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Technical Paper

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WATER ACTIVITY AND ITS PRACTICAL IMPORTANCE FOR BAKED PRODUCTS

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The moisture content of a bakery product plays a key role in determining its eating quality and acceptance by consumers. A 'moist eating' characteristic is most often sought in bread crumb and cakes but is shunned in biscuits, hard cookies and pastry products. Bread products have moisture contents of around 40%, while that in cakes and sponges is between 15 and 25%. Biscuits and cookies are usually much lower in moisture, with levels below 10%, except for some soft eating cookies which are closer in eating character to cakes and may have moisture contents of around 15%. However, in the finished baked product there is another important property related to the presence of water, namely water activity .

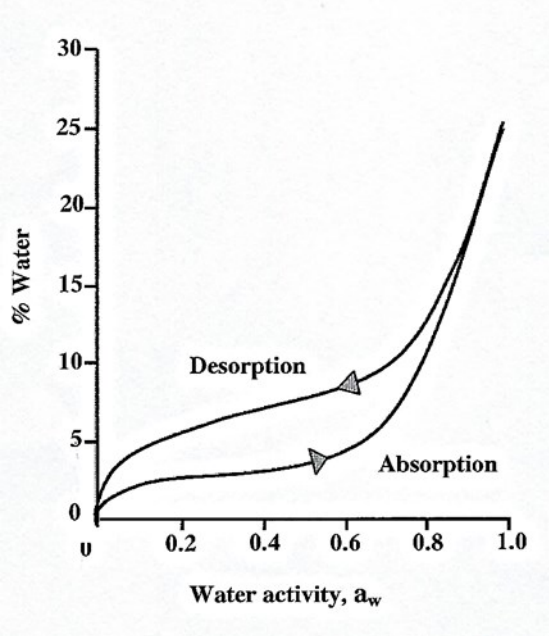
In addition to moisture content, water activity (a_w) and Equilibrium Relative Humidity (ERH) are terms used frequently in the description of bakery products. They are a means of explaining the potential of the behaviour of water within products or between components in a composite product. Simply, they are a measure of how mobile water is within a product and how it may therefore take part in a whole range of physical and chemical processes. As a measure of how well moisture is 'locked up' within a given product matrix, they are particularly useful as an indicator of the availability of water for microbial growth that may lead to food spoilage.

In addition, water activity and ERH give significant information on potential changes in food properties that are not related to microbial spoilage. Many of these changes relate to those properties which the consumer associates with the loss of freshness in the food, loss of intrinsic characteristics or to other adverse changes in the quality.

WATER ACTIVITY

The Links Between Moisture Content and Water Activity

For each bakery product, there is a unique relationship between its moisture content and its water activity; this can be expressed as a simple curve, which takes the general form shown in the adjacent Figure. The precise relationship between the two properties depends on whether the material being assessed is undergoing dehydration (e.g. drying or baking) or hydration (e.g. wheat flour proteins forming gluten, or the absorption of water by starch). The two different processes are usually described as desorption and adsorption respectively and they may yield different shaped curves. The individual curves are commonly referred to as isotherms, and to differentiate between the two processes it is common to refer to a desorption isotherm and an adsorption isotherm. It should be noted that individual ingredient and product isotherms are temperature-specific, and the temperature at which the isotherm was established should always be quoted. Once an isotherm has been established for a given food, changes in moisture level can be used to predict changes in product water activity.



The isotherms for ingredients that might be used in the bakery can be determined using solutions of known strength (i.e. known moisture and solids contents) and measuring the water activity of these solutions. By making a series of different strength solutions, it is possible to plot the curves and so derive the ingredient isotherm of interest. However, it should be appreciated that in the complex processes that are involved in the preparation of bakery foods, it is likely that many of the ingredients present undergo both of these changes, perhaps more than once. It is also difficult to be sure that the ingredient interactions that typically occur in bakery processes have not influenced the nature of an individual ingredient isotherm. Consequently, it can be particularly difficult to prepare the 'true' isotherm that would be the most relevant for practical use in baking. In such cases other, less precise but more practical techniques are of greater value.