

Guidelines for vegetables processing

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Outline

EU Organic farming, rules on production

Definition of fruit and vegetables

processing:

- Minimally processed
- Moderately processed
- Highly processed

Description processing methods:

- Fresh-cut vegetables
- Vegetables canning
- Refrigeration and freezing preservations
- Drying vegetables
- Processing of vegetable juice and blends
- Vegetables fermentation and pickling
- Vegetable spices and herbs



Learning Outcomes

- Improved the basic and applied concepts and knowledge of food quality and processing applied to raw materials produced according to organic practices
- Enhance technical knowledge required to optimize process and technologies to organic raw materials of organic production and the factors that need to be taken into account
- Develop knowledge and skills on food quality and safety and main criteria applied to organic produce



PROCESSING OF ASPARAGUS – GENERAL ASPECTS

The mature asparagus plant is dark green-fern-like foliage of about 0.91 m height. The edible portions of asparagus are the spears or the stems (cladophylls) that develop from the crown; asparagus can be white, purple, green, or a combination of purple and green



The plant can be productive for 15 years or more



Harvesting of the asparagus begins in the spring



Asparagus stored for about 2-3 weeks at a temperature of 2 degrees and at a high relative humidity (90-95%)



PROCESSING OF ASPARAGUS – GENERAL ASPECTS

After harvesting, the asparagus is directed to the processing lines



Processing lines



Minimal processing



Freezing



Canning



PROCESSING OF BROCCOLI – GENERAL ASPECTS

Broccoli (*Brassica oleraceae* var. *italica*) belong to the Brassicaceae family (formerly known as Cruciferae). Many crops of colas such as cauliflower, cabbage, chickens, bok choy and brussels sprouts belong to the *B. oleracea*. Broccoli is a fast-growing and compact plant with flesh head and narrow heads of flowers (curds) or buds, usually green in colour, arranged in a tree shape on branches sprouting from an edible peduncle. It is a cool weather, slow maturing crop.



Broccoli is cooled to about 4.4 °C to lower the breathing rate

Broccoli can be seeded directly or seedlings can be transplanted into the field

Broccoli is harvested when it is uniform in color, from blue-green to green and narrow dome heads that rise above the leaves



PROCESSING OF BROCCOLI – GENERAL ASPECTS

After harvesting, broccoli are directed to the processing lines



Processing lines



Cooking



Freezing



PROCESSING OF CAULIFLOWER – GENERAL ASPECTS

Although a biennial crop, some varieties are grown as cool season annuals, requiring moderately cool climates for growth. The edible portion of the cauliflower is a compact head or curd (thick undeveloped yellow to creamy white flowers), which constitutes approximately 45% of the vegetable (Madhavi and Ghosh 1998; Sanders 2009).





PROCESSING OF AVOCADO – GENERAL ASPECTS

Avocado is classified as *P. americana*. It belongs to kingdom Plantae, family of Lauraceae, order Laurales, genus Persea, and species *P. americana*. Avocado tree is dense, evergreen, and tall (~20 m), then fruit is a climacteric and used primarily as a vegetable. Like olives, avocado is rich in monounsaturated fatty acid (oleic acid), health-promoting phytosterols, and phenolic antioxidants.



Avocado trees grow well in hilly sloping land with loose or sandy loam soil.



Before packaging, avocados are washed, lightly cleaned, sized and classified for quality



The avocado is harvested when it is not completely mature (commercial maturity)





PROCESSING OF AVOCADO – GENERAL ASPECTS

The harvested avocados are washed, slightly cleaned, sized and classified for quality and directed to the processing lines

Processing lines



- Fresh-cut avocado
- Frozen avocado
- Dried avocado
- Guacamole
- Avocado puree (sauce)
- Avocado oil



PROCESSING OF DRY BEANS – GENERAL ASPECTS

Dry beans provide a good source of protein, which is two to three times that of cereal grains, and are a rich source of dietary fiber and starch (Osorio-Diaz et al. 2003). Furthermore they are a good source of vitamins (thiamine, riboflavin, niacin, vitamin B6, and folic acid) and certain minerals (Ca, Fe, Cu, Zn, P, K, and Mg). Dry beans also contain about 1% of polyunsaturated fatty acids, especially linoleic and linolenic acids (Augustin and Klein 1989; Kutos et al. 2002). Finally, they are rich in micronutrient such as phenolics and antioxidant (Amarowicz and Pegg 2008).



