water and therefore no appreciable drying costs or effluent disposal problems.

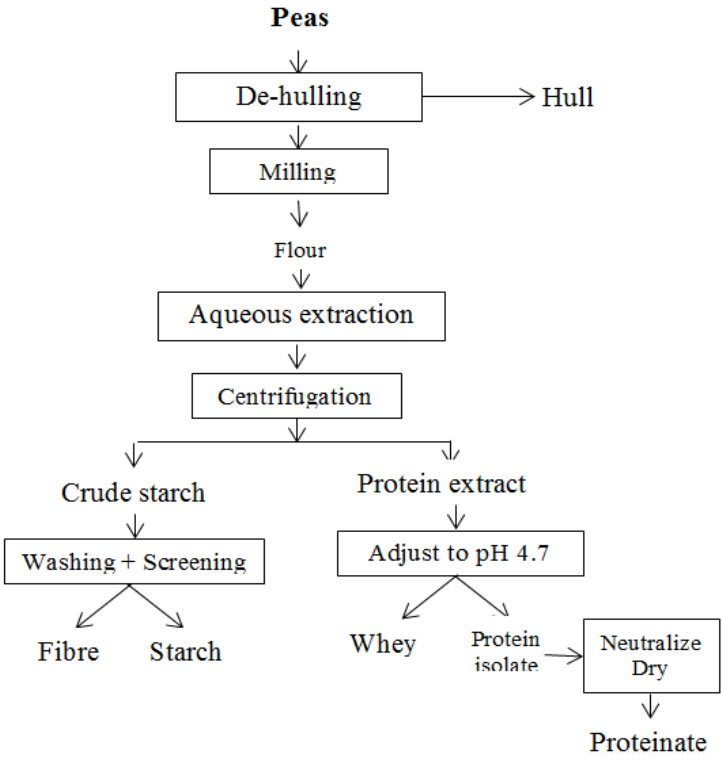


Fig 4: Wet Processing of pea for food ingredient

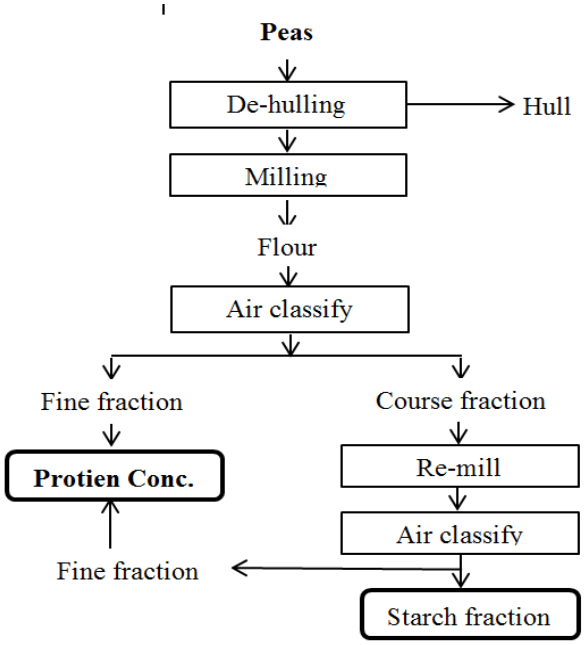


Fig 5: Dry Processing (Air classification) of pea for food ingredient

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