The effect of heat shock on browning-related enzyme activity in lettuce

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Abstract

A major defect limiting the shelf life of minimally processed lettuce is wound-induced enzymatic browning, caused by the activity of phenylalanine ammonia-lyase (PAL), polyphenol oxidase (PPO) and peroxidase (POD).

Regarding the inhibition of enzymatic browning, several studies considered mild heat shock as an effective alternative for the use of chemical additives. Preliminary tests were conducted to study the effect of heat shock (treatment temperature ranging from 30 to 60 °C and treatment time ranging from 30 to 150 sec) on the sensory characteristics (general appearance, discoloration and texture) of excised midrib segments of Iceberg lettuce. Based on the observations of these experiments, specific treatment temperatures (30, 40, 45 and 50 °C) and one treatment time (60 sec) were selected for more detailed studies. The effect of heat treatment was evaluated on specific days (day 0, 1, 2, 3, 7 and 10) during storage (7 °C) by determining the browning potential and analyzing the activity of PAL, PPO and POD.

A heat shock treatment of 60 seconds at 50 °C was found to be most effective in inhibiting enzymatic browning with little or no negative effects on the sensory characteristics of Iceberg lettuce. Compared to the control tissue (4 °C – 60 sec), the activity of both PAL and POD did not increase after wounding and remained at their initial levels up to 10 days after processing and heat shock treatment (50 °C – 60 sec), while the activity of PPO seemed unaffected. Exposure to 45 °C or lower temperatures had little or no effect on all measured enzymes.

Mild heat shock treatment seems promising, but remains an energy-consuming (washing) step when applied in the food process chain. Therefore, in a second phase, research on the enzymatic browning issues can be focused on the identification of natural compounds (e.g. extracted from waste streams) with an equally effective anti-browning activity.