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Effect of blanching on drying kinetics of quince pomace undergoing conventional hot air and low-pressure superheated steam drying

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The process of extracting fruit pectin includes the drying of pomace to prevent enzymatic destruction. It is known that best quality pectin is obtained from pomace dried at low temperature. Moreover, blanching and reduction in oxygen content as that condition obtained by low-pressure superheated steam drying (LPSSD), reduce pectin color. Last improve is obtained by inhibition of enzymatic reactions. The main objective of this work was to determine the effect of blanching on drying kinetics of quince pomace undergoing conventional hot air and LPSSD drying, a method recognized as less aggressive. Quince pomace drying was conducted to final to initial water content ratio (X/X_o)< 0.07, where X is the water content. Drying curves were fitted to Page model. Results show statistical differences between drying methods; however, differences in kinetics were not found among treatments (blanching or not). As a conclusion, blanching of quince pomace did not affected drying kinetics, and both assayed methods of drying (conventional and LPSSD) required the same time to reach the same final water content. Therefore, pomace drying method should be selected by preferentially considering pectin quality and energy consumption.

1 Introduction

The process of extracting fruit pectin includes the drying of pomace to prevent enzymatic destruction. Papers on the quality of pectin extracted from commercially dried citrus and apple pomace are accessible (Crandall et al., 1978; Constenla et al., 2003). However, work showing the loss of pomace quality during drying of alternative pectin sources, as quince, are unavailable. It is known that best quality pectin is obtained from pomace dried at low temperature. Moreover, blanching and reduction in oxygen content as that condition obtained by low-pressure superheated steam drying (LPSSD), reduce pectin color (Pelegrina et al., 1998; Elustondo et al., 2002). Last improve is obtained by inhibition of enzymatic reactions. The main objective of this work was to determine the effect of blanching on drying kinetics of quince pomace undergoing conventional hot air and LPSSD drying, a method recognized as less aggressive.

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2. Materials and Methods

The quince pomace studied was obtained from commercial fruits harvested in 2008. Quince fruits were washed and cut with a lab cutter (Mervisa Model 3, Brasil). Juice was extracted by pressing in a hydraulic press (6 Bar). Obtained pomace was washed both in cold and hot (70ºC) water for 10 min, to reduce sugar content and to inhibit enzymes activity, in the last case (blanching). After that, blanched samples were cooled down in cold water and 0,6 kg pomace aliquots were individually dried in (i) a continuous, rotary drier, or (2) a low-pressure superheated steam drier, LPSSD (Fig. 1). Conventional drying conditions were speed of rotation, 45 rpm; air velocity, 1.0 m/s; and T_{dr}= 60°C, measured at the air outlet. LPSSD system was performed under the same comparative drying conditions (0,6 kg pomace in a rotary basket at 45 rpm and 60ºC) but total pressure was reduced to 100mBar, to ensure steam overheating. Initial pomace moisture content was approximately 0,8 g/g.

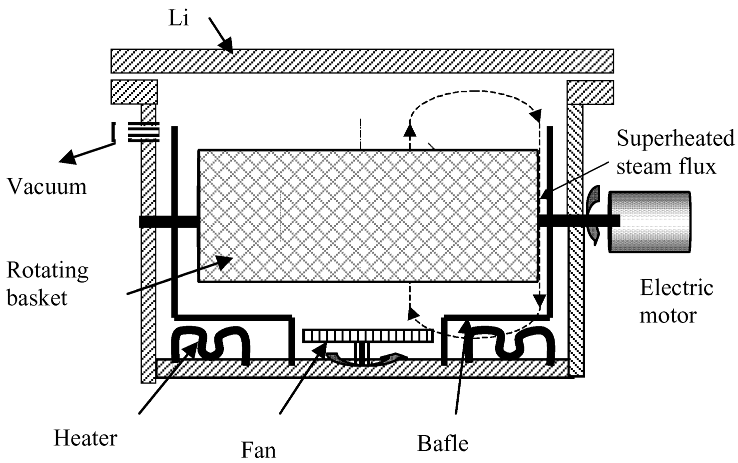

Figure 1: Schematic representation of the low-pressure superheated steam drier.

