

Basic operations in fruits and vegetable processing

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Hundreds of fruits and vegetables types are grown in all parts of India. Fresh fruit and vegetable reach small scale fruits vegetables suppliers, they are then sent to local markets as well as fruits and vegetables exporters. Last decades have seen the number of Indian fruit vegetables suppliers and fruits vegetables exporters rising to an all time high. Especially there has been a steep rise in the number of vegetable exporters.

The total production of fruits and vegetables in the world is around 370 MT. India ranks second in the world with an annual output of 32 MT. While there are almost 180 families of fruits that are grown all over the world, citrus fruits constitute around 20% of world's total fruit production. Major Indian fruits consist of mango, banana, citrus fruits, apple, guava, papaya, pineapple and grapes. The fruits are processed into various products such as fruit juices & concentrates, canned fruit, dehydrated fruit, jams & jellies etc.

India with its current production of around 32 million MT of fruit, accounts for about 8% of the world's fruit production. The diverse agro-climatic zones in the country make it possible to grow almost all varieties of fresh fruits and vegetables in India. The fruit production in India has recorded a growth rate of 3.9%, whereas the fruit processing sector has grown at about 20% per annum. However, the growth rates have been extensively higher for frozen fruits & vegetables (121%) and dehydrated fruits & vegetables (24%). There exist over 4000 fruit processing units in India with an aggregate capacity of more than 12 lakh MT (less than 4% of total fruits produced). It is estimated that around 20% of the production of processed fruits is meant for exports, the rest caters to the defense, institutional sectors and household consumption, Mango and mango-based products constitute 50% of exports.

The fruit and vegetable processing industry in India is highly decentralized. A large number of units are in the cottage/home scale and small scale sector, having small capacities up to 250 tonnes/annum. In general, fruit and vegetable processing offers good opportunities for small-scale businesses. This is because:

- Raw materials are readily available (often in surplus)
- Most equipment is reasonably affordable and
- The products, if chosen correctly, have a good demand and can be profitable.

Processing fruits and vegetables is intended to do two things:

1. To preserve them by slowing down the natural processes of decay caused by microorganisms, enzymes in the food, or other factors such as heat, moisture and sunlight.
2. To change them into different foods, which are attractive and in demand by consumers.

Processors must choose their products very carefully. It is not enough to assume that processing can be a successful business simply because there is plenty of cheap fruit available. There must be a good demand for the processed food and this must be clearly identified before a business is set up. The best types of products for small-scale production are those that have a high 'added-value' as well as a good demand. A high added value means that cheap raw materials can be

processed into relatively expensive products. It also means that this can be done at a small scale of processing using equipment that is affordable.

Together with GHP, GMP and proper management, processors (and retailers) should be aware of new laws that are coming in India that relate to food safety. These are based on standards produced by an organization known as the “Codex Alimentarius Commission” and they apply internationally. Some manufacturers of processed fruits and vegetables already export their products. The requirements of new food safety laws can be met using good manufacturing and hygienic practices, and a technique known as the Hazard Analysis Critical Control Point (HACCP) system. The vegetables must be grown following sanitary practices, including harvesting and post-harvest handling.

Characteristics of fruits and vegetables

Although there are many similarities between fruits and vegetables, there is one important difference that affects the way that these two types of crop are processed: *Most fruits are more acidic than most vegetables!* This is important because food poisoning bacteria cannot grow in more acidic fruit products. Even if a processor makes a mistake in processing, fruit products cannot cause food poisoning. If the mistake allows moulds and yeasts to grow, they produce obvious signs of spoilage, which stops consumers eating the food. If a contaminated product is eaten, yeasts and moulds rarely cause food poisoning.

Vegetables are less acidic than fruits and food poisoning bacteria are able to grow in many vegetable products. Some types of bacteria produce toxins in the food without signs of spoilage and consumers may be unaware of the contamination and eat the toxic food. It is therefore especially important that vegetable processors carefully follow the correct processing methods and pay strict attention to hygiene and sanitation to reduce the risk of harming their customers.

After harvest, micro-organisms and naturally occurring enzymes rapidly change the colour, flavour and texture of fruits and vegetables. There is a limited amount of time available before they must be processed. Other problems that face fruit and vegetable processors include:

- Most fruits and vegetables are seasonal. For a business to operate throughout the year, crops must be either part-processed for temporary storage, or a succession of crops must be processed as they come into season.
- Raw materials have to be bought during a relatively short harvest period when prices are lowest. There is therefore the need to have sufficient cash available to buy a year’s supply of crop.

Production and Processing Facilities

Because fresh fruits and vegetables spoil rapidly, it is better to locate a processing unit in the area where they are grown. This reduces transport costs and also reduces the amount of handling, which means that crops are more likely to be in good condition when they arrive at the processing unit.

