

Drying tomatoes in a small tray dryer

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Abstract: Drying tomatoes with high initial moisture content have several advantages such as: maintaining mineral constituents, inhibition of the action of microorganisms, reduction of the cost of transportation, handling, and storage and is an alternative to the problems of waste disposal and pollution. Moreover, dried products, besides the more economical and affordable package, is an option for light and quick meals. Small and low cost tray dryers are hard to find in the Brazilian market. Producing your own dehydrated food is a practice used in many countries for domestic consumption, as a gift, for small-scale enterprises, because some people appreciate handmade products that are related to a healthier product, without additives. The present study aimed to dry tomatoes and evaluates the characteristics such as: loss of final mass, drying time, and cost of drying in a portable low cost tray dryer. The dryer was built in plastic body and trays. Two heating conical resistors with 600 W each, and a 26W-fan were used. Approximately 1.4 kg of tomatoes was used in this test. The samples were previously sliced, washed, and the endocarp and seeds were removed. The weight loss during the process was obtained by successive weightings of tomatoes in the trays each hour. The final drying was determined when the tomatoes were around 25% of moisture content. The initial moisture content of the tomatoes was determined by oven drying using 10 g of chopped tomatoes, dried at 95 °C for 24 h. To evaluate the drying cost the yield of dried tomatoes, the losses during the preparation of the fresh tomatoes slices, the drying time, and the rate of product ready for the drying period were determined. The energy cost was US\$ 1.97, plus US\$ 0.13 of osmotic solution, additional R\$ 7.80/kg of tomatoes (off season). The final cost was US\$ 5.35 to process 1 kg of fresh tomatoes. During the season, one can buy tomatoes at US\$ 0.42/kg, which reduces the cost to US\$ 2.50/kg. Whereas the process reduces weight by 10.83 times, the pound of dried tomatoes would cost US\$ 27.15 in crop condition. As this portable dryer holds 2 kg of tomatoes by drying, the cost could be reduced to US\$ 1.55/kg considering fresh tomatoes or US\$ 16.50/kg dried tomatoes. The dryer presented the ideal medium parameters for drying fruits (51.6 °C and 1.2 m/s) in a drying process of 8 hours. The cost per hour of drying in this experiment, due to be in between tomato crop season was considered high. However, there are conditions to reduce this cost at the harvest time and by increasing the density of tomatoes in the dryer trays.

Keywords: drying, tomatoes cost

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1 Introduction

Tomatoes (*Lycopersicon esculentum* Mill) are considered a fruit because they are developed from

fertilized ovaries and have seeds inside their locular cavity. The dried tomatoes is a product that has recently hit the Brazilian market shelves and displays an increasing consumption mainly as an ingredient in pizzas, salads, and pastas (RAUPP et al., 2009).

Drying tomatoes with high initial moisture content has advantages such as: maintenance of mineral constituents; inhibition of the action of microorganisms;

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reducing costs of transportation, handling and storage, and because it is an alternative solution to the problems of waste disposal and pollution. Moreover, dried products are a more economical and affordable option for packaging and could offer light and quick meals (LUH & Woodroof, 1975).

Osmotic dehydration is used as pre-treatment of the drying tomatoes process since it allows to obtain a final product with better appearance, sensory, and nutritional quality, also reducing energy costs of the drying process. It consists in soaking the tomatoes in a solution with water activity lower than the food, such as brine or syrup (Camargo, 2003).

Queiroz & Campbell (2003) studied the drying time of tomatoes at a temperature of 60 °C. The tomatoes that were cut into four pieces and were seedless were dried at approximately half of the time of those halved and with seeds. The tomatoes were dried to moisture content levels varying from 25% to 35% and afterward the process the tomatoes were immersed in oil with 3% NaCl.

Small and low cost tray dryers are hard to find in the Brazilian market. To produce your own dehydrated food is a practice used in many countries for domestic consumption, for gift, for small-scale enterprises, because some people appreciate handmade products that are associated to the idea of a healthier product, without additives.

The present study aimed to dry tomatoes and evaluated the characteristics of the product such as the loss of final mass, the drying time, and the cost of drying in a portable tray dryer made with low cost.

2 Material and methods

A plastic electric tray dryer was built. Its heating source was two heating conical resistors of 600 W each. The air flow was provided by a CE, 26 W, 220 V/60 Hz fan.

The material to be dried was 1.36 kg of usual tomatoes. They were previously washed in potable water and immersed in water solution containing 250 mL/L of

sodium hypochlorite at 2% - 2.5% of active chlorine for 30 minutes. The treatment consisted in 2 parts of solution to 1 part of tomatoes in weight, to eliminate contamination by microorganisms. Then, the tomatoes were cut into four pieces, with a stainless steel knife. The seeds were cored and removed. A pretreatment was performed on tomatoes, leaving them immersed for 4.5 hours in an osmotic solution of 3% NaCl and 10% of sugar, according to Carlson et al. (2009), in the proportion of 1:2 by weight (tomato:solution) at 40 °C, to promote pre-dehydration and improve the sensory quality. After this, the tomatoes were quickly washed in filtered drinking water and dried with paper towels. The skin was pierced with toothpick. Then, they were placed in an airtight container in refrigerator at 5 °C for 14h. They were then weighed and arranged in the trays of the dryer side by side with the peel side down. The ambient air conditions were observed, as well as the air dryer exhaust flow.