The dry bean is an annual crop which thrives in a warm climate

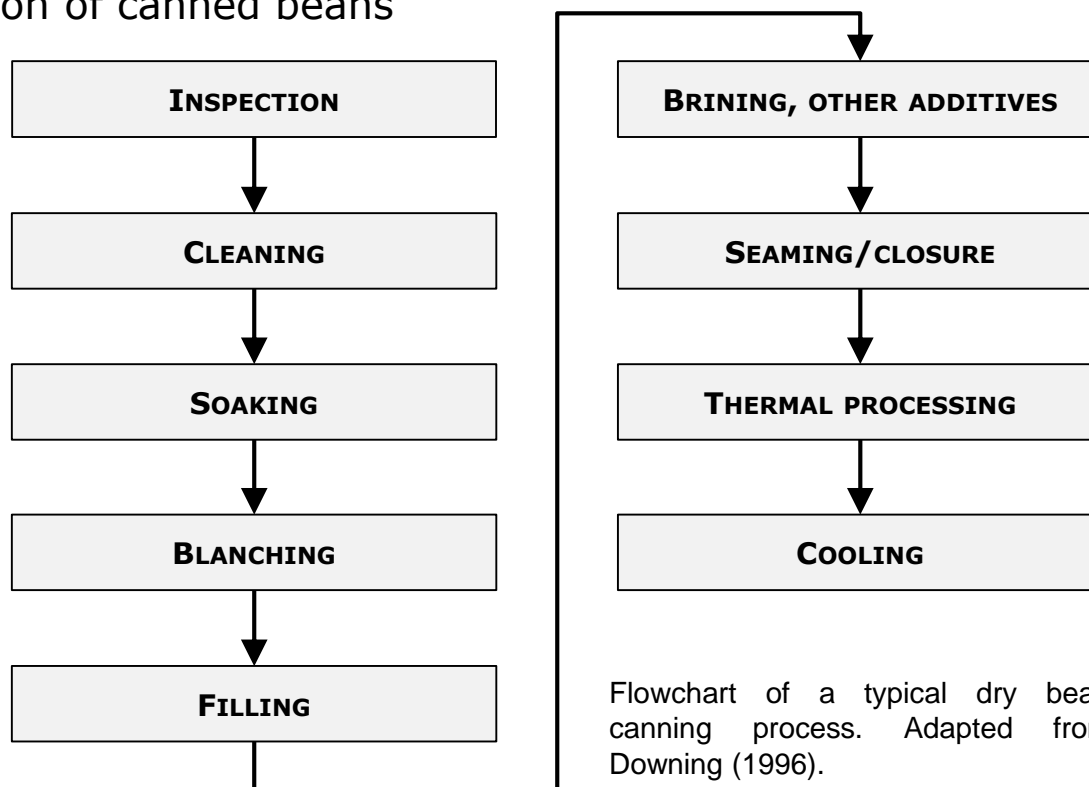
The beans are only ready for harvesting when the moisture content drops to 16 % (w/w), ideally 15 %



CLICK TO PLAY!

PROCESSING OF DRY BEANS – GENERAL ASPECTS

Canned beans: Canning is the most common processing procedure used to manufacture a variety of beans products. These include beans processed in brine or sauce, in combination with meat stews, chili and the like. Below is showed a flowchart for the preparation of canned beans



Flowchart of a typical dry bean canning process. Adapted from Downing (1996).



PROCESSING OF CARROTS – GENERAL ASPECTS

Carrot, a fresh season harvest, is grown worldwide. Its color varies from orange to deep red, from light violet to violet, yellow or white. The shape of the carrots makes them easy to handle during harvesting, cleaning, shipping and distribution



Carrots are grown from seed and take about four months to mature



PROCESSING OF PEAS – GENERAL ASPECTS

Many plants including certain vegetables (such as peas) produce storage proteins of considerable nutritional importance.



