

# POST HARVEST





## *Vegetables Processing Toolkits*



### **POST HARVEST**

#### **1.- Vegetable processing - general information**

The vegetables may be marketed in different ways. The "in-natura" form is the simplest one for commercialization, but it requires fast consumption.

The post-harvesting treatments and the different processings are targeted to the increase of the vegetable conservation period, besides aggregating value to the products.

The objective of the whole technological process used for the conservation of vegetables is to paralyze and/or delay the senescence of the vegetal matter.

In other words, to reduce its breathing rate to the utmost. However, the maturation stage and the physical conditions of the vegetable should be taken into account at the harvesting moment.

In addition, the time between harvesting and the vegetable preparation should be the shortest as possible.

Such cares are necessary for reducing or avoiding the deterioration by microorganisms, therefore obtaining a better-qualified product at the end of the process.

The vegetables are products sensible to physical damages. Therefore, their harvesting should be manually made, by avoiding any shock type with the vegetable.

These physical damages are potential areas for the development of microorganisms and for occurrence of both chemical and enzymatic reactions, which will cause accelerated deterioration of the vegetal tissue.

The stages of harvesting and transport should be accomplished with the maximum care.

The Primary processing involves several phases designed to select and remove inedible fractions from the vegetables, as well as to cleaning them.

In the Secondary processing, the cleaned vegetables from the first process are used. The secondary processing of vegetables includes the following phases: classification, cutting, blanching, the processing itself (frozen, drying...), packaging and storage.

**Drying.** By removing the water from the vegetable tissue, the dehydration process prolongs the shelf-life of these vegetables. The obtained product may be rehydrated before its consumption.

**Frozen.** In the freezing process, the water available in the food is reduced. This way, the microbial growth is hindered, therefore the probability for occurrence of chemical and enzymatic reactions causing deterioration in the product are reduced. The freezing process

prolongs the shelf-life of the vegetables. The obtained product should be thawed before being consumed.

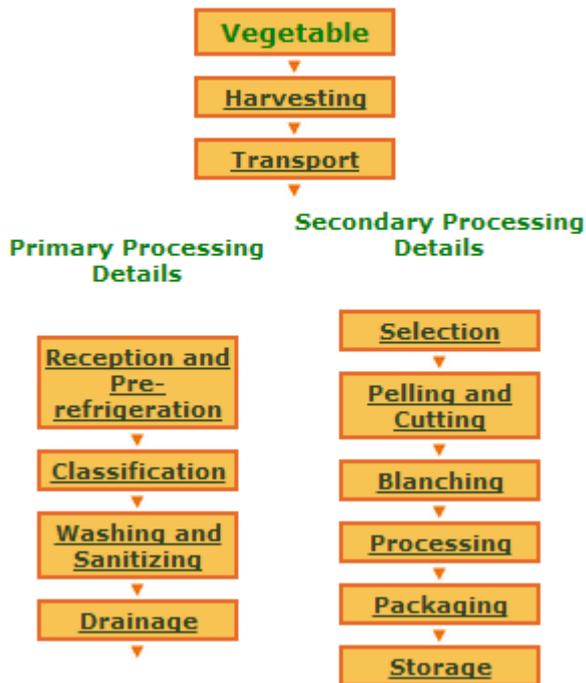
Projects and small businesses may involve just one or several activities throughout the chain, from crop growing to the production of edible products.

Some small business activities are set up in order to clean, cut and packing the vegetables. These businesses can be successful as there is very little need for equipment. However, as with all businesses, there must be a rigorous quality control and there must be a clear demand for the product, too.

## 2.- The post-harvest Vegetable System

### Vegetable Processing details

#### Post-Harvest primary Treatment



### 2.1-Post-Harvest primary Treatment

#### Post-Harvest primary Treatment



## **A.-Harvesting**

The vegetable harvesting should be accomplished when they reach the physiologic maturation point.

However, the vegetable should be harvested at the maturation stage that is more adapted to processing.

It should not show physical damages (mechanical) nor contamination and deterioration points.

