INFLUENCE OF DIPPING PRETREATMENTS ON DRYING OF 'PEDRO XIMENEZ' GRAPES IN CHAMBER AT CONTROLLED TEMPERATURE[•]

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Key words**:** chamber drying, CIELab, phenolic compounds.

1. INTRODUCTION

Grape drying methods based on chamber-drying with controlled temperature are reliable, fast, and easy to use, but require high efficiency to be profitable. Because the energy needed to operate this drying method is not free, drying times should be as short as possible, favoring the loss of grape water. A number of dipping pretreatments for grapes have been tested in recent years with a view to increase grape skin permeability, so facilitating moisture removal and expediting drying. The effects of such chemical pretreatments on grape are widely documented (Riva *et al.*, 1986; Saravacos *et al*., 1988; Pangavhane *et al.*, 1999; Azzouz *et al*., 2002; Doymaz, Pala, 2002), the composition of the particular chemical agents used, their concentration, pH, temperature, and the dipping time being the main factors governing the alteration of the skin microstructure (Esmaiili *et al*., 2007). The most common pretreatments involve the use of an oil emulsion or diluted alkaline solution to accelerate the grape drying by reducing the resistance of moisture transfer from the skin surface (Saravacos *et al.*, 1986), improving the moisture diffusion coefficient (Riva, Peri, 1986). Pangavhane *et al.* (1999) have reported that dipping treatments not only shorten drying times (with economic advantage), but also improve raisin quality in relation to its color, texture, and flavor.

In this work, the influence of two dipping treatments on the drying rate of 'Pedro Ximenez' grapes is studied, as well as the impact on color and phenol contents in the resulting raisins, which are largely used to produce sweet wines of the same name.

2. MATERIALS AND METHODS

2.1 Sample collection

'Pedro Ximenez' grapes were harvested in the Montilla-Moriles region (southern Spain).

[•] QUAD. VITIC. ENOL. UNIV. TORINO, 31, 2009-2010

2.2 Drying experiments

Grapes were dipped in pretreatment solutions and dried afterward at 50 °C. Pretreatment solutions and dipping time were the following: D0, untreated grapes; D1, dipping of grapes in alkaline emulsion of olive oil (7 % of K_2CO_3 + 0.4 % of commercial olive oil) (Vazquez *et al*., 1997) for 1 min at ambient temperature; and D2, dipping of grapes in alkaline emulsion of ethyl oleate (2.5 % of K_2CO_3 + 2 % of ethyl oleate) (Di Matteo *et al*., 2000; Doymaz, 2006) for 10 s at ambient temperature. Samples were periodically collected, and the weight loss of the grapes was measured. The reducing sugar content (measured as °Brix) was used as tracking criterion of the grape dehydration process. Drying was concluded when the sugar concentration was around 450 g L^{-1}. In the laboratory, the raisins were crushed and subsequently pressed in a vertical press similar to those used at the industrial level.

2.3 CIELab

Color analyses were carried out following CIE recommendations and using the visible spectrum obtained from 380 to 780 nm. In this work, the following CIELab uniform space colorimetric parameters have been considered: rectangular coordinates L* (black-white component, lightness), a* and b* (chromatic coordinates representing red-green and yellow-blue axes, respectively). These parameters were measured using as references the CIE 1964 Standard Observer (10° visual field) and the CIE standard illuminant D65.

2.4 Dialysis

Musts were dialyzed using cellulose dialysis tubing (Sigma-Aldrich) that retained the molecules of a size 12000 Da. About 15 mL of must was put into the dialysis tubing, and it was placed in a vessel with 1 L of water. This solution was maintained at 4 °C with stirring for 12 h, followed by a replacement of the water surrounding the dialysis tubing. This procedure was repeated six times. The dialyzed fraction was obtained by dilution to 25 mL with distilled water of the volume of must that remained in the dialysis tubing.

2.5 Phenolic compounds

They were determined using the method proposed by Serratosa *et al*. (2008).

3. RESULTS

As showed by grape-drying curves obtained at 50 °C by plotting moisture contents (kg of water kg^{-1} of dry solid) versus drying time (fig. 1), the drying rate increased with dipping pretreatments: the solution of potassium carbonate shortened the drying time by 21.4 % while the alkaline ethyl oleate emulsion did by 35.7 %.

CIELab space for the musts and their respective dialyzed fractions (fig. 2) showed that in the three drying methods studied (with and without pretreatments) the obtained musts were darker, with a clear redness and increase in color intensity, without significant differences among them.

