

# Abstract

Fresh citrus trade constitutes a basic pillar of the Spanish citrus industry, which should be given all the attention because of its economic importance.

In modern agriculture, the widespread use of chemicals is common, but the possible presence of residues in food is an issue of increasing importance for public health opinion.

The citrus industry must address a change involving the introduction of new methods for fruit production, handling and storage to ensure the overall quality of the fruit. The adaption of some postharvest treatments (greening application of coatings, cold storage, etc.) to the fruit characteristics at harvest is important for achieving safe, healthy and high quality food in the XXI century.

The germicidal effect of UV-C irradiation has been successfully tested in different foods but not at an industrial scale as a method for surface disinfection at room temperature of fresh citrus fruit without leaving residues on the product, which is considered a good alternative for food preservation.

Postharvest diseases affect the fruit from harvest to the consumer table, and cause significant economic losses to the citrus industry. Losses from disease are highly variable and depend on the production area, species, cultivar, age and condition of the trees; weather conditions throughout the season, the time and method of harvest, postharvest handling of the fruit, storage conditions and destination market.

At the global level, important economic losses are caused by strict wound pathogens such as *Penicillium digitatum* (Pers.: Fr.) Sacc, and *Penicillium italicum* Wehmer that cause, respectively, citrus postharvest green and blue molds. The paradigm change, as in the care of field integrated production should be based on a Integrated Clean Postharvest Disease Control strategy (CINCEP), based on deep knowledge of the pathogen epidemiology and all the preharvest and postharvest factors that determine their incidence in order to incise on it at the right time to minimize economic losses.

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UV-C irradiation has a maximum emission peak at 254 nm and has been found that this wavelength provides the greatest germicidal action, which has been extensively studied in various plant tissues.

Depending on the intensity and wavelength, UV irradiation can induce a biological stress in plants and activate some defense mechanisms of plant tissues, with the consequent production of phytoalexins.

Immersion in hot water is a physical method to control postharvest diseases in an easy and practical way that can give good results, especially in combination with other treatments of different nature.

The feasibility of UV-C light and hot water used in combination is mainly due to their dual mode of action. The effects of both heat and irradiation treatments on postharvest diseases can be direct or indirect.

Irradiation with UV-C is considered a potential additional tool in CINCEP strategies for the control of citrus decay, although UV-C alone cannot achieve the high efficacy of the fungicides used nowadays for disease control.

The specific objectives are to:

- Design and evaluate several prototypes for ultraviolet light application to citrus fruit after harvest, using lamps emitting UV-C, including low pressure mercury.
- Evaluate the curative and preventive activity against green mold caused by the pathogen *Penicillium digitatum* on mandarins and oranges, exposed to UV-C light alone or in combination with another postharvest antifungal treatment such as hot water.
- Evaluate different application doses of UV-C on the designed prototypes to establish the effective and no phytotoxic range.
- Relate the control ability of the treatments with the main external and internal fruit quality parameters, fruit maturity and fruit susceptibility to *Penicillium digitatum*.
- Determine the effectiveness of UV-C treatment alone or in combination with hot water on the most important commercial cultivars of mandarin and orange in Valencia.

The results obtained with the prototypes, showed that the best prototype is number III, in which the UV light is applied over rotating rollers.

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The results indicate that UV light has an indirect hormetic effect on the fruit in preventive trials. The combination with hot water also improves the results when applied in the sequence of hot water followed by application of UV-C in the rotating UV applicator prototype III, but not vice versa.

Fruit ripening conditions along the season influence the efficacy of the applied dose of UV-C and higher doses can cause undesirable phytotoxic, which can be minimized by the combination with hot water. The studied doses that have been more effective for mandarins and oranges at different ripening stages are: 2.5kJ/m<sup>2</sup> on fruit at commercial maturity and subjected to degreening, and the range 5 to 10kJ/m<sup>2</sup> on fruit that has reached physiological maturity, which varies depending on the characteristics of the fruit along the season and always in combination with hot water.