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INFLUENCE OF THE DRYING METHOD ON THE COMPOSITION OF DRIED PEARS

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Abstract: In Portugal, a traditional product named “Pêra Passa de Viseu” is made by direct open air sun exposure. However, this procedure does not comply with modern quality standards, and therefore in the last years some investigation around this product and the production method has been carried out to better understand it and establish alternative production techniques such as a solar stove, a solar drier and a drying tunnel. The chemical properties of the pears obtained by these methods were analyzed and quantified, trying to obtain a product more similar to the traditional one. The results show that the dryings carried out with sun exposure (inside glass) do not produce fruits much different than those dried by the traditional method.

Keywords: pears, sun dried, composition, different drying alternatives

INTRODUCTION

Drying fruits allows their preservation by reducing the water content, and thus inhibiting enzymatic modifications and microbial growth. Besides preservation, among the important advantages of drying are the reduction in size and weight, facilitating transport and reducing storage space as well as avoiding the expensive cooling systems. Finally, it increases food diversity, allowing alternative ways of consuming foods (Guiné and Castro, 2003).

Solar drying has been used for centuries, but it is restricted to areas with a high solar incidence. In spite of the slowness of the process and the need of much handwork, this is undoubtedly the cheapest of drying methods. However, it has some important disadvantages, like the dependence on natural factors that cannot be controlled as well as the need of great exposure areas (Sousa et al., 1992).

The fruits that are traditionally dried are grapes, figs, plums, peaches and apricots, but more recently apples and pears have gained importance in this area.

Pears of the variety S. Bartolomeu (Figure 1) have been used over the years in Portugal to produce, by open-air sun exposure in the summer, a traditional dried pear, which is very appreciated in Portugal, especially in Christmas time.

Fig. 1. S. Bartolomeu pears

The traditional solar drying process includes the following steps: (1) peeling; (2) first drying stage, in which the pears are exposed to the sun for 5 to 8 days; (3) barrelling, a process in which the pears are covered and left at shadow to increase elasticity; (4) pressing, the operation where the pears change their shape from round to flat; (5) second drying stage, also at the sun, but for only 2 to 3 more days (Guiné and Castro, 2002).

This product, obtained through this traditional way, has obvious disadvantages (Karathanos and Bellassiotis, 1997), either concerning the drying efficiency or the sanitary quality of the final product (Barroca et al., 2006). For these reasons, attempts have been made to study alternative production methodologies, including the use of solar stoves, among others.

The organoleptic properties that influence the final product quality are the color, flavor and texture. The changes in color and flavor occurring during drying are usually associated with the presence of phenolic compounds.

In the present work pears of the variety S. Bartolomeu (used to produce the dried pears) were dried following the traditional method at direct solar exposure and also with the alternative systems (Guiné et al., 2009). These alternatives to the direct sun exposure method consisted mainly in three possibilities that were performed in 3 different institutions: a solar stove built at ESAV (Escola Superior Agrária de Viseu), a solar drier constructed at ESTV (Escola Superior de Tecnologia de Viseu) and a tunnel drier that was placed at UC (Universidade de Coimbra).

The objective of this study was to understand which system allows the obtaining of a product more similar to the traditional one, in terms of chemical properties.

EXPERIMENTAL

In this work pears of the variety S. Bartolomeu were harvested in August. The pears were peeled and then dried uncut by the traditional method and also by the three alternative systems tested:

- Traditional: the traditional open-air sun drying, in which the fruits are left at the sun in the open field (Fig. 2);
- ESAV solar: a solar stove/greenhouse made of aluminum with 3 mm greenhouse glass (Fig. 3). It is 3.2 m long, 1.9 m wide, 2.0 m high in the center and 1.3 m high at the sides. It a door and two roof windows, and the floor is covered with easily washable tiles to facilitate cleaning. The stove has coupled a ventilator to help the air convection, which was operated in the present experiments at the maximum rotating speed of 1700 rotation per minute, corresponding to the extraction of 900 m3/h of air (Guiné et al., 2007).
- ESTV solar: a solar drier developed specifically for the drying of pears, made of glass with different levels, designed for a more efficient use of the solar energy (Fig. 4). It is approximately 1 meter high and the steps are 1 meter long by 20 cm wide. The drier has 5 steps, and their back is covered with a reflecting material, so as to increase the heating capacity and improve the efficiency.
- UC drying tunnel: a drying tunnel of approximately 50 high and 50 cm wide, and about 1 m long (Fig. 5). The circulating air is heated by a solar collector, placed outside the laboratory. The temperature was kept constant at 40-42 ºC and the drying air velocity was always 1.1 m/s.

