Title Determination of membrane integrity in onion tissues treated by pulsed electric fields: Use of microscopic images and ion leakage measurements

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Abstract

The influence of electrical field strength and number of pulses on cell rupture of onion tissues was investigated by two different methods to understand the changes in cell viability of plant tissues after pulsed electric field (PEF) treatment. The impact of pulsed electric field parameters on cell integrity of 20 mm diameter, 4 mm thick disks of Sabroso onions (*Allium cepa* L.) was determined by ion leakage measurements and microscopic method. The effect of treatments on cellular integrity was visualized by neutral red staining of the onion cells. Cell rupture is essential for optimal process design before extraction of desirable compounds and/or drying of plant tissues. Experimental results were obtained for onion disks treated with electrical pulses at field strengths of $E \approx$ 167 V/cm and 333 V/cm, pulse width of ti = 100 μs, frequency of f = 1 Hz and the number of pulses, n = 1 to 100. At 167 V/cm electric field strength treatment cell rupture was not observed however ion leakage increased and air spaces around cell walls disappeared, most likely due to changes in cell membrane permeability. Irreversible cell rupture occurred at 333 V/cm. Ion leakage values and ruptured cells count were increased with increasing pulse number. 92.2 ± 5.9 % of the onion cells were ruptured after 333 V/cm and 100 pulse treatment. Small plant cells that are located near vascular bundles and upper epidermis showed higher resistance to pulsed electric field treatments.