Processed fruit and vegetable products are likely to be sold in different markets and there is less reason to locate the unit near to customers. An ideal site is close to a fruit and vegetable growing area and near to a main road leading to an urban centre.

The location of the processing unit must be able to provide:

- Reliable electricity
- Adequate potable water.
- Access for workers and staff (public transport, distance down an access road)
- Good quality roads (dry season only, potholes that may cause damage to glass containers)
- Other facilities (e.g. schools, medical facilities, shops)

The building

All fruit and vegetable processing should have a hygienically designed and easily cleaned building to prevent contamination of products. Within the building, food should move between different stages in a process without the paths crossing. This reduces the risk of contaminating finished products by incoming, often dirty, crops, as well as reducing the likelihood of accidents or of operators getting in each other's way. There should be enough space for separate storage of raw materials, away from ingredients, packaging materials and finished products.

Water supply and sanitation

Potable water is essential in all fruit and vegetable processing, as an ingredient in some products and for washing down equipment. An adequate supply of potable water should be available from taps in the processing room. If there is no mains supply, or if the mains supply is unreliable or contaminated, water from boreholes is likely to be relatively free from microorganisms, but it may be contaminated with sand.

Potable water is drinking water that is wholesome and clean and does not cause illness. It is free from any micro-organisms and parasites and from any substances that in numbers and concentrations constitute a potential danger to human health.

If necessary, water should be treated to remove micro-organisms. There are four ways of treating water at a small scale: by filtration; heating; ultra-violet light or chemical sterilants, such as hypochlorite (also known as 'chlorine solution' or 'bleach'). Micro-organisms can also be destroyed by boiling water for 10-15 minutes, but this is not realistic for large volumes because of the high fuel costs and the time required. Ultra-violet light destroys micro-organisms in water and commercial treatment units are suitable for processors that use a lot of water.

Production Planning - Raw Materials/Ingredients

Having decided how much product to make, a processor needs to calculate how much fruit or vegetables to buy. This is based on the recipe for the product and the likely levels of wastage/ losses during the process. Losses arise from peeling, spoiled raw materials, and spillage during filling into packs, or from food that sticks to equipment. Typical losses are shown in Slide, but it is important to measure it in each process so that accurate figures can be used in the calculations.

The process flow diagram of various processes has been shown. The common aspect is cleaning; sorting, peeling etc, but each product requires some unique operations. If the process involves removing water (by drying or boiling), the amount of final product is calculated by knowing the solids content before and after processing as shown in the slide presentation.

Packaging

When selecting packaging materials, the processor should consider:

- technical requirements of the product (for protection against light, air, moisture etc.)
- the design (for promotional and marketing requirements) and
- the relative cost and availability of different types of packaging.

New glass jars, bottles or plastics can be used depending on the type of product.

Calculate number of containers and boxes needed for a production run. This is a simple calculation.

Record Keeping

There are four sets of records that should be kept by the owner of a small fruit and vegetable processing unit:

1. Financial records;
2. Production records;
3. Quality assurance records;
4. Sales records.

Dried Products

Some vegetables are blanched before drying to prevent colour changes and to reduce the number of contaminating micro-organisms. In hot water blanching, vegetables are immersed in boiling water in a wire basket. The bright green colour of some vegetables can be protected using 1% sodium bicarbonate in the blancher water and the texture of soft vegetables can be protected using a 2% calcium chloride solution. For steam blanching, vegetables are placed in a strainer over a pan of boiling water. Steaming takes longer than water blanching, but fewer nutrients are lost. Blanching time and general process flow chart is shown in the slide.

Chutneys

Chutneys are made by boiling vegetables or sour fruits with sugar, spices and sometimes vinegar if there is little acid in the fruit. If a dark product is required, sugar is added before heating, or it is added towards the end of boiling for a lighter product. The high sugar content and acid preserves the chutney after a jar has been opened.

Equipment

The throughput figure allows the processor to decide the size and/or number of pieces of equipment that are required. In doing this, decisions need to be taken on the benefits of employing a larger number of workers or buying a machine to do a particular job. Equipment for boiling, filling and drying are shown in slides.

Hygiene and Sanitation

- Raw material should be suitable for its intended purpose
- Processing facility should be in sanitary condition
- Equipment (must be cleanable and kept clean)
- Persons handling food and their responsibilities to protect it from contamination
- Building design and construction including water supplies, drainage, toilet facilities, wash-hand basins, provision of first aid facilities, places to store clothing, facilities for washing food and equipment, lighting, ventilation, protection against infestation by rats and insects and removal of wastes.

In conclusion, the excess fruits and vegetables can be processed into high quality products.