Canning



Freezing



Drying

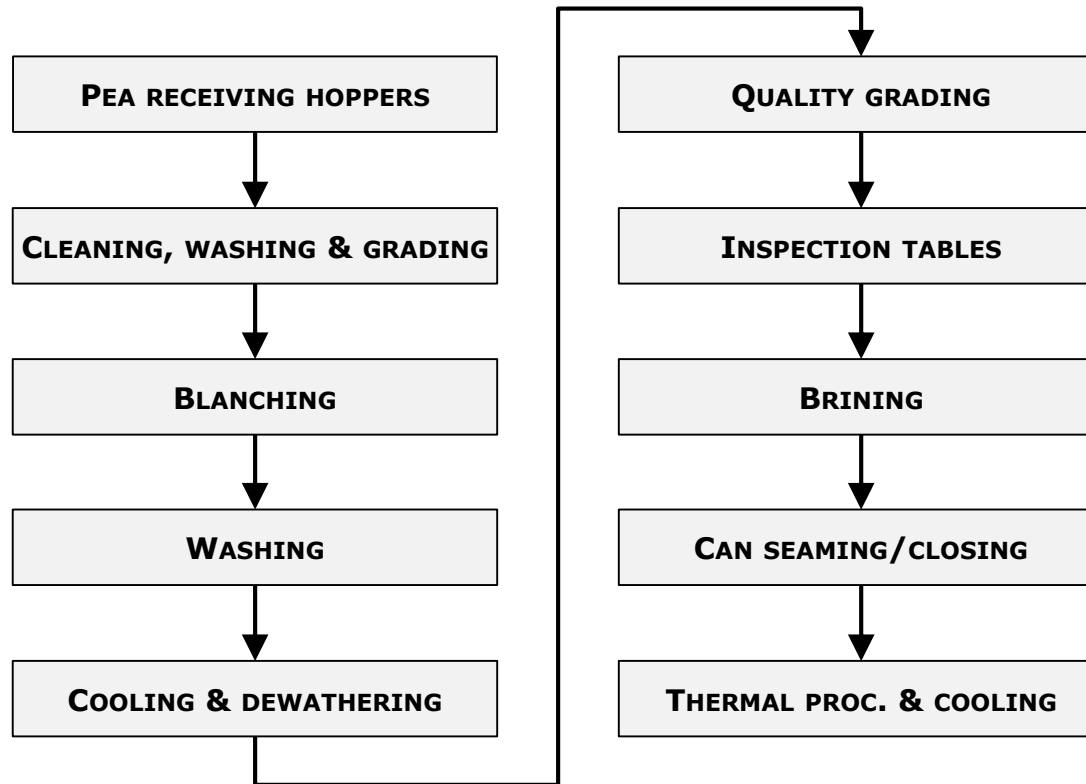


Puree



PROCESSING OF PEAS - CANNING

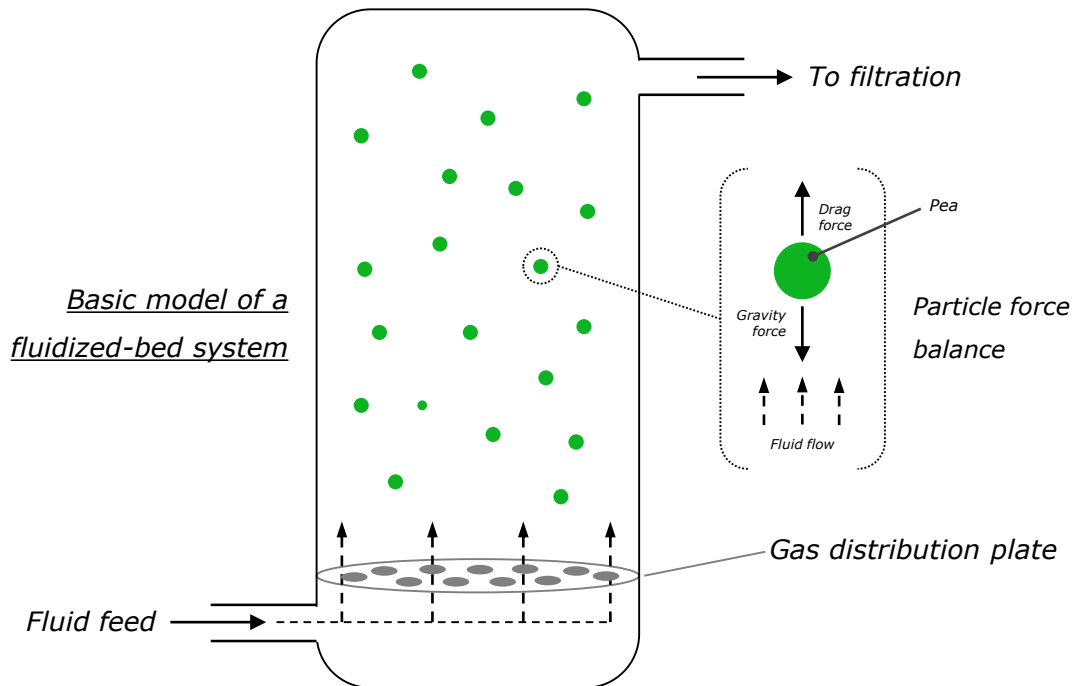
A typical commercial pea canning process flowchart is shown.





PROCESSING OF PEAS - FREEZING

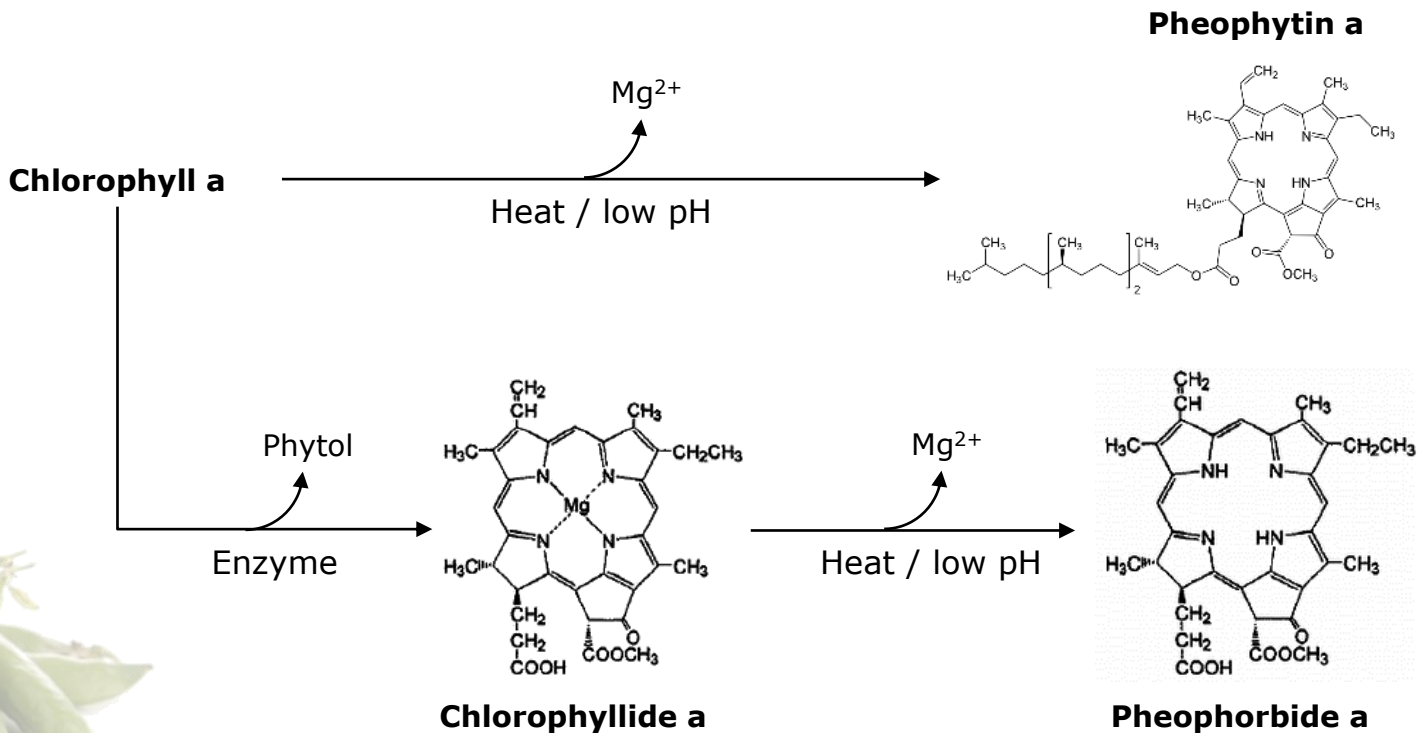
Fluidized-bed technique is commonly used and has been very successful for freezing peas. The technique is so rapid that peas are brought down to a temperature of 0°C in about 4 min.





