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INTERNATIONAL FOOD CONGRESS

Novel Approaches in Food Industry

NAFI 2011

26 - 29 MAY 2011

ALTIN YUNUS RESORT HOTEL

CESME IZMIR TURKEY

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Variation of textural properties in pears dried by different solar methodologies

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Abstract

In Portugal, the variety of S. Bartholomew (*Pyrus communis* L.) pears are subject to an artisan drying process consisting of direct open-air sun exposure, leading to a traditional product with unique texture characteristics, called "Pêra Passa de Viseu". However, the drying process does not provide the current standards of safety and, therefore, recent investigations have emerged with alternatives to the traditional drying process.

The changes that occur in the pears during the drying process are of the most importance to define the sensory characteristics and the quality of this product. As the texture is a highly valued characteristic for this product, it is necessary to verify that the different drying methods give place to products as similar to the traditional as possible. Thus, this study aimed at determining the changes that occur in the texture with the drying process and compare the texture of pears dried by two different drying processes, namely the traditional open-air and the solar stove with ventilation. Pears of the Portuguese variety S. Bartholomew were obtained from a local producer, both in the fresh state and after drying by the traditional procedure. Some of the fresh pears were dried by the alternative method.

From the results obtained, it was possible to observe that both drying processes affected the initial texture. However, no important differences were seen when the two drying methods were compared with each other, thus allowing to conclude that the alternative drying methodology can be used to replace the traditional one, without altering the textural properties of the final product and with an highly added value in food safety.

Keywords: Pear, drying, solar stove, texture, hardness, adhesiveness, springiness, cohesiveness, chewiness.

1. Introduction

Drying by the open-air sun exposure consists of the removal of a fraction of water by the action of natural atmospheric conditions. It is one of the oldest methods used in food preservation. This process does not require expensive equipment, representing the most economical method of drying (1). It has, however, some disadvantages, such as the sluggishness of the process and its dependence on climatic conditions, and the possibility of food contamination due to their exposure to all kinds of dust, insects and other small animals, jeopardizing the product quality and food safety (2).

Over several centuries, figs, plums, grapes, peaches and apricots have been subjected to the drying process, but lately other fruits, such as apples and pears have assumed much importance in this type of processing (3,4).

In Portugal, the variety of S. Bartholomew (*Pyrus communis* L.) pears (Figure 1) originate a traditional product with a unique characteristic texture, called "Pêra Passa de Viseu," obtained by an artisan process of drying consisting of direct open-air sun exposure (3,4). This solar drying method includes five different phases which are described briefly below:

1) Pears are peeled manually;

2) Peeled and uncut pears are left at direct sun exposure in open fields for 5 to 6 days - 1st drying (Figure 2);
3) Pears are covered and left in the shade to increase elasticity – barreling;
4) Pears are pressed so that their form changes from their round shape to a flattened form – pressing (Figure 3);
5) Pears are left again in direct sun exposure for 2 to 3 more days - 2nd drying (Figure 4).

Figure 1. Pears of the variety S. Bartolomeu.

Figure2 First drying stage.

Figure 3. Pressing operation**.**

Figure 4. Second drying stage.

This drying process does not provide the current standards of safety, therefore it is important to improve the traditional drying methods (5). Recent investigations have emerged with alternatives to traditional drying processes. Examples of these alternative methods are: i) drying in a stove with solar assisted ventilation, ii) drying in a solar drier with natural convection and iii) drying in the tunnel were the air is heated by the solar collector (6).

The food textural properties, together with the appearance and flavor, determine the quality of these food products, and therefore, their acceptance by consumers. Hence, it is important to control and predict the changes that occur in the texture with processing operations, such as drying (4).

The texture profile analysis (TPA) is an instrumental method, largely used, for accessing texture of foods, and it is performed by a texture analyzer. This equipment is used to compress a sample of food (study sample) twice in a reciprocating motion, mimicking the action of a jaw. Thus, during the analysis, an initial compression is performed, followed by a decompression and a second compression. From this analysis a force versus time graph is obtained, from which the texture parameters can be calculated (7).

Given that the texture is an important parameter to define the quality of this product, it is quite interesting to see if the different methods drying originate products with similar characteristics to those obtained by the traditional method. Thus, the objective of this study was to determine the changes that occur in texture with the drying process, and compare the texture of pears dried by two different drying processes, namely the traditional and the drying in a solar stove with ventilation.

2. Experimental procedure

The object of study was the variety of Portuguese pears called S. Bartholomew obtained from a local producer, both fresh and after drying by the traditional method described earlier. Some of the fresh pears were then dried in the Agrarian School of Viseu (ESAV) by the alternative method, in a solar stove with forced convection. In both drying processes, after harvest, the pears were peeled before being submitted to the drying process.

