Influence of initial temperature on olive enzyme activity during malaxation – a model system experiment

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Introduction

The chemical composition, nutritional value and sensory properties of virgin olive oils are largely influenced by the activity of endogenous enzymes of olives. During crushing and malaxation, these enzymes are activated and lead to a change in the quantitative and qualitative composition of phenolic compounds and to the formation of various volatile compounds. Since their activity is largely temperature-dependent, thermal conditioning during the malaxation process, which is therefore time-consuming, has a decisive influence on the final olive oil quality, with recommended temperatures generally ranging between 25 and 30 °C. However, considering the different optimal temperatures of each enzyme, it is hypothesised that changing the initial temperature for malaxation could increase their joint activity.

The aim of this study was to investigate the effect of initial temperature on the activity of commercial β-glucosidase and lipoxygenase.

Materials and methods

Model solutions of the enzymes (β-glucosidase and lipoxygenase) and their substrates (p-nitropheniyglucopyranoside and linolenic fatty acid, respectively) were tempered at temperatures ranging from 15 to 40 °C and then incubated at 25 °C for 30 min to simulate the malaxation process. The enzymatic activity was measured after 1 min of incubation at the desired temperature and again after the malaxation process. Activity was determined according to the methods of Romero-Segura et al. (2009) for β-glucosidase and a method of Pérez et al. (1999) for lipoxygenase.

Results

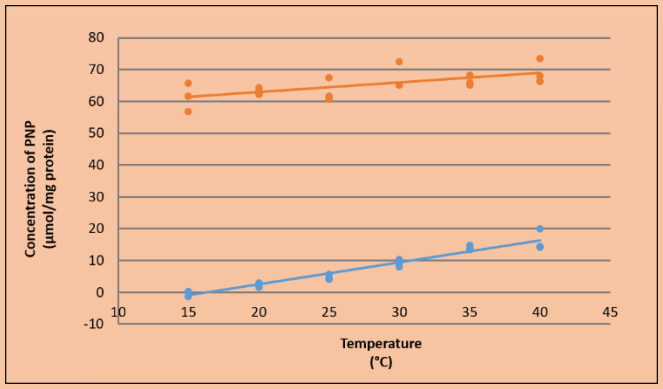

Fig.1 Effect of initial temperature on β-glucosidase activity. The blue line shows the activity at the indicated temperature and the red line shows the enzyme activity after an additional 30-min incubation time at 25°C, expressed as concentration of p-nitrophenol (PNP).

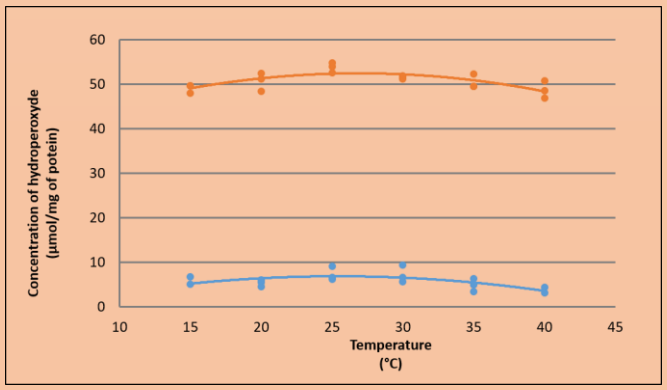

Fig. 2 Effect of initial temperature on lipoxygenase activity. The blue line shows the activity at the indicated temperature and the red line shows the enzyme activity after an additional 30-min incubation time at 25°C, expressed as the concentration of hydroperoxide formed.

Conclusions

The initial temperature of the model solutions before malaxation had a significant effect on β-glucosidase and lipoxygenase activity.

The β-glucosidase was not active at lower temperatures (15 and 20 °C), whereas its activity increased exponentially at higher temperatures.

Lipoxygenase activity increased with temperature up to 30°C and then decreased significantly at higher temperatures.

The simulated malaxation process further increased the amount of products released, with curves after 30 min almost parallel to those after heat treatment, suggesting that the initial temperature affects the final concentration of products in the mixture.

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