PROCESSING OF PEAS - PUREE

Pea purees are susceptible to color degradation due to heat exposure, low pH and enzymatic activity





PROCESSING OF ONION AND GARLIC – GENERAL ASPECTS

Onion and garlic are commonly consumed vegetables and they can be found in a number of prescriptions in different traditions and cultures. They are subjected to various processes before consumption.

Onion



Garlic



Onion and garlic processing

- » *Drying (most common method)*
- » *Distillation*
- » *Maceration in oil*
- » *Hydro-alcoholic short extraction*
- » *Hydro-alcoholic long maceration*



PROCESSING OF TABLE OLIVES – GENERAL ASPECTS

The terms table or edible olives are used for treated or processed olives harvested at maturity. Table olives are available in different shapes, colors, flavors and tastes.



*Spanish-style
green olives*



*American-style
black olives*



*Greek-style
black olives*



*Kalamon-style
Greek olives*



PROCESSING OF TABLE OLIVES – SPANISH-STYLE GREEN OLIVES

The terms table or edible olives are used for treated or processed olives harvested at maturity. Table olives are available in different shapes, colors, flavors and tastes.



*Spanish-style
green olives*



*American-style
black olives*



*Greek-style
black olives*



*Kalamon-style
Greek olives*



PROCESSING OF TABLE OLIVES – AMERICAN-STYLE BLACK OLIVES

The terms table or edible olives are used for treated or processed olives harvested at maturity. Table olives are available in different shapes, colors, flavors and tastes.



*Spanish-style
green olives*



*American-style
black olives*



*Greek-style
black olives*



*Kalamon-style
Greek olives*



CLICK TO PLAY!

PROCESSING OF TABLE OLIVES – GREEK-STYLE BLACK OLIVES

The terms table or edible olives are used for treated or processed olives harvested at maturity. Table olives are available in different shapes, colors, flavors and tastes.



*Spanish-style
green olives*



*American-style
black olives*



*Greek-style
black olives*



*Kalamon-style
Greek olives*



CLICK TO PLAY!

PROCESSING OF TABLE OLIVES – KALAMON-STYLE GREEK OLIVES

The terms table or edible olives are used for treated or processed olives harvested at maturity. Table olives are available in different shapes, colors, flavors and tastes.



*Spanish-style
green olives*



*American-style
black olives*



*Greek-style
black olives*



*Kalamon-style
Greek olives*



CLICK TO PLAY!

PROCESSING OF TOMATO – GENERAL ASPECTS

Tomato is a versatile vegetable from which a variety of processed products are produced.