To keep the quality of the product, the harvest should be accomplished at the coolest moments of the day, usually at morning, as avoiding the harvesting after heavy rains.

The harvest of the onion should be made when 40 to 70% leaves exhibit yellowish coloration or are dry.

The garlic should be harvested when around 2/3 of their leaves show yellowish aspect and/or they are already dry.

The carrot and onion should be harvested when they reach the typical development of the cultivar. The green beans reach the maximum development before they become fibrous.

The broccoli should exhibit accentuated green coloration, few fibrousness, as well as developed and very closed buds, and slightly accentuated aroma and flavor.

The manual harvesting is the most used method and provides better selection of the raw materials concerning to maturity. In addition, it causes less physical damages, require low capital investment and its return is easily increased.

The mechanical harvesting is not widely used, since the machines are rarely selective and tend to damaging the products. It is recommended for those vegetables that are more resistant to physical damages.

The advantages are: higher return and speed, as well as reduced labor.

The harvested vegetables are placed into bags, wallets, baskets, boxes or buckets.

These should be as clean as possible and should present flat surface to avoid contamination problems and physical injuries.

## **B.-Transport**

The transportation from the field to the industry should be as fast as possible in order to minimize the losses due to the deterioration caused by high temperatures, such as excessive water loss and increased metabolic activity.

The transport of the perishable products may lead to several problems concerning to the quality of the raw material, such as: injuries due to squashing (compression of the first layers or the piling up of boxes containing a load above their capacity); wounds by abrasion with rough surfaces, and mechanical shocks against the surface.

Some cares should be taken, such as: to avoid abrupt movements and falling of the boxes; to control the speed when transporting vegetables or using the suspension systems; to avoid bad-conditioned highways; and to evaluate the surfaces of the containers, and guarantee their cleaning. The transport should be accomplished during cooler periods in the day.

The arrangement of the vegetables for transporting should be made, by prioritizing a good air circulation among the products.

## 2.2-Primary processing

### Primary Processing Details



### A.-Reception and Pre-refrigeration

When arriving to the industry, the vegetables are weighed. The unloading of the products should be preferably accomplished in rolling belts with water spraying nozzles or in tanks with water and ice, when the vegetables are broccoli, cauliflower, green bean and carrot.

Every impact or more abrupt mechanical shock should be avoided. The addition of chlorine (40 to 200 mg/L) into water inside the tanks is recommended in order to reduce the microbial load that the vegetables carry from the field.

The pre-refrigeration with cold water is important for lowering the temperature of the raw material, which is usually transported in open trucks exposed to solar radiation.

### B.- Classification

The objective is to classify the raw material according to its quality, by separating the vegetative parts that are adapted to the processing from the others that will not serve to this finality. The vegetables that are immature, deteriorated, squeezed, wilted, mechanically injured and/or contaminated must be eliminated.

### C.- Washing and Sanitizing

Washing and sanitizing constitute an extremely important phase in vegetable processing. This processing should be accomplished in three stages in order to remove the earth particles and other impurities found in the raw material, besides reducing the microbial load.

Immersion washing: is not an efficient way to remove impurities, but it is useful as a preliminary treatment. If this is the only washing way adopted, it is important that at least three stages be adopted in its accomplishment. The change of water should be frequently accomplished; otherwise, the tanks become contamination focus.

Washing by agitation in water: the efficiency of this process will be relatively high if it is preceded by the immersion process. The agitation may be performed by simple agitators, by

compressed air, and using pumps or helixes that are isolated from the product by a resistant-screen box.

Spray washing: this is the most efficient method. It should be associated to the immersion stage before the product is subjected to water jets, in order to promote the softening of the impurities adhered to the food. It is important that the whole surface of the material is reached by the water jets, located above and below the perforated conveyor belt that transports the raw material, otherwise perforated, rotary, and lightly sloping drums that are provided with spraying nozzels should be used.

#### **D.- Drainage**

Drainage is an important operation for elimination of the excessive water adhered to the surface of the vegetables after the washing process, because the moisture favors the growth of microorganisms.

The drainage may be naturally performed, or using equipments such as the centrifuges.