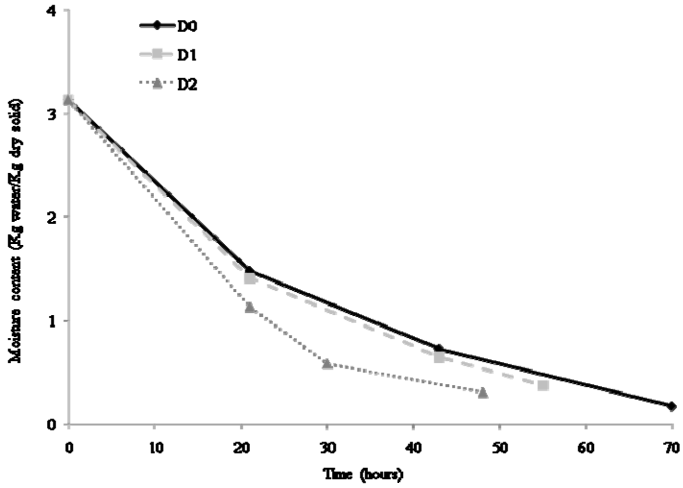

Fig. 1 – Drying curves of grapes dried at 50 °C and without pretreatment.

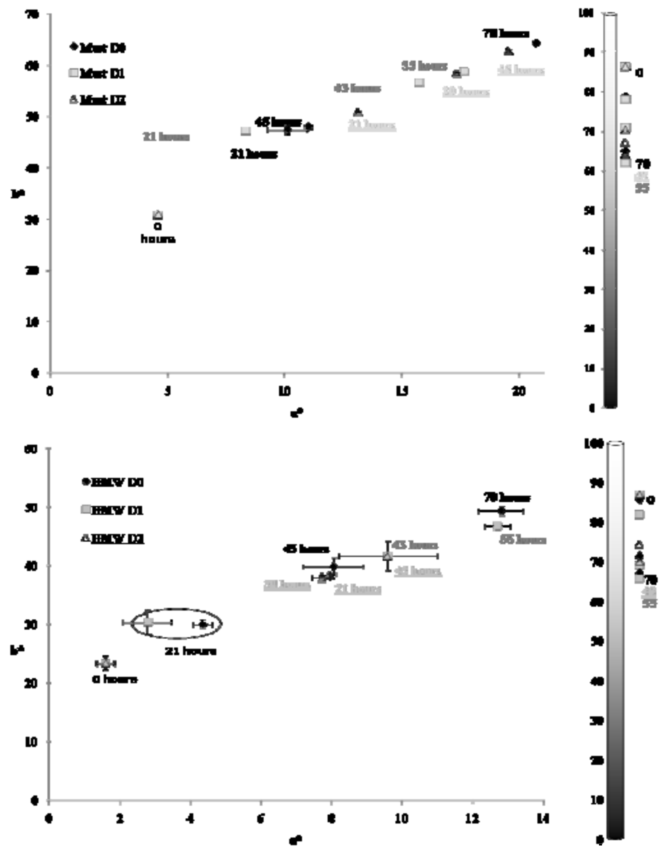

Fig. 2 – CIELab coordinates for the musts obtained from the grapes with and without pretreatment and their dialyzed fractions.

