Sorption Characteristics of Dietary Hard Candy

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Abstract

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This investigation is aimed at the determination of the effect of sugar alcohols sorbitol and isomalt on the sorption properties of hard candy. The equilibrium isotherms of two kinds of hard candy containing sorbitol and isomalt, respectively, were obtained by means of the static gravimetric method at a temperature of 20°C. The isomalt-containing candy proved to sorb less moisture under equal conditions. The Peleg model was found suitable for the description of the sorption isotherms of hard candy.

Keywords: hard candy; isomalt; sorbitol; equilibrium moisture content; sorption isotherm

Low-calorie sweeteners provide sweet taste without calories, or with very few calories. The consumption of low-calorie sweeteners continues to increase. This increasing interest in a health-conscious lifestyle and the advances in food technology stimulate the development of more and better tasting low-calorie foods (Livesy *et al*. 2000; Nabors 2002). Low-calorie sweeteners are also used in other consumer products (Biliaderis *et al*. 1999; Mendonca *et al*. 2002; Beck & Aramouni 2002; Ndindayino *et al*. 2002).

Knowledge of the sorption properties of foods is of great importance in food storage, especially as concerns the quantitative approach to the prediction of the shelf life of foods (Stencl *et al*. 1999; Al-Muhtaseb *et al*. 2002). The stability of hard candies during storage depends on a number of parameters (Davies & Labuza 1997; Raudonus *et al*. 2000). One important parameter characterising the stability of amorphous materials is the moisture content (Beck & Aramouni 2002; Nowakowski & Hartel 2002).

The objective of this study was to evaluate the equilibrium sorption isotherms of hard candy sweetened with isomalt and sorbitol.

MATERIAL AND METHOD

Material. Two kinds of hard candy containing sugar alcohols were investigated: manufactured by Sula®(Germany) with sorbitol, and manufactured by Alpi® (Bulgaria) with isomalt. The initial moisture content of the candies was 4.47% and 2.26% d.b., respectively.

Procedure.The equilibrium moisture contents (EMC) of the hard candy were determined at 20°C. The static gravimetric method was applied (Wolf *et al*. 1985). Samples of 0.5 ± 0.1 g were weighed in weighing bottles. The weighing bottles were then placed in hygrostats with eight saturated salt solutions (LiCl, $MgCl_2$, K_2CO_3, NaBr, $Mg(NO_3)_2$, $SrCl_2$, NaCl, KCl), used to obtain constant water activity (a_w) environments (Bell & Labuza 2000). All salts used were of reagent grade. At high water activities ($a_w > 0.70$), crystalline thymol was placed in the hygrostats to prevent microbial spoilage of the samples (Wolf *et al*. 1985). The hygrostats were kept in thermostats at 20 ± 0.1°C. Samples were weighed (using a balance with an accuracy of 0.0001 g) every three days. Equilibrium was acknowledged when three consecutive weight measurements showed a difference less than 0.001 g. The moisture content of each sample was determined by the air-oven method at 105°C. The EMC were determined by calculating the means of triplicate measurements.

Data analysis. The description of the EMC/a_W relationship was verified according to the following models:

Peleg $$M = A(a_w)^B + C(a_w)^D \quad (1)$$

GAB $$M = \frac{ABCa_w}{(1 - Ba_w)(1 - Ba_w + BCa_w)} \quad (2)$$

where: M – EMC in % d.b.
a_w – water activity as a decimal
A, B, C, D – coefficients

The model coefficients were calculated by the least squares method using a non-linear regression program.

