

BLANCHING

Blanching serves a variety of functions, one of the main ones being to destroy enzymic activity in vegetables and some fruits, prior to further processing. As such, it is not intended as a sole method of preservation but as a pre-treatment which is normally carried out between the preparation of the raw material (Chapter 3) and later operations (particularly heat sterilisation, dehydration and freezing (Chapters 12, 15 and 21)). Blanching is also combined with peeling and/or cleaning of food (Chapter 3), to achieve savings in energy consumption, space and equipment costs.

A few processed vegetables, for example onions and green peppers, do not require blanching to prevent enzyme activity during storage, but the majority suffer considerable

loss in quality if blanching is omitted or if they are under-blanching. To achieve adequate

enzyme inactivation, food is heated rapidly to a pre-set temperature, held for a pre-set

time and then cooled rapidly to near ambient temperatures. The factors which influence

blanching time are:

- type of fruit or vegetable
- size of the pieces of food
- blanching temperature
- method of heating.

The heat resistance of enzymes is characterised by D and z values (Chapter 1).

Enzymes which cause a loss of eating and nutritional qualities in vegetables and fruits

include lipoxygenase, polyphenoloxidase, polygalacturonase and chlorophyllase.

Two

heat-resistant enzymes which are found in most vegetables are catalase and peroxidase.

Although they do not cause deterioration during storage, they are used as marker enzymes

to determine the success of blanching. Peroxidase is the more heat resistant of the two, so

the absence of residual peroxidase activity would indicate that other less heat-resistant

enzymes are also destroyed. The factors that control the rate of heating at the centre of the

product are discussed in Chapter 1 and can be summarised as:

- the temperature of the heating medium
- the convective heat transfer coefficient
- the size and shape of the pieces of food
- the thermal conductivity of the food.

Blanching reduces the numbers of contaminating micro-organisms on the surface of

foods and hence assists in subsequent preservation operations. This is particularly important in heat sterilisation as the time and temperature of processing are designed to achieve a specified reduction in cell numbers. If blanching is inadequate, a

larger number of micro-organisms are present initially and this may result in a larger

number of spoiled containers after processing. Freezing and drying do not substantially

reduce the number of micro-organisms in unblanched foods and these are able to grow on

thawing or rehydration.

Blanching also softens vegetable tissues to facilitate filling into containers and removes air from intercellular spaces which increases the density of food and assists in

the formation of a head-space vacuum in cans.

Steam blanchers

The advantages and limitations of steam blanchers are described in Table 10.1. In general

this is the preferred method for foods with a large area of cut surfaces as leaching losses

are much smaller than those found using hot-water blanchers.

At its simplest a steam blancher consists of a mesh conveyor belt that carries food through a steam atmosphere in a tunnel. The residence time of the food is controlled by

the speed of the conveyor and the length of the tunnel. Typically a tunnel is 15m long and

1–1.5m wide. The efficiency of energy consumption is 19% when water sprays are used

at the inlet and outlet to condense escaping steam. Alternatively, food may enter and

leave the blancher through rotary valves or hydrostatic seals to reduce steam losses and increase energy efficiency to 27%, or steam may be re-used by passing through Venturi valves. Energy efficiency is improved to 31% using combined hydrostatic and Venturi devices (Scott *et al.*, 1981). In conventional steam blanching, there is often poor uniformity of heating in the multiple layers of food. The time–temperature combination required to ensure enzyme inactivation at the centre of the bed results in overheating of food at the edges and a consequent loss of texture and other sensory characteristics.

Hot-water blanchers

There are a number of different designs of blancher, each of which holds the food in hot water at 70–100°C for a specified time and then removes it to a dewatering-cooling section. The advantages and limitations of hot-water blanchers are described in Table 10.1.

In the widely used *reel blancher*, food enters a slowly rotating cylindrical mesh drum

which is partly submerged in hot water. The food is moved through the drum by internal

flights. The speed of rotation and length control the heating time. *Pipe blanchers* consist of a continuous insulated metal pipe fitted with feed and discharge ports.

Hot water is

recirculated through the pipe and food is metered in. The residence time of food in the

blancher is determined by the length of the pipe and the velocity of the water.

These

blanchers have the advantage of a large capacity while occupying a small floor space. In

some applications they may be used to transport food simultaneously through a factory.

Developments in hot-water blanchers, based on the IQB principle, reduce energy consumption and minimise the production of effluent. For example, the *blancher-cooler* has three sections: a pre-heating stage, a blanching stage and a cooling stage (Fig.

10.1(b)). The food remains on a single conveyor belt throughout each stage and therefore does not suffer the physical damage associated with the turbulence of conventional hotwater blanchers. The food is pre-heated with water that is recirculated through a heat exchanger. After blanching, a second recirculation system cools the food. The two systems pass water through the same heat exchanger, and this heats the pre-heat water and simultaneously cools the cooling water. Up to 70% of the heat is recovered. A recirculated water-steam mixture is used to blanch the food, and final cooling is by cold air. Effluent production is negligible and water consumption is reduced to approximately 1m³ per 10 t of product. The mass of product blanched is 16.7–20 kg per kilogram of steam, compared with 0.25–0.5 kg per kilogram in conventional hot-water blanchers. An alternative design, used for blanching broccoli, lima beans, spinach and peas, is described by Wendt *et al.* (1983) in which water and food move counter-currently (Fig. 10.1(c)).