

SLICING/SIZE REDUCTION

Size reduction or 'comminution' is the unit operation in which the average size of solid pieces of food is reduced by the application of grinding, compression or impact forces.

When applied to the reduction in size of globules of immiscible liquids (for example oil globules in water) size reduction is more frequently referred to as homogenisation or

emulsification. The size reduction of liquids to droplets (by atomisation) is described in

Chapter 15. Size enlargement is achieved by extrusion (Chapter 14), agglomeration (Chapter 15) or forming (Chapter 5).

Size reduction has the following benefits in food processing:

- There is an increase in the surface-area-to-volume ratio of the food which increases the rate of drying, heating or cooling and improves the efficiency and rate of extraction of liquid components (for example fruit juice or cooking oil extraction (Chapter 6)).

- When combined with screening (Chapter 3), a predetermined range of particle sizes is produced which is important for the correct functional or processing properties of some products (for example icing sugar, spices and cornstarch).

- A similar range of particle sizes allows more complete mixing of ingredients (Chapter 5) (for example dried soup and cake mixes).

Size reduction and emulsification have little or no preservative effect. They are used to

improve the eating quality or suitability of foods for further processing and to increase the

range of products available. In some foods they may promote degradation by the release

of naturally occurring enzymes from damaged tissues, or by microbial activity and oxidation at the increased area of exposed surfaces, unless other preservative treatments

are employed.

Different methods of size reduction are classified according to the size range of particles produced:

1. *Chopping, cutting, slicing and dicing:*

(a) large to medium (stewing steak, cheese and sliced fruit for canning)

(b) medium to small (bacon, sliced green beans and diced carrot)

(c) small to granular (minced or shredded meat, flaked fish or nuts and shredded vegetables).

2. *Milling* to powders or pastes of increasing fineness (grated products > spices > flours

> fruit nectars > powdered sugar > starches > smooth pastes)

3. *Emulsification* and *homogenisation* (mayonnaise, milk, essential oils, butter, ice cream and margarine).

Equipment

This section describes selected equipment used to reduce the size of both fibrous foods to

smaller pieces or pulps, and dry particulate foods to powders. Summaries of the main

applications are shown in Tables 4.1 and 4.2. Further details of the properties of powders

are given by Lewis (1996) and in Chapter 15.

Most meats, fruits and vegetables fall into the general category of 'fibrous' foods. Meats are frozen or 'tempered' to just below their freezing point (Chapters 19 and 21) to

improve the efficiency of cutting. Fruits and vegetables have an inherently firmer texture

and are cut at ambient or chill temperatures. All types of cutters require the blade to be

forced through the food with as little resistance as possible. Knife blades must be kept

sharp, to both minimise the force needed to cut the food and to reduce cell rupture and

consequent product damage and reduced yield. In moist foods, water acts as a lubricant,

but in some sticky products, such as dates or candied fruits, food grade lubricants may be

needed to cut them successfully. In general blades are not coated with non-slip materials,

such as 'Teflon' or poly-tetra-fluoro-ethylene (PTFE) as these may wear off and contaminate the product, and are instead mirror-polished during manufacture.

During the 1990s improved cutting has been achieved with the introduction of

ultrasonic cutters. These use knife blades or ‘horns’ (probes) which vibrate longitudinally (as a piston) at 20 kHz, with a cutting stroke of 50–100 μ m. Details of the component parts and method of cutting are described by Rawson (1998). They are readily automated

and have the following benefits:

- quality of the cut face is visually excellent
- the product is virtually undisturbed
- the required cutting force is significantly reduced
- multi-layered products or hard particles contained in a soft matrix can be cut
- the blade is self-cleaning
- crumbs and debris are significantly reduced
- it is cost effective, having low running costs
- less sharp blades are needed and longer intervals between sharpening, compared to conventional blades (Rawson, 1998).

The technique is particularly suitable for products that are difficult to cut using other

methods (for example, sticky confectionery, hot bread and soft cake) and is increasingly

used for bakery products of all types, frozen pies, ice cream, and fresh meats, fish and

vegetables.

Size reduction of fibrous foods

There are four main types of size reduction equipment, classified in order of decreasing

particle size as follows:

1. slicing and flaking equipment
2. dicing equipment
3. shredding equipment
4. pulping equipment.