Juice



Pulp



Canned



Powder



Soup



Ketchup

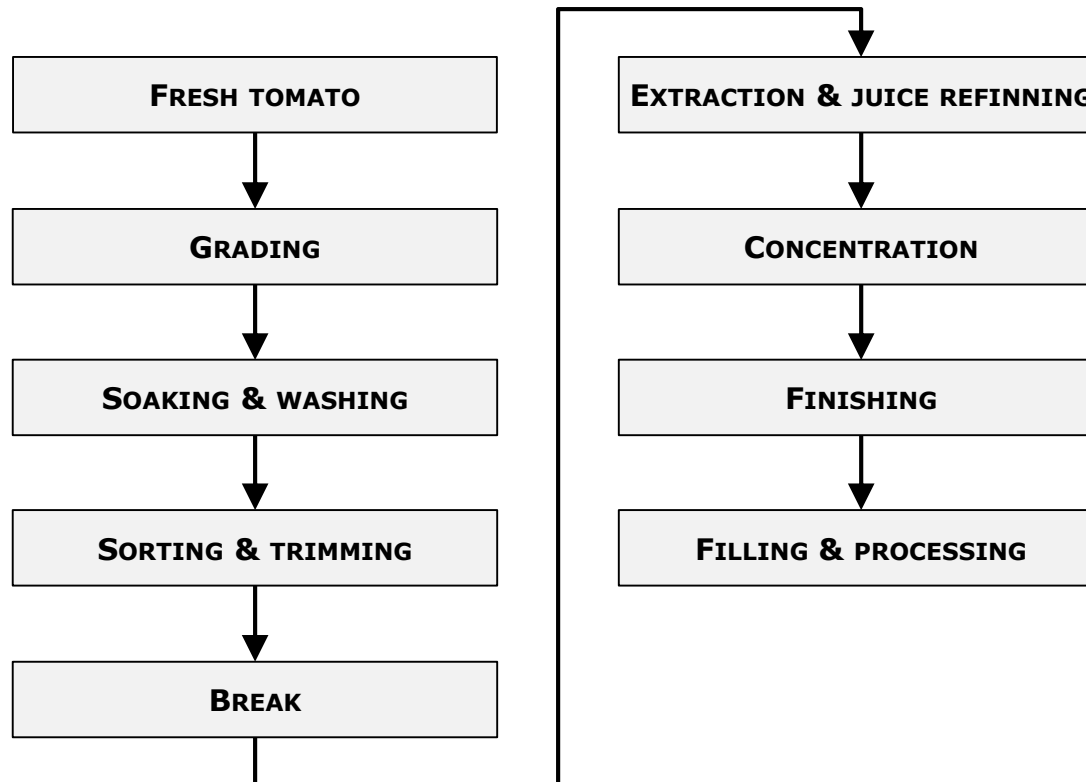


Dried



PROCESSING OF TOMATO – TOMATO PULP

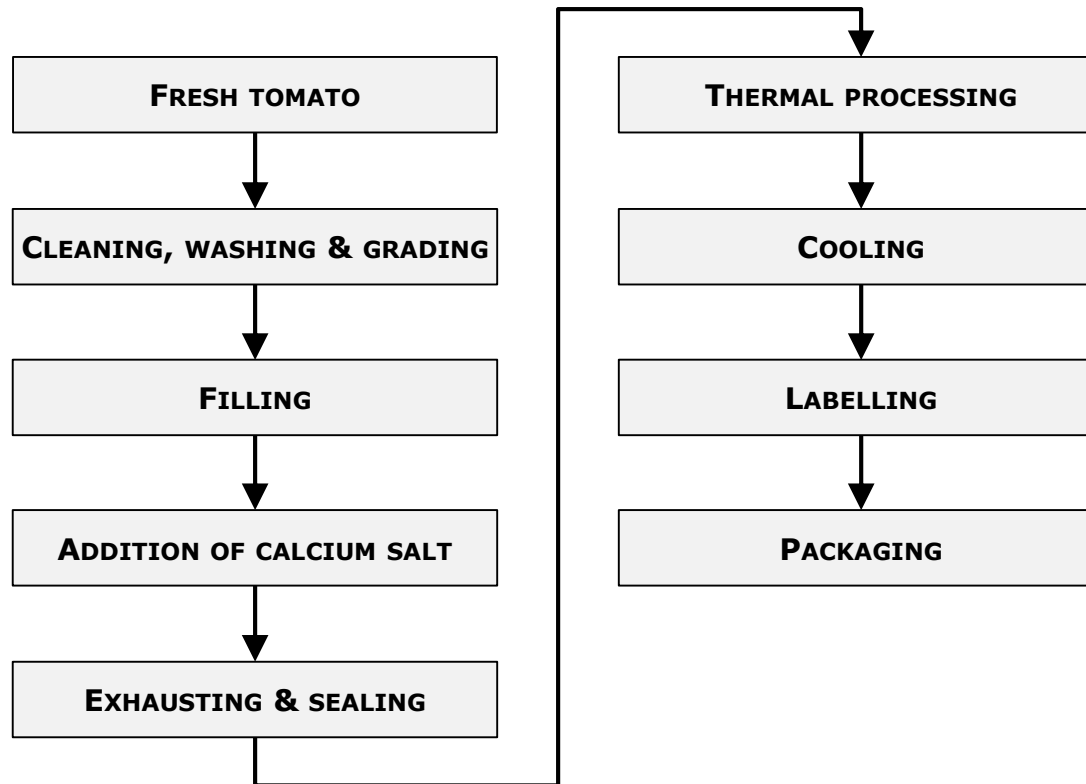
Tomato pulp is obtained from ripe tomatoes, selected and processed immediately after harvest.





