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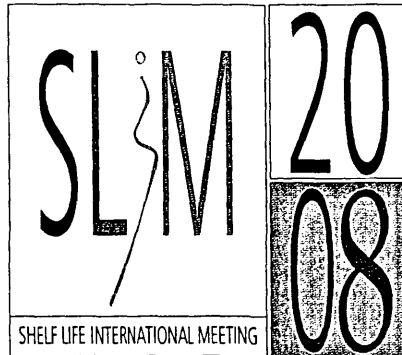
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APPLICATION OF GAB OR OTHER MODELS FOR WATER SORPTION ISOTHERMS DETERMINATION OF TRADITIONAL BAKERY PRODUCTS

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ABSTRACT

The vapour sorption isotherms of five typical baked foods were determined at 20°C. In particular, the methodology proposed by Cost Projects 90 and 90 bis have been used. The latter procedure implies using a proper number of pieces of each product. The products have been closed in desiccators, in which nine different equilibrium relative (ERH) humidity have been created. The relative humidity inside desiccators have been checked daily until equilibrium, before placing samples. Moisture content of samples has been measured by a gravimetric method, while water activity has been determined by a dew-point hygrometer. All obtained data have been interpolated to fit the GAB equation or other equations and the mean relative percentage deviation modulus (E%) calculated.

Key words: bakery products; biscuits; cookies; shelf-life; sorption isotherms.

INTRODUCTION

The shelf-life of packaged foods is strictly dependent on product formulation and technology, on packaging characteristics, mostly as barrier to gases and light, and

on storage conditions. The shelf-life can be predicted both with the classic, but time and cost expensive, simulated approach, either by normal or accelerated testing, or by a more simple and flexible mathematical model approach, which takes in consideration all the variables related to product/packaging/environment system (Fava *et al.*, 2000). One of the key factors in setting up the mathematical model is the obtainment of food sorption isotherms.

The aim of this work was to obtain the sorption isotherms of five typical Sardinian bakery products, in order to use them in further mathematical modelling for shelf life evaluation.

MATERIALS AND METHODS

Five traditional bakery products (“tiriccias”, “copulettas”, “papassinos”, biscuits and savoyards) were obtained by a local plant and soon transported at our lab, where they were immediately used for the determinations. The vapour sorption isotherms were determined at 20°C. In particular, the methodology proposed by Cost Projects 90 and 90 bis have been used (Wolf *et al.*, 1985). The latter procedure implies using a proper number of pieces of each product. The products have been closed in desiccators, in which nine different equilibrium relative (ERH) humidity have been created by using nine salts, ranging from 0.11 to 0.92 aw, and weight changes at different times have been measured until a constant value has been attained. The relative humidity inside desiccators has been checked daily until equilibrium with a Micropack Humidity Data Logger (Mesa Laboratories, Inc., Colorado USA), before placing samples. Moisture was evaluated in triplicate according to the AOAC method (AOAC International 2000), while water activity has been determined by a dew-point hygrometer (Aqualab Series 3, Decagon, Pullman USA). All obtained data have been interpolated to fit the GAB equation or other equations using TableCurve 2D software Version 5.01. To evaluate the goodness of fit of each model, the mean relative percentage deviation modulus (E%) was used. The E% is widely adopted throughout the literature, with a modulus value below 10% indicative of a good fit for practical purposes (Lomauro *et al.*, 1985).

RESULTS AND DISCUSSION

The Table 1 shows the estimated parameters of model coefficients and the corresponding mean relative percentage modulus, that describe the goodness of fit of the isotherms of the five bakery products. Moisture sorption isotherms of the five products clearly show a sigmoid (Type II) shape. Examination of the results indicate that the GAB and BET models best describes the experimental adsorption and desorption data for the bakery products considered throughout the entire range of water activity. In fact, the E(%) value was always below 10% when using BET and GAB models. Modelling of sorption data with BET and GAB equations allows the determination of monolayer moisture content values, m_0 , which ranged 0.0345-0.0542 g/g on dry basis and 0.0355-0.0599 on dry basis, respectively. The values are in the range found for other starchy based foods (Lomauro *et al.*, 1985; Palou *et al.*, 1997; Kim *et al.*, 1998). It is noteworthy the higher m_0 value of tiriccias and copulettas, that differ from the other products, as they have a short crust.

Table 1 - Estimated values of coefficients and mean relative percentage deviation module obtained for sorption models applied to experimental adsorption data

Model	Constants	Products				
		Tiriccas	Papassinos	Biscuits	Savoyards	Copulettas
GAB	Mo	0.0599	0.0355	0.0413	0.0378	0.0570
	K	0.9770	1.0541	0.9766	1.0187	0.9955
	c	4.4936	2.7933	3.8600	3.0227	1.8191
	E(%)	1.96	2.91	5.52	1.76	8.61
BET	Mo	0.0534	0.0497	0.0345	0.0451	0.0542
	c	7.311	1.3695	8.977	1.7649	2.2873
	E(%)	2.21	4.78	3.34	5.41	6.38
Oswin	a	2.4071	3.021	3.430	4.5430	4.0387
	b	0.5544	-0.7032	-0.560	-0.1683	-0.030
	E(%)	15.23	22.67	36.66	42.78	37.81
Chen	a	0.1138	0.2218	0.110	-0.0958	-0.1687
	b	-1.0038	-1.8121	-1.450	-2.0091	-1.8029
	E(%)	19.84	32.18	44.86	51.10	47.23
Henderson	a	-0.7163	-0.8511	-0.7441	-0.4018	-0.2871
	b	2.2591	2.8051	3.1824	4.1594	3.6718
	E(%)	15.58	21.45	35.14	40.76	35.48

The data reported can be useful for food manufacturers to predict the shelf life of these products.

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