Fig. 2. Traditional drying method

Fig. 3. ESAV solar stove (greenhouse)

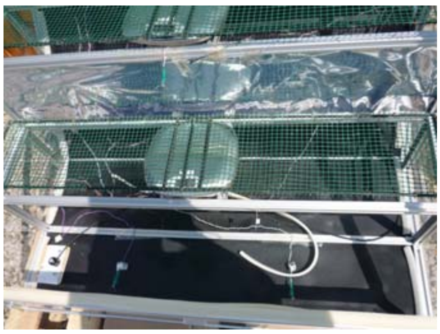

Fig. 4. ESTV solar drier

Fig. 5. UC drying tunnel

RESULTS AND DISCUSSION

The results presented in this communication refer to three consecutive study years.

The general appearance of the pears after suffering the first drying in the traditional process is depicted in fig. 6 As it can be seen, the appearance of the pears changes very much, especially in colour, and apart from these modifications it is expected that there are also some important chemical alterations.

Fig. 6. Pears after the first drying stage (left) and at the beginning of drying (right)

Fig. 7 shows for the first year of study the variations in some properties (hardness, acidity, moisture, total soluble solids and mass) from the fresh state to the dried state, for the drying carried out in the solar stove at ESAV. In this case, three harvests were made, one in the same date as the traditional producers harvest their pears, one other harvest one week before that date and finally one third harvest one week after the traditional harvest date.

The graph in fig. 7 shows that drying indices an important reduction in hardness, acidity, moisture and mass. However, the total soluble solids content does not change much with drying, thus indicating that the sugars were not so affected in this case. Furthermore, the differences between the three harvests were not very significant.

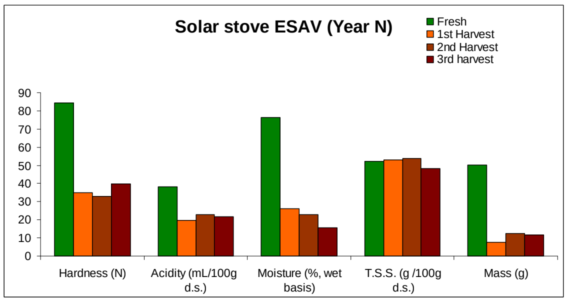

Fig. 7. Variation in the pear's properties for drying in the ESAV solar stove in three harvest dates

Fig. 8 shows some chemical attributes (moisture, acidity and total soluble solids - TSS) for the dried pears obtained with the 3 different methodologies of drying, as compared to the pears produced by the traditional drying process. It can be seen that the tunnel drying produced pears with a much higher water content, but also with a higher sugar content, when compared to the traditional drying. With respect to these two properties, the system that led to production of pears more similar to the traditional ones was the ESAV solar stove. Regarding acidity, no significant differences were encountered between all the systems tested.

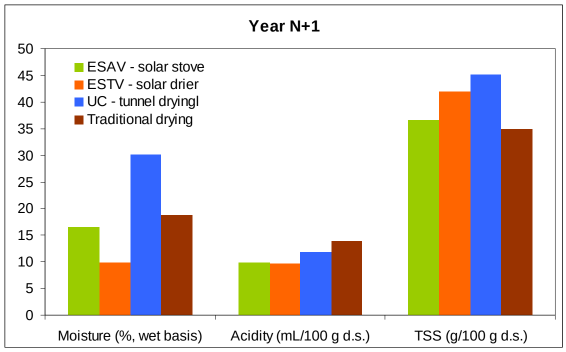

Fig. 8. Variation in the pear's properties for drying in different drying systems

When comparing these same parameters (moisture, acidity and TSS) for the three consecutive years of study (fig. 9), it can be seen that in the last year of the study (year N+2) the dried pears were sweeter than in year N+1 for all systems. With respect to acidity, and comparing the same years, the pears were more acid in ESAV and UC and less acid for ESTV. However, these differences are very sight, and the general overview is that the results of the three years of study do not differ so much.

