

R

## Effect of different pre-treatments on drying of green table olives (*Ascolana tenera* var.)

By F. Gambella<sup>1</sup>, A. Piga<sup>1\*</sup>, M. Agabbio<sup>1</sup>, V. Vacca<sup>1</sup> and G. D'hallewin<sup>2</sup>

<sup>1</sup>Dipartimento di Scienze Ambientali Agrarie e di Biotecnologie Agro-Alimentari: «Sez. Tecnologie Alimentari» - Università degli Studi. Viale Italia, 39. 07100 Sassari (Italy).

<sup>2</sup>Istituto per la Fisiologia della Maturazione e della Conservazione del Frutto delle Specie Arboree Mediterranee - C.N.R.  
Viale dei Mille, 48. 07100 Sassari (Italy).

### RESUMEN

#### Efecto de diferentes pretratamientos en la deshidratación de aceitunas verdes de mesa (*Ascolana tenera* var.).

Se han deshidratado aceitunas verdes de mesa en horno a temperatura de 50°C tras ser sometidas, alternativamente, a cuatro pretratamientos diferentes para ayudar a su desecación. Los resultados mostraron que es posible obtener aceitunas exentas de amargor y de alta calidad combinando su inmersión en salmuera caliente (50°C), a una concentración del 10% en NaCl durante 10 minutos, seguida de una deshidratación durante 32 horas. Las aceitunas deshidratadas alcanzaron una humedad residual del 20% y no manifestaron signos de putrefacción en un año.

**PALABRAS-CLAVE:** Aceituna verde de mesa - Amargor - Deshidratación - Pretratamiento.

### SUMMARY

#### Effect of different pre-treatments on drying of green table olives (*Ascolana tenera* var.).

Mature green olives (*Olea europea* L.) were dried in a forced air oven at 50°C, after being subjected alternatively to four different pre-treatments. Results indicate the possibility to obtain bitter-free and high quality olives by combining a ten minutes dip in a 10% hot brine (50°C) followed by a 32 hours dehydration. The latter product reached 20% of residual humidity and did not rot for one year.

**KEY-WORDS:** Bitter - Dehydration - Green table olive - Pretreatment.

### 1. INTRODUCTION

One of the most important elements in table olive processing is the removal of the bitter taste of the fruit by hydrolysis of oleuropein to give hydroxytyrosol. De-bittering can be accomplished in a time ranging from less than one day to even one year. In the former case, known as «Spanish or Sevillian style» the bitter compound is removed from green olives with a short time (less than 24 hours) dipping in a 1-4% NaOH solution, that is followed with washings

in water or dipping in neutralising solutions (Fernández Díez, 1990). Processing with the «natural style» green or black olives involves, instead, placing fruits in a NaCl brine, so that a very long time may be needed to reduce the oleuropein content in the olive flesh (Balatsouras, 1990; Deiana *et al.*, 1992). Olive quality following the two main processing methods is comparable and satisfactory, but both technologies imply some difficulties. In the «Sevillian style» the pollution issue of the neutralising rinse water disposal is a pin in the neck behalf the increasing environment concern of people, while the long time required to hydrolyse the oleuropein is the limiting factor for the «natural style». New technologies are needed in order to reduce the length of the de-bittering process and to reduce or completely replace the use of sodium hydroxide and the subsequent neutralising washes. In the Mediterranean area a traditional approach to preserve black table olives is the dehydration of fruit by means of heat (oven) or by mixing fruit with salt in wooden barrels. This latter technology provides olives ready for consumption within 20-60 days (Brighigna, 1984). Hot air dehydration of blanched olives (dips in boiling water for a few minutes) followed by a 2 or 3 day storage in salt is used in Italy for the «Majatica di Ferrandina» cultivar. Savastano (1937) improved this traditional method by using a 10% NaCl brine-blanching dipping for 1 to 5 minutes before drying olives with hot air oven at 70-80°C, in order to obtain a 15% humidity content product in 24 hours. This technology, however, due to the high drying temperatures could drastically reduce the original quality of the fruits. Cucurachi *et al.* (1971) improved the latter by subjecting the black olives to blanching at 80°C for 1 minute, piercing with needles and then dipping in a 2% NaCl brine for 12 hours, before dehydration at 50°C.

With this in mind, we carried out a drying trial with air at 50°C on green olives, after they had received four different pre-treatments in order to improve the dehydration and the de-bittering rate. We used fruit of «Ascolana tenera», that is an Italian appreciated

cultivar for table processing. The aim of the work was to obtain ready to eat olives, which have both high palatability and satisfactorily microbial stability, using a mild drying technology.

