Nano silver application impact as vase solution biocide on postharvest microbial and physiological properties of ‘Cherry Brandy’ rose

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Abstract
The major cause of vase life reduction in cut flowers is water relation interruption which is mostly due to vase solution microbial proliferation and consequently vascular occlusion resulting in solution uptake reduction. In order to control microbial proliferation biocides are usually integrated in vase solution preservatives. Beside microbial proliferation control, biocides could affect cut flower’s quality and physiology in various aspects. In order to find an easy to use, non toxic and inexpensive compound for large scale application, cut ‘Cherry Brandy’ roses were treated with colloids of nano silver particles (1, 2.5 or 5 %) and sterilized distilled water (control). Effects of nano silver as vase solution biocide and its impact on vase life, water relation, vase solution microbial kind and population beside different physiological parameters such as chlorophyll degradation, chlorophyll fluorescence and membrane permeability were investigated during this study. Results indicated that nano silver treatment significantly increased vase water relation, vase solution microbial kind and population beside different physiological parameters such as chlorophyll degradation, chlorophyll fluorescence and membrane permeability were investigated during this study. Results indicated that nano silver treatment significantly increased vase life and did not result in any evident side effects. It also improved solution uptake and consequently retarded weight loss. Beside that nano silver application as vase solution efficiently disinfected vase solution and consequently prevented vase solution microbial proliferation. Membrane permeability was best maintained by 1% nano silver treatment. Besides that, 1% nano silver treatment resulted in the highest chlorophyll content. Nano silver application also resulted in chlorophyll fluorescence reduction and loss of photosynthetic activity during vase life.

Key words: Bacillus, chlorophyll content, chlorophyll fluorescence, ion leakage, microbial count, microbial kind.

Introduction
Cut flowers vase life is affected by several factors such as cell programmed death 4, ethylene induced senescence 18, 31, dehydration 16, 20, 39, 44 or loss of assimilates and substrates 9, 17. Among the above mentioned, water relation and balance play a major role in postharvest quality and longevity of cut flowers 20 and water stress during this period is often the reason of short vase life for cut flowers 40. Water relation interruption is mostly due to microorganism proliferation in vase solution and occlusion in the basal end of the cut flower stem by microbes 1, 8, 19, 40. Stem blockage could take place by the bacteria 1, 8, 19, 40, or by extra cellular polysaccharides and degradation products of dead cells 1. Besides vessel blockage, bacteria secrete pectinases and toxic compounds and produce ethylene 45, thereby, accelerate senescence.

It has been shown that beside vase life reduction, disruption of water relation in rose flowers causes some physiological disorders such as bent neck 1, 6, 39, lack of flower opening 1, and wilting of the leaves accompanied by improper opening and wilting of flowers 1, 38. Therefore, controlling and reducing microbial proliferation is a prerequisite for extended quality and longevity of cut flowers, especially roses. On the other hand applied biocides could also affect other physiological properties of cut flowers specially their photosynthetic apparatus function and membrane permeability by their toxic compounds severally or moderately during aging and senescence.

In order to prevent microbial proliferation in vase solutions of cut flowers, various compounds and chemicals have been used, namely, silver nitrate 38, silver thiosulphate 38, 41, aluminium sulphate 40, hydroxyquinoline sulphate 18, hydroxyquinoline citrate 13, 23, 32, 39, 41 and sodium hypochlorite 23, 39, 41. Some of these compounds such as silver nitrate and silver thiosulphate have shown environmental risks and health hazards 1. Recently new efficient biocides with low toxicity have emerged. Nano silver is one which is more efficient compared to other Ag forms due to higher surface area to volume ratio 12. Formerly nano silver was broadly used as a biocide in different industrial products such as home appliances, cosmetics, textile, and pharmaceutics 12. Although it was initially introduced as a biocide into cut flower research 19, 32 on cut gerbera flowers and after that applied on cut ’Movie Star’ roses 20, 21, still there is need of more evidence and knowledge on the application of nano silver in postharvest studies of cut flowers. This need is more required on physiological aspects such as chlorophyll degradation, chlorophyll fluorescence and membrane permeability which have not been studied before and on cut rose flowers which hold a very large portion of cut flower market and industry, and its cultivars benefit both from the biocidal and the ethylene antagonistic effect of silver.

Regarding the importance of cut rose flowers in the ornamental industry and the influence of vase solution microbe, and also, in order to found an easy to use, non-toxic and inexpensive compound