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Development of a mathematical model for apple juice compounds rejection in a spiral-wound reverse osmosis process

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1	Development of a Mathematical Model for Apple Juice Compounds Rejection in a Spiral-wound Reverse Osmosis Process
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7 8	Abstract
9	The use of Reverse Osmosis (RO) membrane processes for the clarification and the
LO	concentration of apple juice is proposed as an alternative to the conventional concentration
L1	technique, which is based on evaporation and freezing. Several models have been published
L 2	on RO process models relying on different assumptions that predict the permeate flux and
L3	aroma compounds rejections for aqueous solutions apple juice. The solution-diffusion mode
L 4	(Lumped model) has been applied for the previous models. The main instrument of this study
L5	is the use of the gPROMS software to develop a new distributed steady state model that will
16	relax a number of earlier assumptions.
L 7	The model has been validated with an observational data of apple juice filtration derived from
L8	the literature by analysing the permeate flux and the performance of membrane rejection a
L9	different concentrations, temperatures and pressures for a laboratory scale of spiral-wound
20	RO module. Simulated results corroborate with experimental and model predictions.
21	
22	Keywords: Apple Juice Concentration; Spiral-wound Reverse Osmosis; One Dimensional
23	Distributed Model; gPROMS software.
24	1. Introduction
25	The concentration of fruit juices is achieved by reducing the water content. This has many
26	advantages, including easier and cheaper conservation, storage, transportation and
27	distribution of the extracted juice. Conventional methods of fruit juices concentration are
28	usually conducted using a high temperature multi-stage vacuum evaporation process. This
29	process usually results in significant losses of nutritional compounds, such as vitamin C, as

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well as associated thermal effects (Pozderovic' et al. 2006). As a result, RO has become an

alternative process to the conventional methods for removing water from fruit juices and

other liquid foods (Girard and Fukumoto, 2000). However, one of the main disadvantages of

using RO is related to lower concentration of the yield in comparison to the thermal process

due to high osmotic pressure limitation. Having said this, the RO process has affirmed its

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