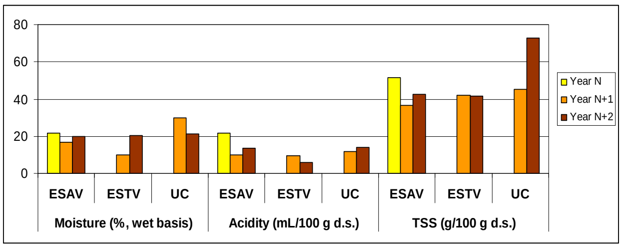

Fig. 9. Comparison of the properties for different systems in three consecutive years

Figures 10 to 14 show, for the last year of study, the variations in some properties of the pears along the drying process, for different systems.

Fig. 10 shows the evolution in moisture along drying in the year N+1 for the pears dried in the ESAV solar stove, the ESTV solar drier and the UC drying tunnel. It can be seen that for these three drying methodologies the loss of water was approximately similar in the earlier stages of drying, until 70 hours. However, after this time, the solar drier led to lower values of moisture more rapidly, followed by the ESAV solar drier and the drying tunnel was the system that needed more than 100 hours to reach the end of drying (reaching the same moisture content of about 20 %). In the drying process, the pears lost 75 % of their initial water, thus reducing the moisture content from 80 % to 20 % at the end.

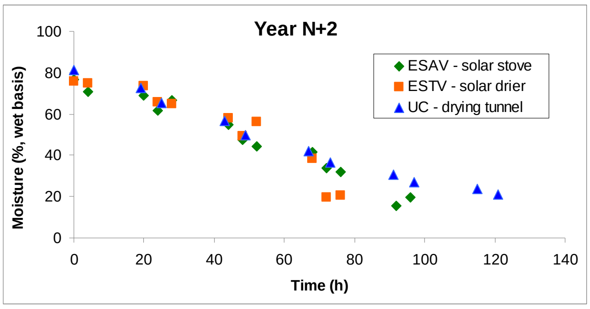

Fig. 10. Variation along drying of moisture for different systems

Fig. 11 shows the variation in pear mass along drying for the two solar drying systems: ESAV solar stove and ESTV solar drier. It can bee seen from the graph that, despite being smaller, the pears in ESAV reached approximately the same size as the pears in ESTV after 70 hours of drying. This was because at this time of drying, the pears in the ESAV system had almost 40 % moisture whereas the pears in ESTV had dried already to 20 % moisture content, thus leading to more water loss.

The graph in fig. 12 shows the height and diameter of the pears dried in the solar drier and solar stove systems. As depicted from the graph, no relevant differences were encountered, either in relation to height or diameter between both systems. The diameter in the ESAV stove is slightly smaller than in the ESTV system, because the pears were at the start smaller. As to the variation along drying it can bee seen that the height suffers a reduction of around 20 % and the diameter suffers a reduction of about 45 %, when compared to the original values.