## 2. MATERIALS AND METHODS

### 2.1. Harvesting and grouping

Green olives were manually harvested in Nuoro (Central-East Sardinia) in the last week of September from a thirty year specialised orchard. Olives were promptly transported to the laboratory, checked for blemishes, washed in cold water (13°C) and dried at room temperature. Fruit calibration took then place and sizes between 19 and 22 mm of diameter were used in the experiment. Calibrated olives were equally divided into five groups (A, B, C, D, and Ctrl), each of them consisting of three 1.3 kg replicates.

### 2.2. Treatments

Group A fruits were pierced (30 wounds/cm) with a steel brush, those of group B were dipped in water at 50°C for 10 minutes (blanching), while the group C received A plus B treatments. Fruits of group D were pierced and then dipped in a water solution of NaCl (10%) at 50°C for 10 minutes, while Ctrl ones received no treatments. List of treatments is shown in Table I.

Table I  
List of the different pre-treatments applied to green table olives (*Ascolana tenera* var.) before dehydration in hot forced air oven at 50°C for 32 hours

Ctrl = none

A = Piercing ( $\cong$  30 wounds per cm<sup>2</sup>) with a steel brush.

B = Blanching in water at 50°C for 10 minutes

C = Piercing (A) + Blanching (B)

D = Piercing (A) + Blanching in a 10% NaCl brine for 10 minutes

### 2.3. Dehydration process and packaging

The olives of each group were then layered on steel shelves and finally dried at 50°C in an oven (model B-Master, Tauro Bologna) with a tangential air flow of 67 m<sup>3</sup>/min. The temperature and relative humidity of the oven were monitored during the whole drying process by an electronic thermocouple. The heating device placed on one side of the oven was equipped by 3 heating elements each of 1 kWh. The dehydration lasted, based on previous experiences (unpublished data), for 32 hrs when the residual humidity in control fruit was in the range of 17-20%. After dehydration fruit was packaged with a domestic sealing device (model Calor Soud'Sac) using

polyethylene bags (95 µm thick) and stored at room temperature until visual alterations arose.

### 2.4. Chemical-physical and sensorial determinations

In order to draw the drying curve, percent dry matter and residual humidity of the olive fruit flesh was checked at fixed intervals (0, 8, 16, 21, 24 and 32 hours) by sampling at random olives from each shelf. At harvest and at the end of the drying process an appropriate sample of olive fruits was squeezed and some quality parameters were inspected on resulting juice (pH, titratable acidity, dry matter, humidity and ashes) according to Fernández Díez *et al.*, (1985), while NaCl content was determined with a potentiometric methodology (Herrington and Kleyn, 1960). Water activity of olive flesh was measured with a manual hygrometer (model Aw-Campus, Rotronic) formerly calibrated with saturated solutions of barium chloride (Labuza *et al.*, 1976). All the determinations were made in sextuplicate. An informal panel test of five untrained persons expressed the perception of the bitter taste based on a 3 point scale being: 1 = no bitterness, 2 = acceptable bitterness and 3 = unacceptable bitterness. During the panel test the preference over the different treatments was also stated. A subjective firmness test was carried out by the panelists by compressing olives between the forefinger and the thumb. Storability of packaged olives was determined visually by inspection of each bag at monthly intervals. The first appearance of any visible microbial alteration on the fruit peel was taken as the time limit storage.

### 2.5. Statistical analysis

Data at the end of the drying process were subjected to a one way analysis of variance (ANOVA) with the MSTAT-C software and those concerning flesh humidity were transformed in arcsine prior to the analysis. Mean separation, where needed, was performed by the Duncan's Multiple Range Test at the 0.01 level of significance.

## 3. RESULTS AND DISCUSSION

### 3.1. Dehydration process

The control of process parameters inside the oven revealed a good stability of temperature, that was in the range of 50±1°C, while relative humidity reached and kept the steady-state (13%) after 2 hours from the experiment start.

Some of the pre-treatments strongly affected the dehydration process. In fact, as it can be observed on Fig. 1, group A attained the lowest residual humidity content throughout the whole dehydration

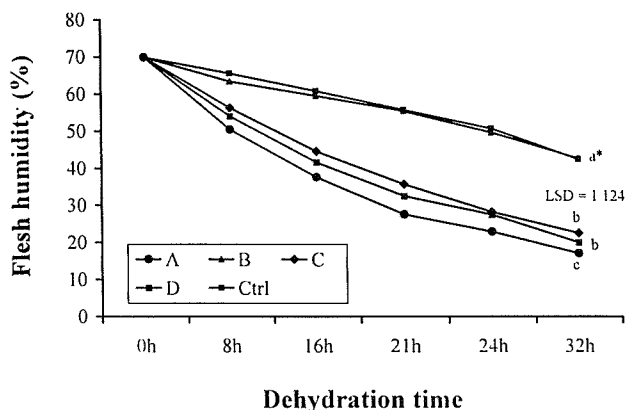


Figure 1

Evolution of humidity content in the flesh of green table olives (*Ascolana tenera* var.) subjected to four different pre-treatments before being dehydrated with hot forced air at 50°C for 32 hours.