PROCESSING OF TOMATO – CANNED TOMATOES

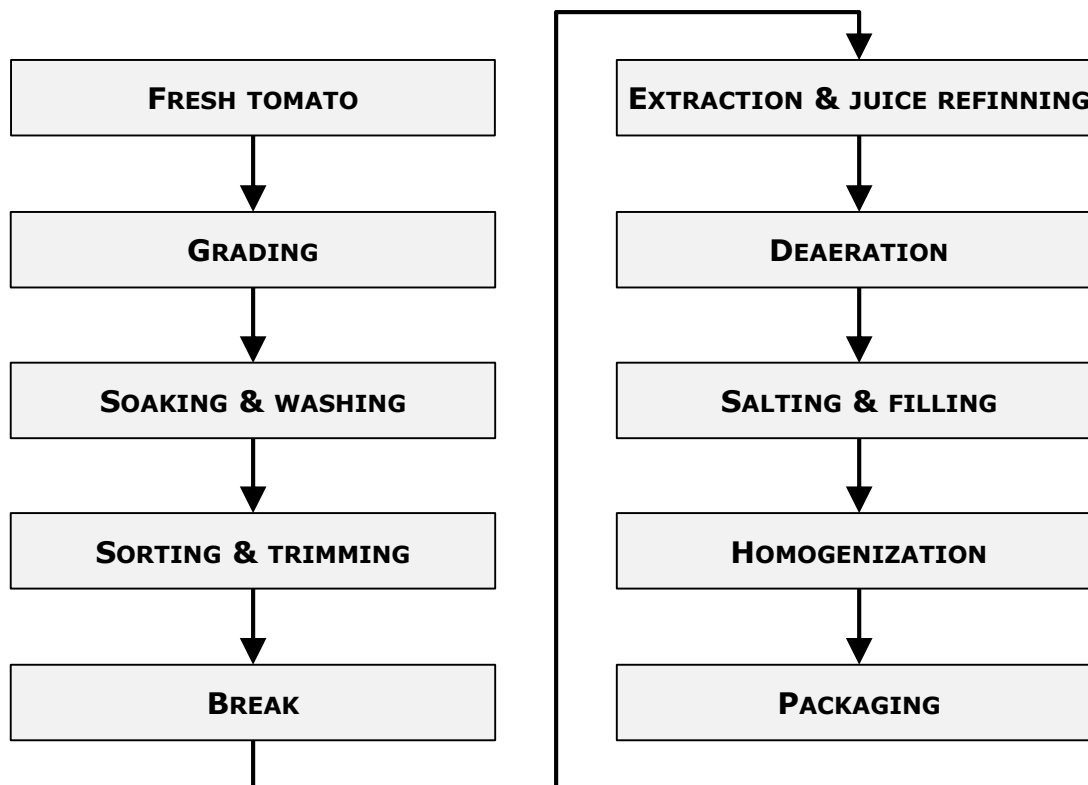
Canned tomatoes are peeled fruits that are processed by heat and then sealed into a can.





PROCESSING OF TOMATO – TOMATO JUICE

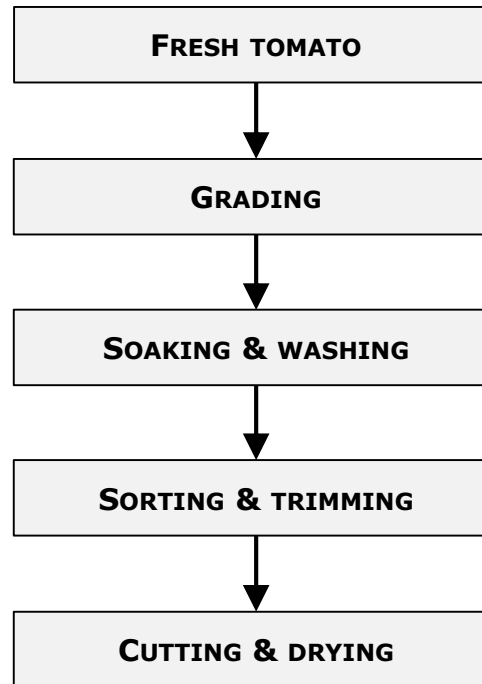
Tomato juice is a juice made from tomatoes, unconcentrated and pasteurized and usually used as a beverage





PROCESSING OF TOMATO – DRIED TOMATO

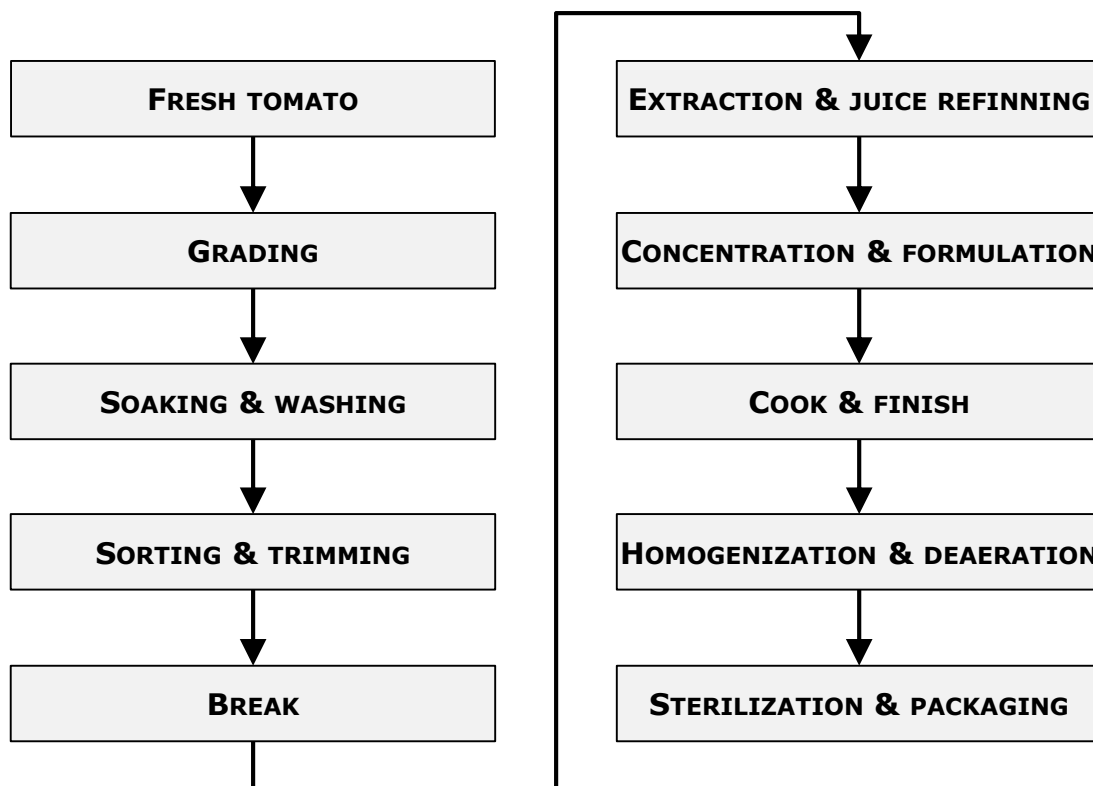
Dried tomato are usually treated with antioxidant before being placed in the dryer in order to improve quality.





