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NOTE

MOISTURE SORPTION ISOTHERM AND TEXTURE CHARACTERISTIC OF APPLE LAVASHAK[1]

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ABSTRACT

The lavashaks produced from Golden Delicious apples were examined for their moisture sorption isotherms and hardness. The moisture sorption isotherm followed the shape typical of most dehydrated fruits. The moisture content of apple lavashak at Aw 0.6, which is considered to be a limit for microbial stability, was 0.26 g/g solid. Hysteresis was considerable for this product. Textural index measured with a penetrometer at Aw of 0.6 was 15, which was considered to have a suitable hardness.

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جذب رطوبت همدما وخصوصیات بافت لواشک سیب

رستم فرجی

استادیار بخش صنایع غذایی وعلوم تغذیه دانشکده کشاورزی دانشگاه شیراز

خلاصه

لواشک تهیه شده از سیب گلدن دلیشس از نظر جذب رطوبت همدما وسفتی بافت مورد آزمایش قرار گرفت. منحنی های جذب رطوبت همدمای این محصول همانند میوه های خشک شده دیگر دارای شکل خاص خود بودند. مقدار آب لواشک محصول در فعالیت آبی کمتر از ۰/۶، که حد پایدار بودن محصول از نظر میکروبیولوژیکی تلقی می شود، مساوی ۰/۲۶ گرم در گرم ماده خشک مشخص شد. هیسترسیس در این محصول نیز قابل ملاحظه بود. سفتی بافت محصول که در فعالیت آبی ۰/۶ با دستگاه پنترومتر اندازه گیری شد، مساوی ۱۵ بود.

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INTRODUCTION

Because of the high production of apples in Iran, there has been an interest to preserve them in forms other than canning or juicing. Drying of apple pulp to produce a product called lavashak is one of the methods which can commonly be used as for other fruit lavashaks. Lavashak is produced by pulping the fruit and spreading it on plates in 0.5 to 1 cm thickness, and drying it either by sun or in a cabinet or tunnel drier.

However, there is a question concerning the quality of the product in terms of texture, color and microbial stability. The extent of water removal is the major factor which determines the microbial stability, according to its water activity (2, 7), and suitability of texture. Smooth texture is important for consumption and an optimum hardness is also important for packing the product. Preparation practices and the method of dehydration may also affect these characteristics (2).

The objective of this study was to determine the effect of moisture removal on the quality of apple lavashak (as determined by texture and water sorption isotherm) which affects the acceptability and stability of the product.

MATERIALS AND METHODS

Fresh apples (Golden Delicious) were purchased from a central distributing market (September through November) and held at 0°C until used (within one week). Lavashak was produced by crushing the whole washed apple, vapor blanching for three minutes at 100°C, and then pulping and finishing through 0.7 mm and 0.4 mm sieves, using a Vettori Manghi pulper finisher. The pulp was spread on trays in 0.5 cm thickness and dried in a cabinet dehydrator at 60°C to a final water content of 0.1 g g^{-1} solid.

Moisture was determined by vacuum oven method at 70°C for

6 to 12 hours (1) and isotherms were prepared using a desiccator technique at 25° C (4). Freeze-dried lavashak samples were used for adsorption studies.

The effect of a temperature shift on the moisture sorption isotherm of lavashaks was determined by a canister-type hair hygrometer (Lambrecht thermo-hygrometer). Each sample used in desiccator method was put into the hygrometer chamber and held at different temperatures (25° C, 35° C and 45° C) for 24 hours to reach equilibrium with the head space before reading was made. The hygrometer was calibrated at 25° C, 35° C and 45° C, using saturated salt solutions of known Aw.

Texture was estimated by hardness determination on the penetrometer (Model 18-007) equipped with an electronic detector (Model 18-009) for the precise adjustment of the penetration tip to just make contact with the test sample surface. From each drying run, five dried samples were examined five times in different places with a 2 cm round bottom metal plunger (10 g and with a load weight of 20 g). The mean of 25 punches was recorded as hardness of the samples in penetration unit (1 unit = one-tenth of mm of penetration).