\* Values at 32 hours with the same letters do not differ significantly following Duncan's Multiple Range Test at  $P \leq 0.001$ . Data are the mean of six determinations and those at the end of drying have been turned in arcsine for statistical purposes

process, while the group B showed the highest one. The latter olives had the same drying pattern of Ctrl group. Both C and D lots reached a significantly higher residual humidity content at the end of the 32 hours drying period, with respect to A group. It seems that blanching had a slight effect in lowering the dehydration rate of pierced olives, while sodium chloride acted in the opposite way. Anyway, all the pierced groups reached a residual humidity percentage around 20% and differed markedly from those not pierced. Thus, piercing was the main factor enabling a good dehydration performance. The lowering dehydration effect of blanching could be attributed, following Levy *et al.*, (1988), to the fact that short hot water dipping act in stabilising the pectic components of the middle lamella. Therefore, cell structure is maintained and this fact probably led to a diminished water loss during dehydration. The

curve shown in Fig. 1 is this of a typical dehydration process. In fact, the first period with a constant dehydration rate is followed by a second one with a decreasing pattern. Comparison of  $a_w$  activities showed that the lower the residual humidity content of the sample group, the lower the water activity value at the end of the process (Tab. II). The only exception was the B lot that resulted in a significantly lower  $a_w$  value, than the Ctrl fruits, even if they had the same residual humidity content. The lowest  $a_w$  value of 0.812 attained by the group A, however, can provide adequate control of most bacteria and yeast, but some moulds, as well as some low water requiring bacteria and yeast can grow (Banwart, 1981; Beuchat, 1983). Anyway, prolonging the drying time up to allow microbial stability would have resulted in a product that need a subsequent re-hydration, in order to make it edible. Cucurachi *et al.* (1971) obtained a tasteful product with a residual humidity content of 10%, but in our case we have to stop drying at a 17-20% value. Thus, we preferred to match a certain but not optimal microbial stability with a good palatability.

### 3.2. Sensorial assay

Informal tasting of dried olives revealed that the bitterness almost disappeared in the D group, that retained this characteristic only close to the pit, while it was somewhat present in group C and Ctrl and quite strong in group A and B. Panellists assignment of preference was strictly dependent on the bitter taste residual (data not shown). In fact, they all preferred the group D olives, even because they were slightly salty. It's to remember that we used green olives, whose oleuropein content and then bitter taste is dramatically higher, if compared to, black ones. No preference was attributed, instead, for chewiness and crispness, that was rated as good for all the groups, although there were differences in

Table II

**Chemical (pH, titratable acidity, NaCl and ashes content) and physical (water activity) parameters of green table olives (*Ascolana tenera* var.) at harvest after being subjected to four different pre-treatments followed by dehydration in hot forced air for 32 hours.**

Treatments	Period	pH	Acidity (% citric acid on fw <sup>z</sup> )	NaCl (% w/w)	Ashes (% on fw)	Water activity
	Harvest	4.8	0.52	0.0	1.16	0.987
A (piercing)	End of process	5.17b*	0.26b	0.00b	1.02c	0.812e
B (blanching)	End of process	5.18b	0.22c	0.00b	1.12b	0.933b
C (piercing + blanching)	End of process	5.25a	0.30a	0.00b	1.00c	0.871c
D (piercing + NaCl blanching)	End of process	5.10c	0.26b	1.59a	1.30a	0.849d
Ctrl (none)	End of process	5.13bc	0.23bc	0.00b	1.13b	0.948a

\* Values followed by the same letter within each column do not differ Duncan's Multiple Range Test at 0.001 level of significance.

<sup>z</sup> Fresh weight.

residual humidity. A subjective finger compression test evidenced a reduced loss of fruit firmness in blanched fruit. In fact, blanched and temperature stabilised olives (at room temperature) appeared firmer than not blanched ones. The drying step, as expected, led olives to change colour from green to brown and Ctrl ones lost the original brightness, that was almost completely retained in the pre-treated groups.

