

Many of these compounds have quite characteristic flavours and have been described for example as:

Furfural – “sweet, woody, almond, baked bread”.

Maltol – “sweet caramel toffee”;

Cyclotene – powerful: “spicy to maple syrup”;

Furaneol – powerful: “strawberry, brown fruit, candy floss”.

Excessive browning of crumb leads to burnt and bitter flavours, overcoming the pleasant “fruit cake” characteristics.

Many other compounds, as yet unidentified, doubtless contribute to the overall flavour. More details of the chemistry of this complicated set of reactions are found in Chapter 8.

The final crumb flavour is dependent on three major factors:

- Moisture content;
- Temperature;
- Time at each stage.

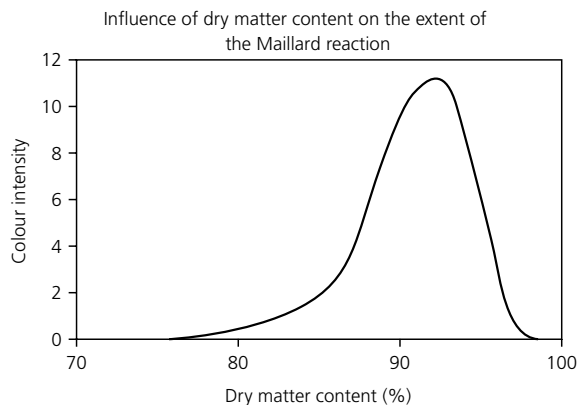
These three factors are largely determined by the processing equipment chosen to make the crumb.

The effect of moisture content can be as illustrated as shown in Figure 6.3 (Bouwman-Timmermans and Siebenga, 1995).

Initially the crumb mixture contains a lot of water and so the optimum moisture for browning is at quite an advanced stage of the drying process, when the moisture has been reduced to below 10%. The optimum time for other products of the Maillard reaction do not necessarily occur at quite this same moisture content.

The effect of temperature is by far the most significant of the three factors. Figure 6.4 shows the contours of the flavour volatile dihydro-hydroxymaltol (DHHM) with moisture and temperature (Edmondson *et al.*, 2005).

Similar contours were obtained by *tasting* finished crumb paste. Equivalent contours were obtained for the taste descriptors “brown fruit” and “treacle” (Wells, personal communication).



**Figure 6.3** Moisture content and the Maillard reaction.

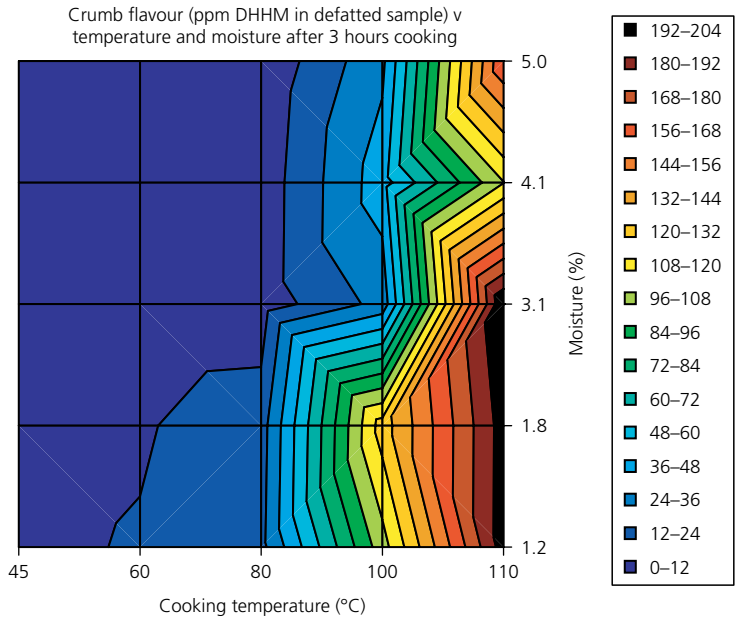


Figure 6.4 DHM formation during crumb manufacture after 3 h cooking.

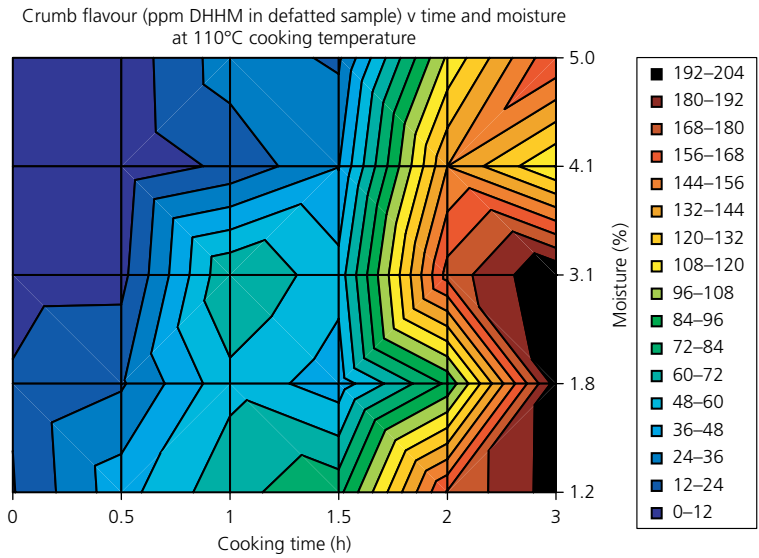


Figure 6.5 Effect of cooking time and temperature on the production of the flavour volatile DHM.

As expected, the cooking time was also significant, as shown in Figure 6.5.

It can be seen, therefore, that a very wide range of flavours can be produced by the crumb manufacturer, depending particularly on the moisture, temperature and reaction times of the process.