To determine the weight loss the product and the trays were weighed every hour and Equation 1 to calculate the losses in the process was used:

$$P_m (\%) = \frac{(M_0 - M_f)}{M_0} \times 100 \quad (1)$$

where,

P_m = mass loss (%);

M_0 = initial mass (kg);

M_f = final mass (kg);

The final drying was established when the tomatoes had about 25% of moisture content. The initial moisture content of tomatoes was determined by the oven drying method, using 10 g of chopped tomatoes for each sample. The samples were dried at 95 °C for 24 h in triplicate.

The yield of dried tomatoes, the losses during the preparation of the fresh tomato slicing, the drying time, and the rate of product ready for the drying period was determined to evaluate the cost.

3 Results and discussion

The initial moisture content of tomatoes was 95.3%. The room temperature of the air was 20 °C and the

relative humidity was 65%. During the pretreatment of tomatoes their mass decreased by 34.26%, because of the seeds and medium portion removal of the tomatoes. This value agrees with the one reported by Raupp et al. (2009). Osmotic solution decreased more the weight to 24.86%. This treatment avoided a loss on drying energy. The drying itself decreased 81.31% the mass, which means 435% of reduction in weight in each drying batch, which means 5.35 times. The yield of fresh whole tomatoes compared to the final product was 9.23%, a value close to the one found by Raupp et al. (2009).

The energy cost was US\$ 1.98 plus US\$ 0.13 of osmotic solution, additional US\$ 3.26/kg of tomato (off-season). The final cost was US\$ 5.36 to process 1 kg of fresh tomatoes. During the harvest time one can buy tomatoes at US\$ 0.042/kg, which would reduce the cost to R\$ 2.52/kg. Whereas the process reduces weight by 10.83 times, the kg of dried tomatoes would cost US\$ 27.28 in the harvest time.

As portable dryer holds 2 kg of tomatoes by drying batch, the cost could be reduced to US\$ 1.53/kg of fresh tomatoes or US\$ 16.60/kg of dried tomatoes.

It was noticed that the price of dried tomatoes is very dependent on the price of fresh tomatoes, but mainly the production scale.

The dried tomatoes on the market is usually sold

pickled in oil, which increases the overall weight of the product. This way, it can be sold at a less than 1 kg of dried tomato price. Another factor to be considered is the degree of occupation of the tray in the dryer. In this study 2.46 kg.m⁻² were used, while Camargo (2003) recommends 8 kg/m².

The portable dryer (Figure 1) showed average values for temperature (51.6 °C), speed of the drying air (1.2 m/s), and weight loss of the product during the drying process, as shown in Figure 2. The bottom tray, by being closer to the heat source, took less time to get ready. The dried tomatoes produced in this experiment showed intense red color, characteristic and pleasant smell, similar to tomato paste, slightly acid flavor, soft texture, and easy to chew, not observed by trained panelists.



Figure 1 Tomatoes ready for the drying process.

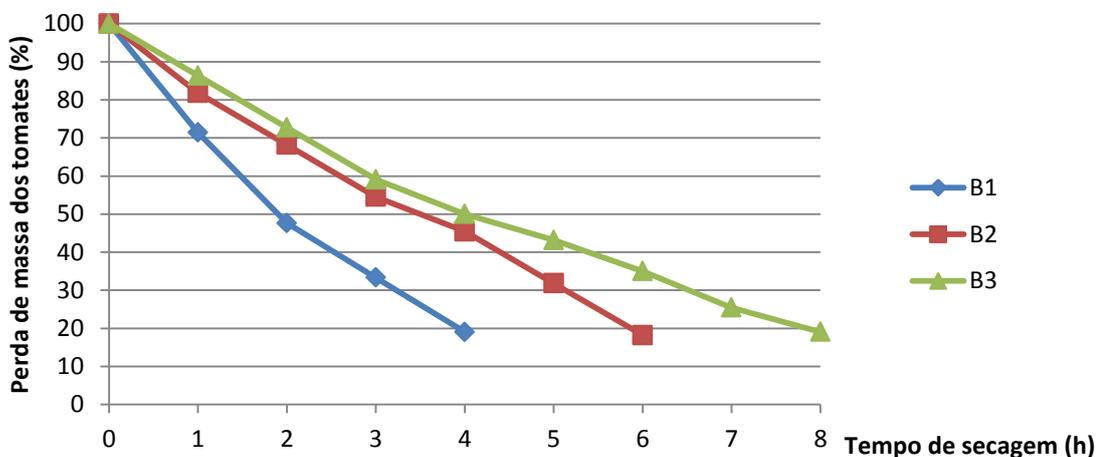


Figure 2 Loss in weight of tomatoes throughout the drying process in the three dryer trays.

4 Conclusion

The dryer presented the ideal parameters for drying fruits (51.6 °C and 1.2 m/s) in a drying tomatoes process of 8 hours.

The cost per hour of drying in this experiment, due

to the tomato off-season was considered high, however, there are conditions to reduce this cost during the harvest time and by increasing the occupation of the dryer shelves. Dried tomatoes sensory characteristics in this experiment were classified as a high quality product.

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