The suitability of the equations was evaluated and compared using the correlation coefficient (r) and the mean relative error (P in %):

$$P = \frac{100}{N}\sum\left|\frac{M_i - \hat{M}_i}{M_i}\right| \quad (3)$$

where: M_i, $\hat{M}_i$ – the measured and the predicted values of EMC, respectively

RESULTS AND DISCUSSION

The mean values of EMC based on the triplicate measurements for the respective water activity are presented in Figure 1. The sorption isotherms follow the characteristic shape of high-sugar foods, type III BET classification (Bell & Labuza 2000), which adsorb small amounts of water at low water activities. However, the moisture content increased sharply at $a_w > 0.6$. The isotherms of some sugar substitutes are of the same kind (Weisser *et al*. 1982).

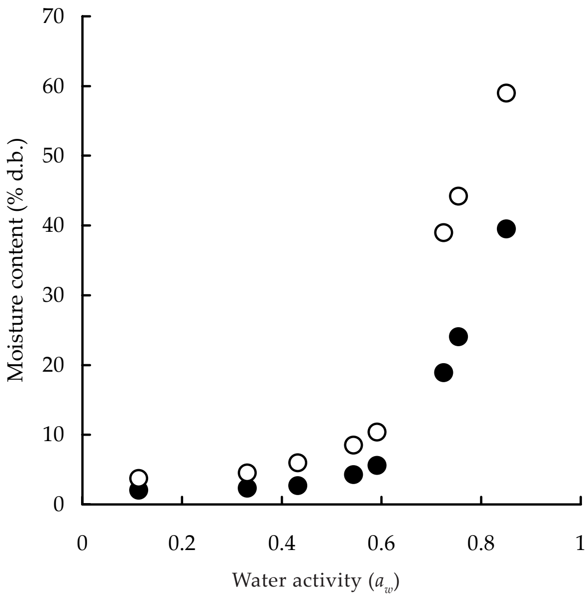

Figure 1. Moisture sorption isotherms of hard candy with: ○ sorbitol; ● isomalt

The observations showed that, at water activity of 0.75, the Sula candy sample lost its shape altogether, while the Alpi candy sample preserved it. The isotherm comparison of the two products demonstrated that the Alpi candy had a considerably lower sorption capacity at all water activities. The reason for that is its content of isomalt which is more hydrophobic than sorbitol (Raudonus *et al*. 2000).

The two models offer a fairly good description of the experimental data up to water activities $a_w < 0,75$. The model coefficients obtained and the values of the mean relative error and of the

Table 1. Model parameters

Parameter	Alpi		Sula	
	GAB	Peleg	GAB	Peleg
A	86.861	173.281	331.601	268.923
B	1.0295	7.354	0.999	6.607
C	0.0191	2.3344	0.0116	3.987
D	–	0.056	–	0.002
P (%)	4.720	2.420	11.090	9.060
r	0.994	0.9997	0.989	0.995

coefficient of correlation (a_w range of 0.1–0.75) are presented in Table 1. With regard to the results of the analysis, the Peleg model can be recommended for the description of the equilibrium isotherms of dietary hard candy.

Conclusions

Hard candies exhibited type III (BET classification) sorption isotherms;

The presence of isomalt in candies reduces their sorption capacity;

The Peleg model can be used to predict the sorption behaviour of hard candies in the range of water activity of 0.1–0.75.

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Souhrn

Hadjikinova M., Menkov N., Hadjikinov D. (2003): **Sorpční vlastnosti dietních tvrdých cukrovinek**. Czech J. Food Sci., **21**: 97–99.

Cílem výzkumu bylo stanovení vlivu alkoholických cukrů sorbitu a isomaltu na sorpční vlastnosti tvrdých cukrovinek. U dvou druhů tvrdých cukrovinek obsahujících sorbitol nebo isomalt byly stanoveny rovnovážné isothermy při teplotě 20 °C. Za shodných podmínek vykázaly cukrovinky obsahující isomalt nižší sorpci vody. Pro popis sorpčních isotherm tvrdých cukrovinek byl shledán vhodný model podle Pelega.

Klíčová slova: tvrdé cukrovinky; isomalt; sorbitol; rovnovážný obsah vlhkosti; sorpční isotherma

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