For texture profile analysis 18 pears were used in the fresh state, 12 pears dried by the traditional method and 14 dried by the ESAV method. In each pear, two types of sample were analyzed: 1) in the case of the fresh pear, one sample included the peel plus pulp and the other only pulp, 2) in the case of the dried pear, the samples consisted in the external pulp and internal pulp. The texture profile analysis to all the samples were performed using a Texture Analyser (TA.XT.Plus, Stable Micro Systems, UK). The textural properties: hardness, adhesiveness, springiness, cohesiveness and chewiness were then calculated by standard equations.

3. Results and Discussion

The data obtained from the texture profile analysis allows, in one hand, to compare the textural properties of fresh pears with those of dried pears and, on the other hand, to compare the same properties for the pears dried by the two different drying processes, namely the traditional (dried pear producer) and the drying in a solar stove with ventilation (dried pear ESAV). The graph in Figure 5 shows the results of the texture profile analysis obtained in the fresh pears and after drying by the two methods in both samplings: the peel and pulp refer to the analysis of the fresh pear, while the external pulp and internal pulp are for the pears after drying.

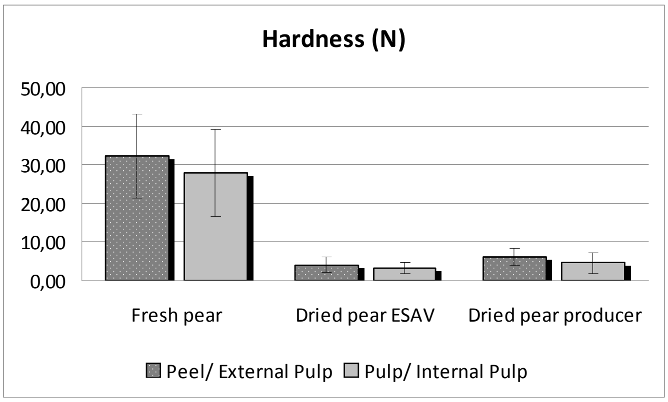

Figure 5. Hardness of fresh pears and dried pears by the solar stove (ESAV) and direct open-air sun exposure (Producer).

The graph in Figure 5 shows clearly that there is a fairly sharp reduction in hardness with the two drying methods, since the fresh pears show hardness values (around 30 N) much higher than the pears after drying (around 5N). In this way, for the fresh pears a higher force is necessary to compress them in the mouth, between the molars, comparably to the dried pears. However, this force is relatively identical for the pears obtained by the two drying methods, although the dried pears from the producer have a medium hardness value just slightly higher than those dried by ESAV, for the two surfaces analyzed. It is worth noting that the peel and external pulp exhibit medium hardness values higher than those for the pulp and internal pulp, which means that both the fresh and dried pears are harder in the external surface than the internal surface, as would be expected.

The graph in Figure 6 shows that the springiness values are identical in the fresh and dried pears by the different methods, and on both surfaces. This means that the elastic nature of the products is similar, meaning that the ability to recover their shape when the deforming tensions are removed, or reduced, does not change much either with drying or with sampling.

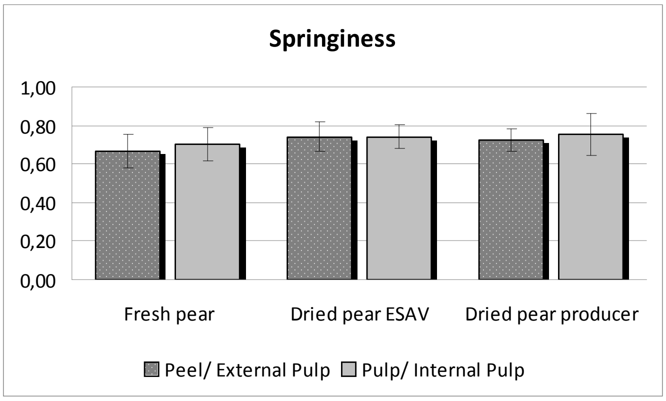

Figure 6. Springiness of fresh pears and dried pears by the solar stove (ESAV) and direct open-air sun exposure (Producer).

Figure 7 presents the results obtained for cohesiveness in the fresh pears and after drying. With regards to this textural parameter, both the dried pear from the ESAV and that from the producer show approximately the same value in both surfaces examined. However, fresh pears show cohesiveness values lower than those of the dried pears, corresponding to an increase of cohesiveness with drying. Therefore, it can be concluded that dried pears possess stronger internal bonds in relation to the fresh pear, thus keeping the product more cohesive.

