chocolate masses. This has a decisive influence on the chocolate taste since amorphous sugar can absorb large quantities of different flavour compounds.

Chocolate masse made experimentally with sugar already ground to its final fineness is unsatisfactory in taste. This is thought to be because the amorphous sugar, normally produced during the refining stage, is missing and thus not available for flavour absorption. However, the rate of recrystallisation increases with increasing temperatures and relative humidities. At very high air humidities, the amorphous sugar that has just been produced may recrystallise immediately after passing through the roll refiner. The flavour components absorbed by the amorphous sugar during the refining of the chocolate masse are then released again during recrystallisation. Under normal conditions, even after a storage period, there is still some amorphous sugar in the finished chocolate.

Amorphous sugar may also have a positive influence in improving the heat stability of chocolate (Niedieck, 1981). A heat stable chocolate may be produced by adding 1–10% of finely ground amorphous sugar pastes to the conched chocolate masse. This is then subjected to several days' heat treatment at temperatures between 20 and 35 °C (68 and 95 °F). A network of matted sugar particles is then formed and stabilises the moulded chocolate, which will not soften again even at higher temperatures. The amorphous sugar may be made, for example, from something like a high-boiled candy mass, which includes sucrose and invert sugar or dextrose.

The advantage of some freshly manufactured crumb chocolates, as far as heat stability is concerned (compared with using single components, such as cocoa mass, milk powder and sugar) is that the sugar present in this crumb is at least partially in the amorphous state (see Chapter 6). This may be because the other ingredients of crumb, such as lactoproteins, fat and non-fat cocoa components are likely to have a pronounced retarding effect on the recrystallisation of the sugar.

4.7 Other sugars and bulk sweeteners

Apart from sucrose, there are numerous other sugars, polysaccharides, and sugar alcohols (polyols), some of which are important in the production of confectionery articles or have received special attention in recent years. More often than not they have major differences as far as physical, chemical or physiological characteristics are concerned and not all of them are suitable for the production of chocolate masses.

4.7.1. Invert sugar

Invert sugar is a mixture consisting of equal parts of the monosaccharides fructose and glucose (dextrose) that is produced during hydrolytic cleavage of the disaccharide sucrose, using either the activity of specific enzymes or that of acids. It is commercially available as syrup or as a partially crystallised paste with a dry solids content of 65–80%. Invert sugar is naturally present in many fruits and in honey. This product is not suitable for the manufacture of chocolate because it is almost exclusively supplied as an aqueous solution. Publications from Japan, however, refer to the manufacture of a pseudo-chocolate using freeze-dried dates in which the natural sweetness is almost exclusively made up of invert sugar. The sweetening power of invert sugar corresponds closely to that of sucrose (Anon., 1981).

4.7.2 Glucose

The monosaccharide glucose, also known as dextrose, is present in nature where it is found, together with fructose, in many fruits and in honey (invert sugar). Since it was prepared in the past from grapes, glucose is also known as grape sugar.

Today, glucose is normally produced industrially by an extensive hydrolysis of starch into high-conversion glucose syrup, from which it is crystallised in the form of glucose monohydrate. About 9% water is retained as a constituent of the glucose. Part of this water of crystallisation is released at temperatures that are commonly reached during the conching and produces an adverse effect on the rheological properties of the chocolate (see Chapter 11). It is preferable, therefore, to use glucose with no water content (anhydrous dextrose) for the manufacture of chocolate (Hogenbirk, 1985).

Although there have been many attempts to produce glucose chocolate, chocolates sweetened with only glucose have never become very popular because their taste characteristics differ from the standard product. This, however, does not prevent glucose being used in small quantities together with sucrose for the sweetening of chocolate. The sweetening power of glucose is only slightly more than half of that of sucrose. The current EU regulations allow for it to replace any or all of the sucrose in any chocolate recipe.

A variety of glucose syrups (corn syrups) with solids contents of about 70–80% may be produced by means of partial saccharification of starch. These syrups, together with glucose, may also contain maltose and other saccharides of higher molecular weight. Furthermore, syrups with various degrees of fructose are made by means of partial enzymatic isomerization of glucose. Glucose syrups are not used commercially to make chocolate on account of their water content, and nothing has yet been reported concerning the use of spray-dried glucose syrups in chocolates. On the other hand, large amounts of glucose syrup are used for the manufacture of hard-boiled candies, toffees, fondants and so on.

4.7.3 Fructose

Fructose is a monosaccharide, also known as fruit sugar, which is present, together with glucose, in almost all fruits and in honey (invert sugar). Fructose is currently produced in most large-scale processes by isolation and subsequent crystallisation from fructose containing glucose or invert sugar syrups. Fructose is naturally hygroscopic. The sweetening power of fructose is usually considered to be higher than that of sucrose. This, however, depends on a number of different