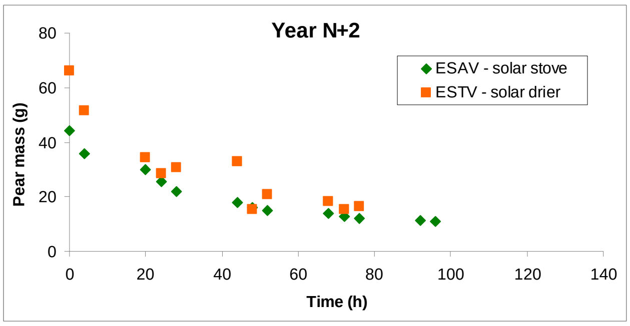

Fig. 11. Variation along drying of pear mass for different systems

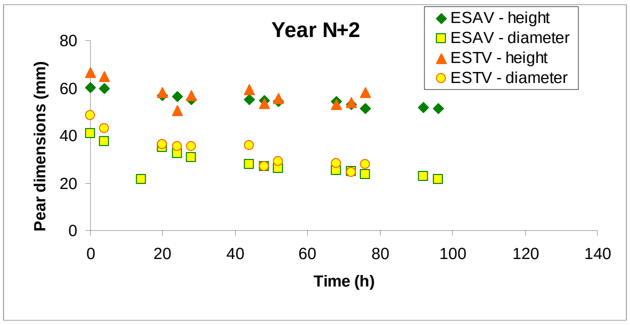

Fig. 12. Variation along drying of pear mass for different systems

Fig. 13 represents the variations in acidity along drying for both solar drying systems (ESAV stove and ESTV dryer) and also for the UC drying tunnel. The results show that the reduction in acidity is of 63 % in the ESTV solar drier, 57 % in the ESAV solar stove and 53 % in the UC drying tunnel. These results are expected, since the temperature in the drying tunnel never exceeded 42 ºC, whereas in the solar systems, the temperatures in the hottest hours of the day could be quite higher, even higher than 60 ºC. Furthermore, the ESTV solar drier is more efficient in concentrating the heat than the ESTV solar drier, thus inducing a higher loss of volatile acids.

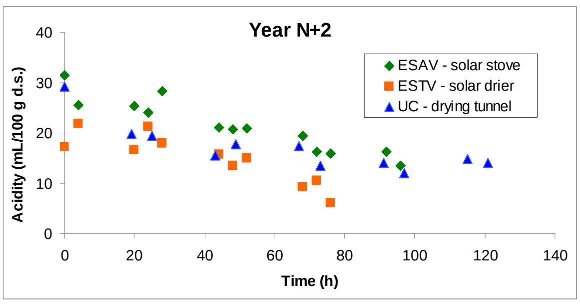

Fig. 13. Variation along drying of acidity for different systems

The graph in fig. 14 shows the variation of total soluble solids (TSS) along drying, for the three alternative drying systems tested. In the first 70 hours of drying, no significant differences were encountered in the different systems. However, after this time, the TSS contents for the drying tunnel were much higher than those found for the other two drying methodologies. Furthermore, after this point, the TSS content increases in the UC drying tunnel, whereas it decreases in the other two solar systems. This results in dried pears that are sugar richer in the drying tunnel, as compared to the solar systems. This is due to deterioration reactions, such as Maillard reactions that occur with a further extent in the solar systems, due to the higher temperatures registered in these dryings.

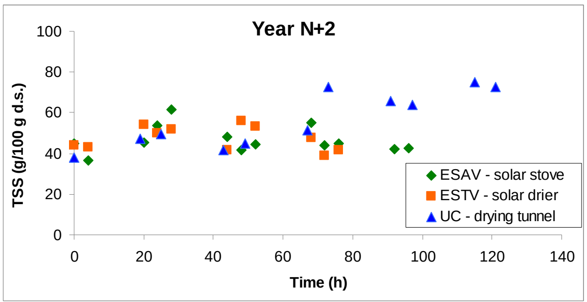

Fig. 14. Variation along drying of total soluble solids (TSS) for different systems

CONCLUSIONS

The traditional drying method for obtaining this kind of pears is too slow and implies too much labour, besides the serious problems related to safety and food quality. Other methodologies were tested, having in mind the possible replacement of the old techniques with modern and expedite possibilities.

The results obtained along a three year period of study reveal that the alternative drying systems tested (drying tunnel, solar stove and solar drier) allow the obtaining of products that are very much alike, being, in particular, the two solar systems very similar. Furthermore, the results obtained show that the three different drying methods carried out do not produce fruits much different than those dried by the traditional method. Thus, these results enable to predict that the systems studied, and particularly the two solar systems, are apparently viable alternatives to the traditional solar drying.

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