PROCESSING OF TOMATO – TOMATO KETCHUP

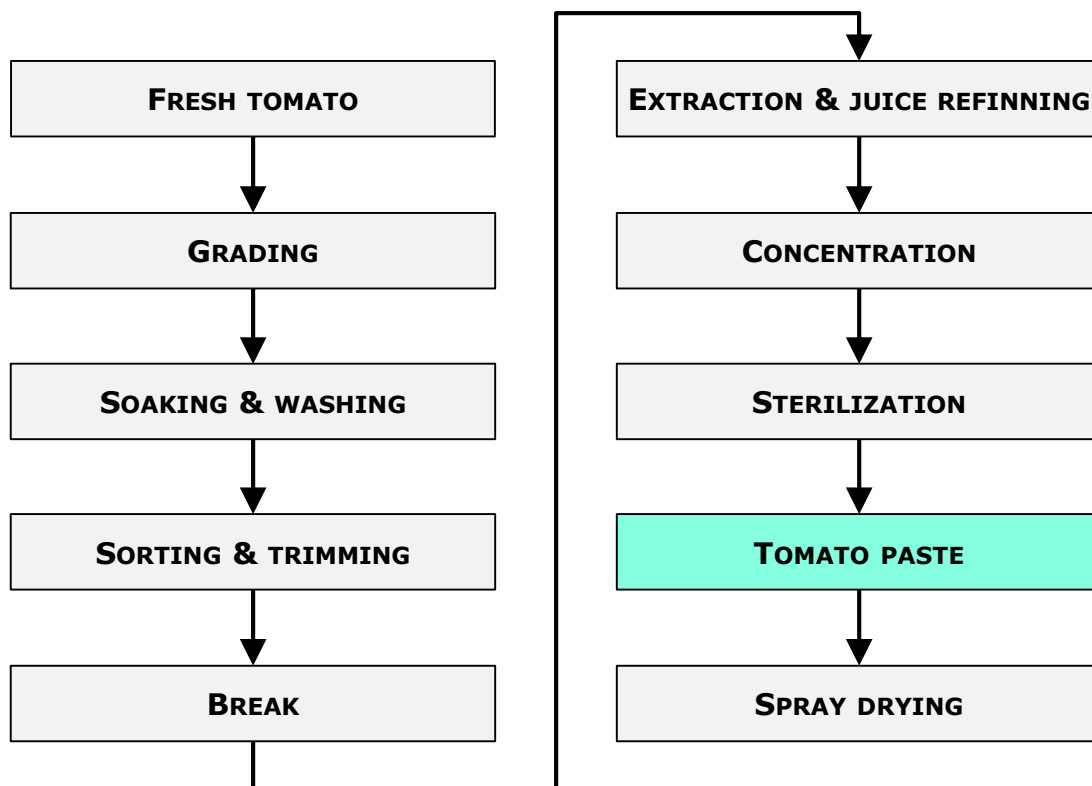
Ketchup is a sweet tomato sauce primarily made from tomatoes, sweetener and vinegar.





PROCESSING OF TOMATO – TOMATO POWDER

Tomato powder is one of the most versatile ingredient, used in many recipes.





CLICK TO PLAY!

PROCESSING OF POTATO – GENERAL ASPECTS

French fries, potato chips, dehydrated, canned potatoes and extruded potatoes are the major potato products.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato



CLICK TO PLAY!

PROCESSING OF POTATO – FROZEN FRENCH FRIES

Frozen french fries are potato for use by fast food and ready-to-eat food outlets and restaurants.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato



CLICK TO PLAY!

PROCESSING OF POTATO – DRIED POTATO

The dehydrated products are used in dried or canned soups and stews, potato salads, casseroles, hash browns, extruded snack foods, mixes for dumplings and potato pancakes, as breading or as corn meal replacement.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato



CLICK TO PLAY!

PROCESSING OF POTATO – CANNED POTATO

Potatoes suitable for canning do not easily disintegrate or slough during processing.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato



CLICK TO PLAY!

PROCESSING OF POTATO – POTATO CHIPS

Potato chips are thin slices of deep-fried potato of about 2% moisture that come in a variety of Flavors.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato



CLICK TO PLAY!

PROCESSING OF POTATO – EXTRUDED POTATO

Potato chips can also be made via a process based on extrusion of rehydrated potato powder.