### **2.2-Secondary processing**

#### **A.-Selection**

The selection may be manually accomplished either on conveyor belts or stainless steel tables. The following factors should be considered in the selection: size and shape, color, texture, spots and the presence of insects.

When working with classified material, several advantages are found in the performance and efficiency of the peeling and cutting machines that will require less adjustments and regulations, besides a better uniformity in the blanching and dehydration operations, therefore a better qualified-product.

#### **B.- Pelling and Cutting**

The cut is made for adjusting the raw material to the processing, besides providing the standardization of both size and shape of the final product. This operation includes the following stages: peeling, slicing, shredding, and removing seeds and eventual deteriorated parts.

The cutting type should be defined according to the needs of the market. In the case of some vegetables, the cut may be accomplished either by specific food processors or by hand. Either for drying process and for the freezing one, it is fundamentally important that the parts to be processed have uniform dimensions. Such a care should be taken mainly for the drying process in order to obtain a final product with better sensorial and physic-chemical qualities.

**Broccoli and cauliflower:** separate the stem from of the flowers. Cut the stems into 12cm pieces. Divide the larger bouquets on such a way they have uniform size around 5 cm.

**Green pepper:** remove the seeds, and cut into slices or cubes. It may be also processed under its whole shape.

**Green bean:** its size should vary from 2 to 4 cm and it should be cut into strips along the length. When there are larger green beans, the cutting should be done to adapt the parts.

**Carrots:** to peel, remove the extremities, cut into roundels or cubes.

**Onion:** peel it by flaming or manually, by removing the top part and the root. Cut into slices from 0.5 to 1.0 cm thickness or into cubes with 0.5 cm side.

**Garlic:** it should be passed between large rubber-rolls fixed at such a distance that the bulbs are not squeezed. The rolls should be separated on such a way to allow for separating the cloves of the garlic. Following, each garlic clove should be either vertically half-cut or cut into roundels with the same thickness.

### **C.- Blanching**

The vegetable blanching is a stage previous to processing and consists in heating the material, by using water or intense steam. The main objectives are: elimination of air from the material tissues, therefore reducing the possibility for occurrence of oxidation of the material during storage; fixation and enhancement of the product coloration; reduction of the microbial load and inactivation of enzymes; elimination of the unpleasant odors and flavors.

In vapor blanching, the vegetables should be maintained above the boiling water, inside a kind of double vapor boiler with hermetic lid, and conditioned in a perforated container made of aluminum or stainless steel in such a way to be warmed only by water vapor. The vaporization time depends on countless variables, such as the cut dimension, the material type that is under processing, and the altitude of the place.

Onions, garlics and green peppers should not be blanched.

**Roundel carrots:** from 3 to 4 minutes under blanching vapor.

**Broccoli:** blanching water for 2 to 3 minutes or vapor for 3 to 5 minutes.

**Cauliflower:** blanching water for 3 to 4 minutes.

**Green bean:** blanching water for 3 to 4 minutes or vapor for 4 to 6 minutes.

### **D.- Processing**

In this phase, the process that will transform the raw material into product occurs, that is, the raw material will be dehydrated or frozen. In both processes, there will occur a reduction in the water activity of the product. See at Dried Vegetable or Frozen Vegetable.

### **E.- Packaging**

It will be made according to the processing given to the vegetables. See in Dried Vegetable or Frozen Vegetable.

### **F.- Storage**

It must be performed according to processing given to the vegetable. See in Dried Vegetable or Frozen Vegetable.

## **3.-Post Harvest Losses of Vegetables**

In the tropics, a proportion of the harvested vegetables is lost because the inadequate management, storage and processing techniques. It is difficult to know the real extent of post-harvest losses, because the data are often conflicting.

Several steps may be taken to limit the losses of vegetables. The most common points for control are the following ones:

Vermin and insect infestation during the whole of the post-harvest chain.

Yield losses due to early harvesting.

Vegetable losses due to transport of material.

Vegetable losses during reception process.

Physical losses due to poor primary and secondary processing techniques.

