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DETERMINATION OF SORPTION-ISOTHERMS IN FOOD

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Water activity (a_w) in food at known moisture content can be determined by instruments or determination of moisture content and equilibration against saturated salt solution in conventional desiccator. However, in these methods equilibration takes a long time, depending upon food composition. In this work a simple and inexpensive method has been developed to obtain sorption-isotherm in short time for determining a_w of a food. A small plastic cup was chosen (7cm/5cm) as a vessel. A weighed food in small glass beaker was rested on plastic stand in the vessel containing saturated salt solution 1/3 of its volume. The vessel was cap-closed and airtight. This technique was used for determination of a_w of dehydrated banana chips and equilibration was reached in 2 days which otherwise required 20 days for the conventional desiccator.

Key words: Modified method, Water activity (a_w), Banana chips.

Introduction

Microorganisms cannot carry out their normal metabolic activities or multiply without water. They cannot grow in pure water or in the absence of water, but grow only in aqueous solutions. Water activity (a_w) is an index of the availability of water for chemical reactions and microbial growth. The a_w is related to equilibrium relative humidity (ERH) or vapour pressure (VP). The a_w has been defined as the ratio of the VP of water above a material and pure water at the same temperature.

$$a_w = P/Po = ERH/100$$

where P= water vapour pressure exerted by food material, Po = vapour pressure of pure water at temperature To, which is equilibrium temperature of the system and ERH= equilibrium relative humidity. The moisture-sorption-isotherm relates moisture content of material to its a_w at a given temperature. In order to obtain a given point, a sample is equilibrated against a solution of a constant and known water activity and its moisture content determined. The primary standard for a_w equilibration is a saturated salt solution. The National Bureau of Standards published a list of 28 salts covering the a_w range 0.03-0.98 (Greenspan 1977).

Materials and Methods

Reagents. All chemicals were of Analar Grade, purchased from BDH Chemical Ltd, Poole, UK.

Preparation of Sample. The laboratory work was carried out in the Department of Food Science and Technology, NWFP Agricultural University, Peshawar. The banana chips before dehydration were sweetened with sucrose 20°brix (Alam *et al* 1994), sucrose-glucose 7:3 40°brix, glucose 40°brix and fructose 30° brix separately (Alam *et al* 1995).

Results and Discussion

To determine the equilibration of water activity of foods, the apparatus used is a large desiccator which holds the standard solutions in place of desiccant. A number of dishes holding the material rest on a support some distance above the solution. This takes many weeks to complete the equilibration. In this research the vessel chosen was a small plastic cup (height 7cm; width 5 cm). The vessel was filled with standard salt saturated solution 1/3 of its volume. Table 1 shows a list of salts used in this experiment. A small glass beaker containing weighed sample (1 g) of dehydrated sweetened banana chip (duplicate) was rested on plastic stand in vessel and then cap-closed and further air-tighted with cellotape. The sample was allowed for 24 h to reach equilibrium at 25°C. When the sample showed no gain or loss, it was considered to be at its equilibrium moisture content (EMC). Moisture content in sample was determined according to AOAC method (1984). The new modified proximity equilibration cell (MPEC) was compared with the conventional desiccator for equilibration of dehydrated banana chips at 25°C. The time taken by MPEC was 2 days as compared with 20-22 days of conventional desiccator. The results were obtained by plotting gain/loss in weight per unit time against known a_w values of salts used in the experiment (Landrock and Procter 1951). By interpolation the a_w value was read at that point where the smooth curve drawn through the plotted data intersects the baseline representing no weight change. Table 2 shows the value of water activity for dehydrated sweetened banana chips determined by MPEC and conventional desiccator. The results of both methods were similar. Four different products of dehydrated banana chips were studied for a_w determination. Product A (sweetened with sucrose 20°brix), Product B (Sweetened with sucrose/glucose

Table 1
Various salts and their water activity at room temperature

Salt	a_w
KNO_3	0.9462
$BaCl_2$	0.9103
$ZnSO_4$	0.8899
K_2Cro_4	0.8586
$(NH_4)_2 SO_4$	0.8134
NaCl	0.7547
NaBr	0.5914
$MgCl_2$	0.3307

Note:- Constant relative humidity varies slightly with temperature (Rockland 1960).

Table 2
Comparison of the conventional desiccator and the modified proximity equilibration cell (MPEC) for determining water-activity

Dried banana chips	Water activity (25°C)	
	Conventional desiccator	MPEC
Product A	0.748	0.754
Product B	0.670	0.663
Product C	0.705	0.710
Product D	0.654	0.652

7:3 40° brix), Product C (sweetened glucose 40°brix) and Product D (sweetened with fructose 30°brix). Further work of preparation, dehydration and treatment with various sweeteners of banana chips has already been reported in detail by Alam *et al* (1994, 1995).

Conclusion

In this work a new inexpensive and simple method "modified proximity equilibration cell (MPEC)," was developed to determine the water activity of a food. In this method a food sample was rested in small glass beaker in plastic cup (7cm/5cm) containing saturated salt solution. The same food sample was also studied for water activity by conventional desiccator. In MPEC method equilibration was reached in 2 days which otherwise required 20-22 days for the conventional desiccator.

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