RESULTS AND DISCUSSION

The moisture sorption isotherm of apple lavashak determined by the desiccator technique (Fig. 1) followed the shape typical of most dehydrated fruits (3). The corresponding values for adsorption and desorption are shown in Table 1. The data indicate that at a given Aw the moisture contents of rehydrated product is considerably higher than that of dehydrated product, which means that for a given Aw, more moisture must be removed from rehydrated than dehydrated product. This characteristic is indicated as hysteresis of the product, which is due to high sugar content in apple. The moisture contents of apple lavashak at Aw of 0.6, which is low enough for microbial stability (7) are 21.2%

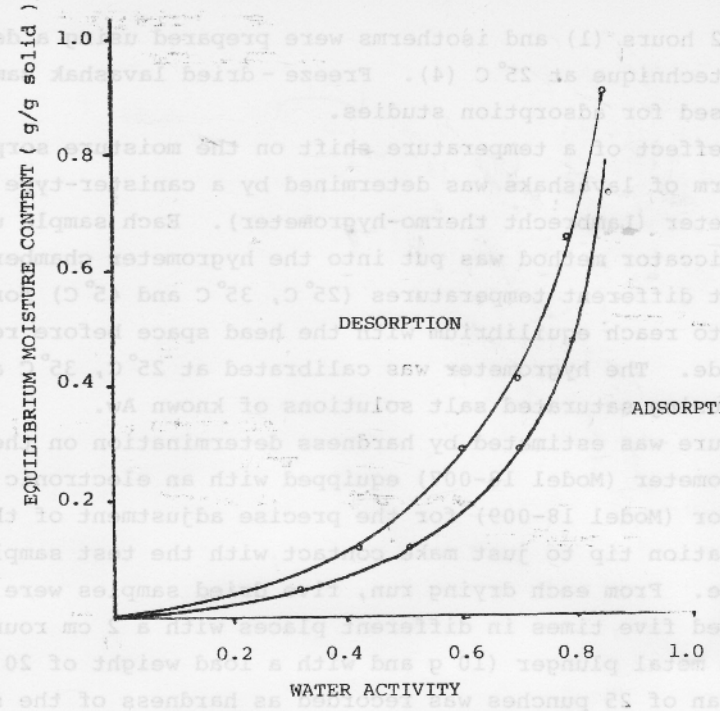

Fig. 1. Adsorption and desorption isotherm at 25°C for apple lavashak.

Table 1. Aw and corresponding moisture contents.

Aw	Moisture content			
	Desorption		Adsorption	
	Db	Wb	Db	Wb
0.32	0.07	65	0.05	4.7
0.42	0.12	10.7	0.08	7.4
0.50	0.18	15.2	0.11	9.9
0.60	0.27	21.2	0.17	14.5
0.65	0.34	25.3	0.22	18.0
0.70	0.42	29.5	0.27	21.2
0.78	0.62	38.2	0.43	30.0
0.86	0.90	47.3	0.80	44.4

(0.27 g g^{-1} solid) and 14.5% (0.17 g g^{-1} solid) for desorption and adsorption isotherms, respectively.

Therefore according to these sorption isotherms it is more efficient to stop drying at 21.2% (0.27 g g^{-1} solid) moisture rather than drying to lower moisture content followed by remoisturizing to above water content. In the first case the product follows the desorption isotherm curve that at 21% moisture the Aw is about 0.6 which should keep the dried lavashak stable from microbial point of view during storage. However, if drying continues far down, the dried lavashak must then be rehydrated to reach 21% moisture. In this case it follows the adsorption isotherm curve, where the final Aw is around 0.7 which makes it susceptible to microbial spoilage.