A typical experimental run lasted 4-6 h to reach a final to initial water content ratio (X/X_o)< 0.07, where X is the water content. Drying curves were fitted to Page (Eq. 1) model:

$$X/X_o = \exp(-kt^n) \quad (1)$$

where X is the water content (kg water/kg dry matter); subscript "*o*" is for initial water content; t is time (h) of drying and k and n are empirical coefficients.

Experiments were performed by triplicate. Statistical comparison of data was determined using analysis of variance (*ANOVA*), followed by the Bonferroni post-test adjustment, where applicable.

3. Results and discussion

Figs. 2 shows typical drying curve for conventional hot-air system of blanched and unblanched quince pomace. On the other hand, effect of blanching on drying kinetics in the case of low pressure superheated steam drying is shown in Fig. 3.
Results show statistical differences between drying methods; however, differences in kinetics were not found among treatments (blanching or not). Table 1 lists *k* and *n* values for conventional and low pressure superheated steam drying of unblanched and blanched quince pomace.

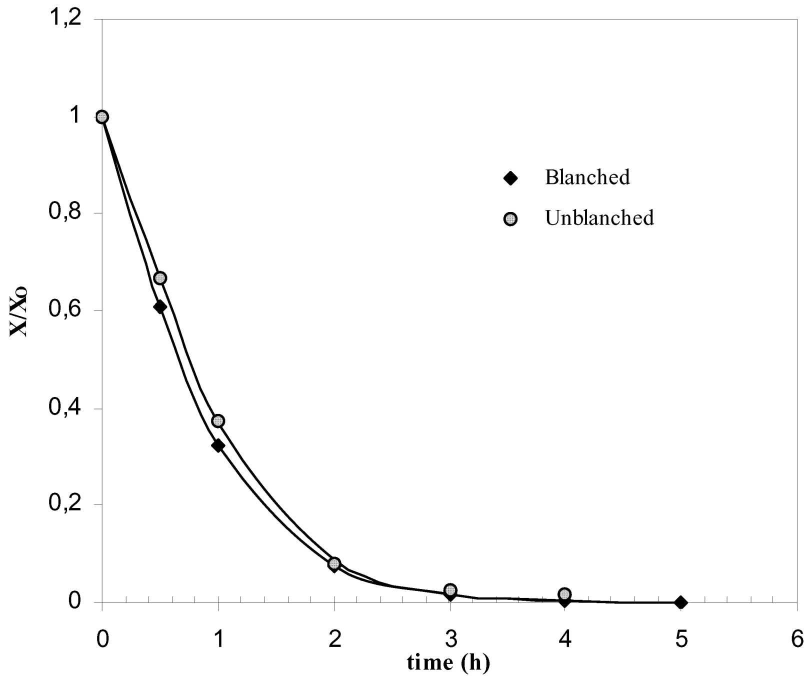

Figure 2: Conventional air drying kinetics of blanching and unblanched quince pomace. Full lines represent Page (1949) model.

Figs. 2 and 3 also shows important differences in drying kinetics with drying method. While conventional air-drying practically shows a monotonic exponential decrease with time, in the case of pomace dried with the LPSS system, a very well defined initial period of drying was observed. Traditional drying literature refers to the constant rate period an interval in which the surface contains free moisture and the material remains at the wet bulb temperature (Crapiste and Rotstein, 1997).

