Optimisation of process parameters for short-term hot-water treatment of apples for fruit salads by non-destructive imaging techniques

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In fruit salads, apples are often the main component. Before processing, careful removal of microorganisms, adherent to fruit skin is a basic requirement to avoid microbiological contamination and to exclude cross-contaminations. For long-term storage, hot-water treatment is known as an effective but gentle sanitation technique, which does not need any additional chemicals. However, for fruit salad production, this technique needs adaptation. Process parameters, in particular treatment temperature and duration, must be optimised to efficiently but also sustainably inactivate microbial spoilage organisms and human pathogens, and to avoid the excessive use of hot water. Care must be taken that badly adapted heat treatment did not adversely affect produces metabolism and, thus, internal quality. Major initial target of heat stress in apple skin cells is the photosynthetic apparatus. Consequently, photosynthesis may be suitable and sensitive marker for heat stress effects. Chlorophyll fluorescence imaging (CFI) and spectral analyses provide rapid and non-invasive means for effective process optimisation. In the presented project, apples of four practically relevant cultivars (‘Braeburn’, ‘Greenstar’, ‘Fuji’ and ‘Granny Smith’) were hot-water treated in the range of 44°C to 64°C for 0.5 min to 5 min. Afterwards and after 7 d of storage at 4°C intact apples were analysed for changes in CFI and spectral parameters to evaluate the potential effects of combinations of processing parameters on the intactness of the photosynthetic apparatus and chlorophyll contents. The results obtained were used to precisely determine the threshold for immediate and shelf-life temperature-stress responses and the optimal non-destructive treatment conditions. In this paper, the results of this study will be discussed in terms of physiological responses, potential practical implications and the cultivar specifity of the fruit reactions.