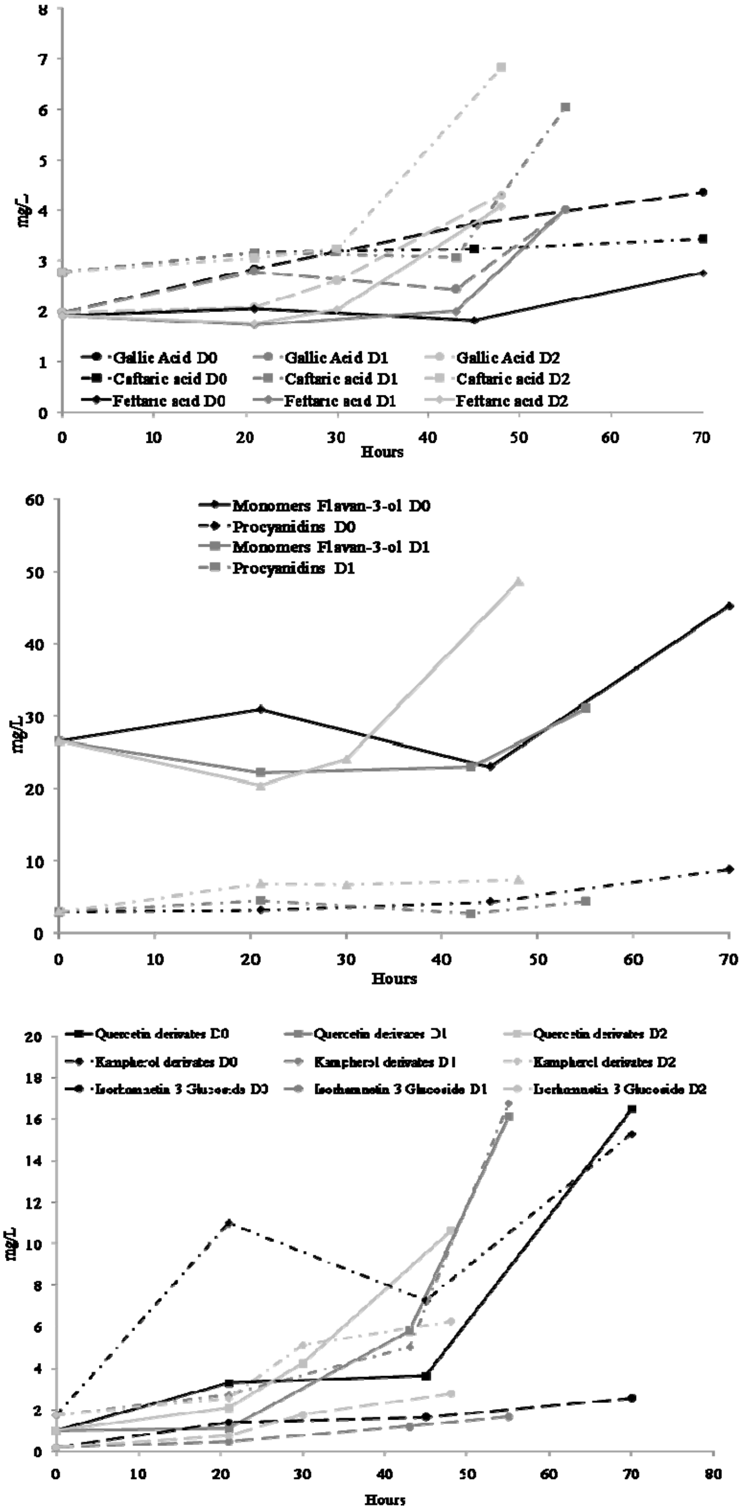

Fig. 3 – Changes in the concentration of phenolic compounds during the drying process.

Gallic acid increased in all treatments in a similar way as a result of effect of concentration by evaporation of water (fig. 3). The concentrations of esters of hydroxycinnamic acids increased as grapes were treated or not. D0 showed a very small increase, suggesting a degradation of these phenolic compounds. D1 and D2 increased similarly to sugars, therefore probably due to the concentration effect.

None of the flavan-3-ol monomers reached the expected concentration because of dehydration of the grapes, showing the lowest increase in the treatment D1, as a result of their faster degradation through enzymatic and/or chemical reactions (Macheix *et al.*, 1991). Procyanidins increased in the three drying methods, with the smallest increase in D1.

Dipping pretreatments did not affect the increase of flavonols.

Abstract

The influence of dipping pretreatments on drying of 'Pedro Ximenez' grapes, destined to the elaboration of sweet wines, in chamber at controlled temperature, has been studied. Changes in color and phenolic composition of raisins produced were observed during the process of raisining. Dipping pretreatments can improve the quality of the raisins produced in terms of lightness, sweet flavor, nutritional quality and better hygiene, in addition shortening drying time. Dipping pretreatments used in this study were solutions of potassium carbonate and olive oil (D1), and alkaline emulsion of ethyl oleate (D2).

CIELab space showed that musts of raisins and their fractions of high molecular weight (HMW), obtained by dialysis, increased a^* and b^* components, while lightness (L^*) decreased.

In relation to phenolic compounds, the drying processes of grapes could increase their concentrations as a result of dehydration, although they could also decrease by participating to non-enzymatic browning, auto-oxidation or enzymatic oxidation reactions. All fractions of phenolic compounds increased during drying of the grapes, with and without dipping pretreatments, and particularly the flavonol fraction.

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