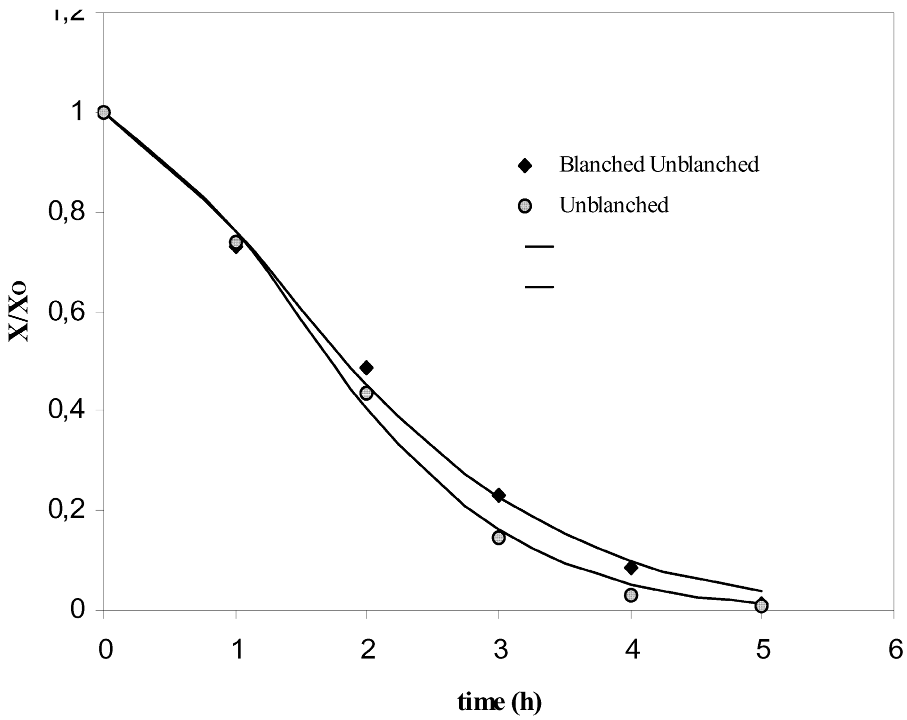

Figure 3: low-pressure superheated steam drying kinetics of blanching and unblanched quince pomace. Full lines represent Page (1949) model.

Table 1: Parameters of the Page's (1949) model of drying (Eq.1)

Eq. (1) parameters	**Drying method**			
	Conventional	Conventional Blanched	LPSSD	LPSSD Blanched
k	*1.017*	*1.039*	*0.303*	*0.264*
	*a**	*a*	*b*	*b*
n	*1.332*	*1.338*	*1.652*	*1.582*
	a	*a*	*b*	*b*

- *Distinct letters correspond to significative differences ($p < 0.05$).*

Fig 4 shows the effect of temperature on conventional drying kinetics of quince pomace. Results clearly indicate that the improvement in drying rate due to an increase of 10ºC in air temperature is not significant enough to submit pomace to more deteriorative conditions, compromising pectin quality.

As a conclusion, blanching of quince pomace did not affected drying kinetics, and both assayed methods of drying (conventional and LPSSD) required the same time to reach the same final water content. Therefore, the method used to dry quince pomace should be selected by preferentially considering pectin quality and energy consumption.

Determination of the properties of pectin obtained from dried quince pomace is in progress..

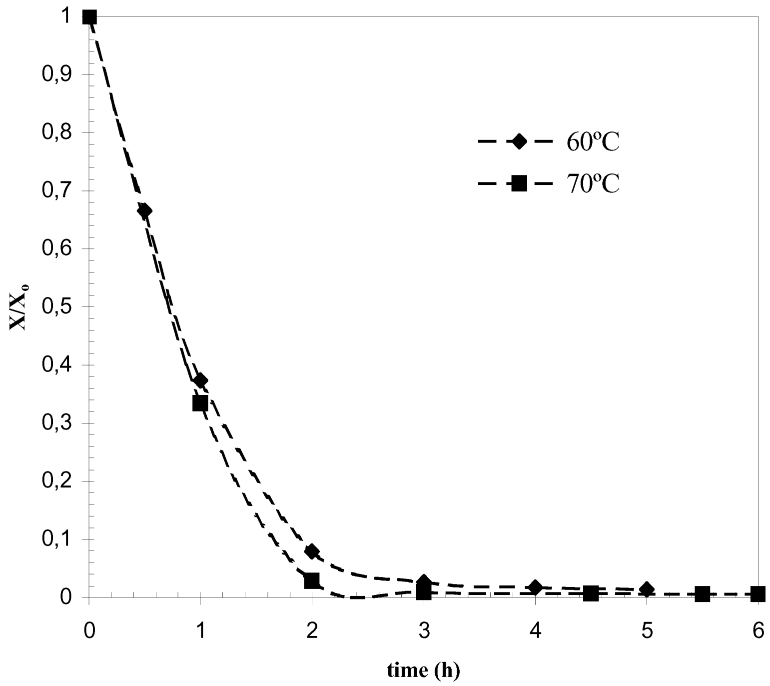

Figure 4: Effect of temperature on the conventional air drying kinetics of quince pomace.

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