The effect of temperature on isotherm is shown in Fig. 2, which indicates that hygroscopicity increased in the range of temperatures examined. These results are in agreement with those obtained by Loncin *et al.* (5) who found that for

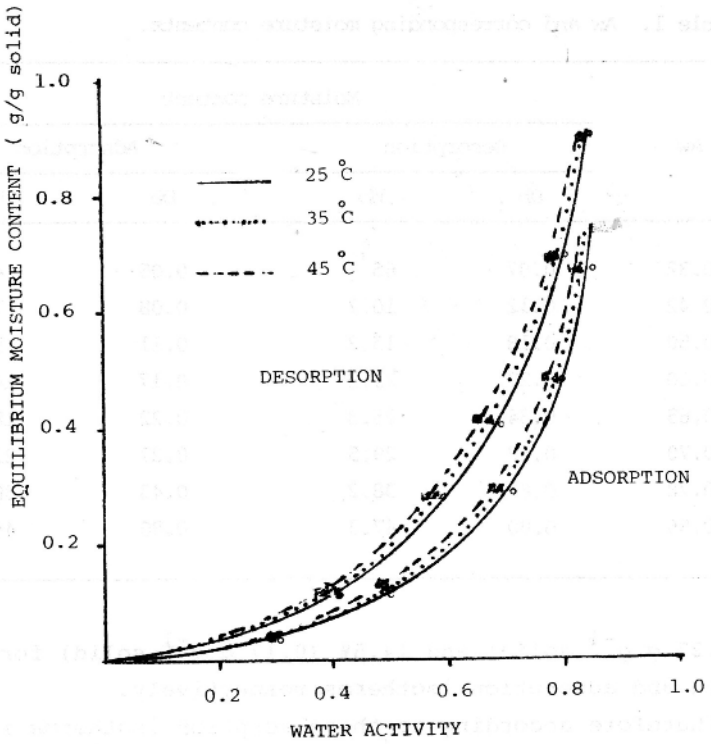

Fig. 2. Water activity shift for apple lavashak at a constant moisture content.

glucose with high moisture content (0.1 g g^{-1}), the hygroscopicity increased with an increase in temperature. The characteristic of the product leads to a better microbial stability but has an adverse effect on efficiency of drying.

Evaluation of the effect of moisture content on texture has been hampered by the difficulties of objectively quantifying texture. Although various tests have been applied, this characteristic remains essentially a subjective attribute. However, a number of studies convincingly have shown that the moisture content of dried or semidried foods plays an important role in determining texture (7).

Although standards for any fruit lavashak texture have not yet been established, the best quality of lavashak texture attributes could be considered to be those which provide an optimum hardness suitable for both eating and packing.

The texture index examined by penetrometer is shown in Fig. 3. It indicates that penetrometer units which are indicative

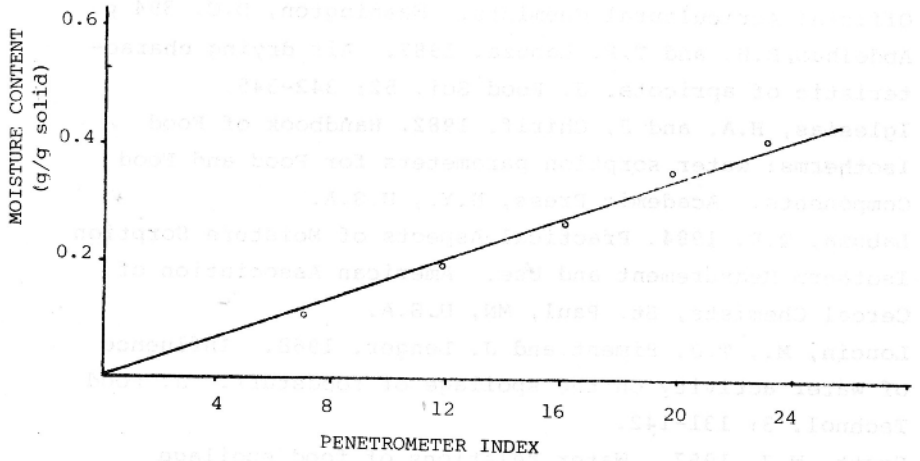

Fig. 3. Effect of moisture content on texture (penetrometer) of apple lavashak.

of softness have linear relationship with moisture content. The penetrometer unit for lavashak with an Aw of 0.6, which is considered to have a good microbial stability (7) was 15. This texture index value was considered to have an optimum hardness in terms of eating and packing of the product. However concerning other qualities of the product, such as browning, effect of SO_2 and organoleptic criteria, more investigations are needed.

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