### 3.3. Olives storability

The group D attained the best storability as, after one year of storage at ambient temperature all the olives bags did not show any visual external symptom of microbial alteration. On the other hand, the more the residual humidity content of the olive flesh, the least the storage time recorded for micro-organisms to spread. In fact, starting from 45 days of storage groups B, Ctrl, C and A decayed, respectively, in 15 days. As a matter of fact, the prolonged shelf-life of group D, if compared to the other treatments, may be attributed to the combined effects of low water activity, packaging and residual NaCl content in the olive flesh. Moreover, it's to highlight that, although the low  $a_w$  value of group A, it was not possible for us to perform the packaging with a strictly aseptic procedure. Thus, olives probably underwent further microbial contamination during the various experimental steps. The only micro-organisms associated with visual decay were funguses.

### 3.4. Chemical determinations

Results of pH, acidity, ashes and sodium chloride of fresh and dried products are reported in Table II. It has been recorded an increase in the pH value mirrored by a concomitant decrease in titratable acidity. Ashes, increased markedly only on D group, as olives absorbed sodium chloride from the brine-blanching treatment, while piercing slightly lowered ash percentage. Salt content in brine-blanched olives was 1.5%.

## 4. CONCLUSION

Results of our study clearly indicate that is possible to obtain tasteful and stable dried «Ascolana tenera» olives by using mild dehydration temperatures and a not too long process time, provided that dipping fruits in a 10% NaCl brine at 50°C for ten minutes is applied before drying. This new pre-treatment allows to speed up the de-bittering and to keep dried olives with rh values ranging between 17 and 20%. In addition, since the residual humidity rh of the dried olives is high, no re-hydration is needed before marketing or consumption. Removal of bitter taste from green olives is, thus, accomplished in a relatively short time (32 hours), without the need to use chemicals, if we except NaCl. Fruits blanched

with salt prolonged their shelf-life, moreover, for up to one year.

## ACKNOWLEDGEMENTS

Research supported by Regione Autonoma della Sardegna, special project «Impiego di energie alternative nei processi di essiccazione di prodotti frutticoli locali». We wish to thank Mr. Domenico Mura for his technical assistance and Mr. Giovanni Tilocca for providing olive fruits.

## REFERENCES

- Balatsouras, G. (1990). Edible olive cultivars, chemical composition of fruit, harvesting, transportation, processing sorting and packaging, styles of black olives, deteriorations, quality standards, chemical analyses, nutritional and biological value of the product. Atti del seminario internazionale: «Olio d'oliva e olive da tavola: tecnologia e qualità», Citta di S. Angelo (Pe), 25-28 Aprile 1990, 291-330.
- Banwart, G.I. (1981). Basic Food Microbiology. The Avi Publishing Company Inc., Westport (Connecticut).
- Beuchat, L.R. (1983). Influence of  $a_w$  on growth, metabolic activities and survival of yeast and moulds. *J. Food Protect.*, **46**, 135-150.
- Brighigna, A. (1984). Le olive da tavola: tecnologie, marketing e impieghi. Edagricole, Bologna (Italy).
- Cucurachi, A., Vitagliano, M. and Gervasi P. (1971) Caratteristiche e utilizzazione delle olive «Majatica di Ferrandina». *Ann. Ist. Sper. Elai.*, **1**, 89-107.
- Deiana, P., Farris, G.A., Catzeddu, P. and Madau G. (1992). Impiego di fermenti lattici e lieviti nella preparazione delle olive da mensa. *Ind. Alim.*, **31**, 1011-1021.
- Fernández-Díez, M.J., De Castro y Ramos, R., Garrido Fernández, A., González Cancho, F., González Pelliso, F., Nosti Vega, M., Heredia Moreno, A., Mínguez Mosquera, I., Rejano Navarro, L., Durán Quintana, C., Sánchez Roldán, F., García García P. and Castro Gómez Millán, A. (1985). Biotecnología de la aceituna de mesa: metodología. Instituto de la Grasa y sus Derivados, C.S.I.C., 385-453.
- Fernández Díez, M.J. (1990). «Biotecnología de la preparación de aceitunas verdes aderezadas al estilo español o sevillano». Atti del seminario internazionale: «Olio d'oliva e olive da tavola: tecnologia e qualità», Citta di S. Angelo (Pe), 25-28 Aprile 1990, 275-290.
- Herrington, B.L. and Kleyn D.H. (1960). A potentiometric method for the determination of chloride in milk. *J. Dairy Sci.*, **43**, 1057-1060.
- Labuza, T.P., Acott, K., Tatini, S.R., Lee, R.Y., Flink, J. and McCall, W. (1976). Water activity determination: a collaborative study of different methods. *J. Food Sci.*, **41**, 910.
- Levy, A., Ben-Shalom, N., Plat, D., and Reid, D. S. (1988). Effect of blanching and drying on pectin constituents and related characteristics of dehydrated peaches. *J. Food Sci.*, **53**, 1187-1189.
- Savastano, G. (1937). Sull'essiccamento delle olive nere di Ferrandina. *L'olivicoltore*, 11-17.