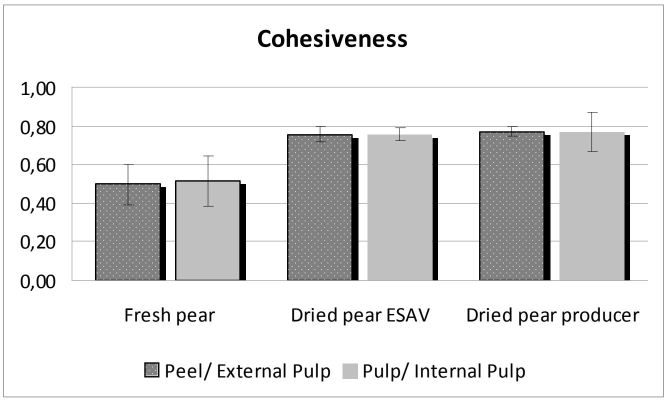

Figure 7. Cohesiveness of fresh pears and dried pears by the solar stove (ESAV) and open-air sun exposure (Producer).

In the graph from Figure 8, it ca be observed that the pears while fresh have different values of adhesiveness for the two surfaces examined, unlike the pears after drying which have similar values of adhesiveness on both surfaces. Thus, for the fresh pear the adhesiveness is higher in the pulp than in the peel, being therefore necessary to do more work to separate the compression probe from the sample. Comparatively, the adhesiveness of pears after drying is higher for the dried pears from the producer in relation of those dried at the ESAV. However, all these considerations are relatively unimportant, considering that the values found for adhesiveness are practically neglegible in all cases.

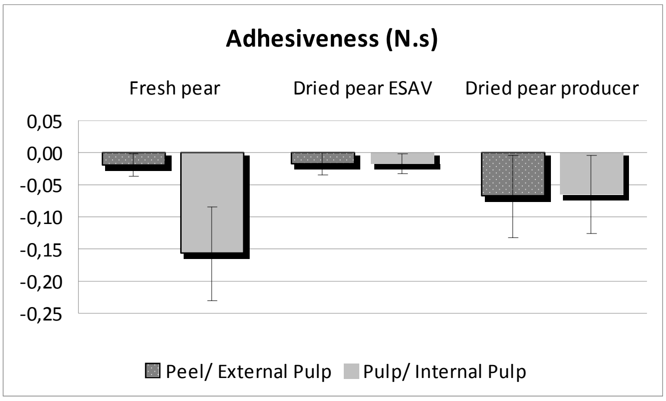

Figure 8. Adhesiveness of fresh pears and dried pears by the solar stove (ESAV) and open-air sun exposure (Producer).

In Figure 9, which shows the values for chewiness (hardness x cohesiveness x springiness) for the fresh and dried pears, it can be observed that the drying leads to a very sharp reduction in chewiness. Therefore, the work applied to chew the fresh pears is greater than that exerted to chew the pears after drying by the two methods. In relation, the pears after drying, the dried pears from the producer showed values of chewiness slightly higher than those dried from the ESAV. This would be expected taking in consideration the values of hardness shown in Figure 5. Comparing, the two surfaces analyzed no important differences are observed.

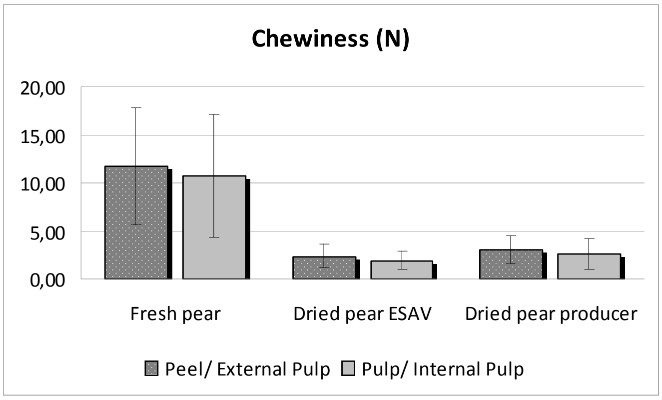

Figure 9.Chewiness of fresh pears and dried pears by the solar stove (ESAV) and open-air sun exposure (Producer).

1. Conclusions

From the results obtained, it was possible to observe that both drying processes affected the texture, especially regarding to the parameters of hardness, cohesiveness, adhesiveness and chewiness, having occurred a reduction of hardness and chewiness, and an increase of cohesiveness and adhesiveness. With respect to springiness, it was concluded that this characteristic does not change much with drying.

From the results obtained for the pears after drying, it was verified that no important differences were seen between the two drying methods, thus allowing to conclude that the alternative drying methodology can be used to replace the traditional method, without altering the textual properties of the final product.

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