Frozen french fries



Dried potato



Canned potato



Potato chips



Extruded potato

References (papers)

- Albanese D, Russo L, Cinquanta L, Brasiello A, Di Matteo M, 2006. Physical and chemical changes in minimally processed green asparagus during cold-storage; *Food Chem* 101:274–280.
- Amarowicz R, Pegg RB, 2008. Legumes as a source of natural antioxidants; *Eur J Lipid Sci Technol* 110:865–878.
- Augustin J, Klein BP, 1989. Nutrient composition of raw, cooked, canned, and sprouted legumes. In: Matthews RH (editor), *Legumes, Chemistry, Technology, and Human Nutrition*; New York: Marcel-Dekker, pp. 187–217.
- Blumenfeld A, Gazit S, 1974. Development of seeded and seedless avocado fruits; *J Am Soc Hortic Sci* 99:442–448.
- Fuchs SJ, Mattison DS, Fellman JK, 2008. Effect of edible coatings on postharvest quality of fresh green asparagus; *J Food Process Pres* 32:951–971.
- Kmiecik W, Lisiewska Z, Korus A, 2007. Retention of mineral constituents in frozen brassicas depending on the method of preliminary processing of the raw material and preparation of frozen products for consumption; *Eur Food Res Technol* 224:573–579.
- Kurlaender A, 2004. Avocados. In: Barrett DM, Somogyi L, Ramaswamy H (editors), *Processing Fruits– Science and Technology*; New York: CRC Press, Taylor & Francis Group, pp. 739–750.
- Kutos T, Golobm T, Kac M, Plestenjak A. 2002. Dietary fiber of dry processed beans. *Food Chem* 80:231–235.
- Hansen M, Lausten AM, Olsen CE, Poll L, Sorensen H, 1997. Chemical and sensory quality of broccoli (*Brassica oleracea* L. var. *Italica*); *J Food Qual* 20:441–459.

References (papers)

- Lewis CE. 1978. The maturity of avocados-a general review; *J Sci Food Agric* 29:857–866; no. 6. Available online at <http://www.bepress.com/ijfe/vol3/iss6/art6>, Accessed on June 22, 2010.
- Mukherjee S, Lekli I, Ray D, Gangopadhyay H, Raychaudhuri U, Das DK, 2010. Comparison of the protective effects of steamed and cooked broccolis on ischaemia-reperfusion-induced cardiac injury; *Brit J, Nutr* 103(6):815–823
- Mudgal VD, Pande VK, 2007. Dehydration characteristics of cauliflower; *Int J Food Eng*, 3: article
- Osorio-Diaz P, Bello-Perez LA, Sayago-Ayerdi SG, Benitez-Reyes MD, Tovar J, Paredes-Lopez O, 2003. Effect of processing and storage time on *in vitro* digestibility and resistant starch content of two bean (*Phaseolus vulgaris*) varieties. *J Sci Food Agric* 83:1283–1288.
- Pao S, Petracek PD, 1997. Shelf life extension of peeled oranges by citric acid treatment; *Food Microbiol* 14(5):485–491.
- Podsedek A, 2007. Natural antioxidants and antioxidant capacity of *Brassica* vegetables: a review; *LWT-Food Sci Technol* 40:1–11.
- Rahman M, Iqbal M, Jilani MS, Waseem K, 2007. Effect of different plant spacing on the production of cauliflower (*Brassica oleracea* var. *botrytis*) under the agro-climatic conditions of D.I. Khan. *Pak J Biol Sci* 10:4531–4534.
- Ramtahal GA, Akingbala JO, Baccus-Taylor GSH, 2007. Laboratory preparation and evaluation of Pollock variety avocado (*Persea americana* Mill) guacamole; *JSci Food Agric* 87:2068–2074.
- Sanders DC, 2009. Cauliflower. Available online at <http://www.ces.ncsu.edu/depts/hort>, Accessed on July 7, 2009.

References (papers)

- Scalzo RL, Bianchi G, Genna A, Summa C, 2007. Antioxidant properties and lipidic profil as quality indexes of cauliflower (*Brassica oleracea* L. var *botrytis*) in relation to harvest time; *Food Chem* 100:1019–1025.
- Siddiq M, Nyombaire G, Dolan KD, Matella NJ, Harte JB, 2006. Processing of sugar-coated red kidney beans (*Phaseolus vulgaris*): Fate of oligosaccharides and phytohemagglutinin (PHA), and evaluation of sensory quality; *J Food Sci* 71:C521–526.
- Sultana B, Anwar F, Iqbal S, 2006. Effect of different cooking methods on the antioxidant activity of some vegetables from Pakistan; *Int J Food Sci Tech* 43:560–567
- Thakur AK, Jain RK, 2006. Studies on drying characteristics of caulifl wer *J Food Sci Tech* 43:182–185.
- Wachtel-Galor S, Wong KW, Benzie FF, 2008. The effect of cooking on *Brassica* vegetables; *Food Chem* 110:706–710.
- Werman MJ, Neeman I, 1987. Avocado oil production and chemical characteristics; *J Am Oil Chem Soc* 62(2):229–232.

References (books)

- Krasaekoopt W, Bhandari B, 2011. Fresh-cut vegetables. In: Handbook of vegetables and vegetable processing. Editor Nirmal K. Sinha. Blackwell Publishing Ltd.
- Madhavi DL, Ghosh SP. 1998. *Cauliflowe*, In: Salunkhe DK, Kadam SS (editors), *Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing*. New York: Marcel Dekker, pp. 323–336.
- Rangavajhyala N, Ghorpade VM, Kadam SS. 1998. *Broccoli*. In: Salunkhe DK, Kadam SS (editors), *Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing*. NY: Marcel Dekker, pp. 337–357.



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