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Post-Harvest Quality Management of Strawberries (*Fragaria x ananassa*)

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Strawberry (*Fragaria* × *ananassa* Duch.) is perennial herb plant that belongs to family Rosaceae and genus Fragaria. Most of the members in genus Fragaria are characterized by polyploidy and their cultivation in temperate zones of the world. Botanically, fruit is not berry but it is aggregate accessory since fleshy part is derived from central receptacle that holds floral ovary. The outermost fruit surface contains imbedded achene (average 200 on each strawberry) that encompasses seeds inside. Strawberry is one of the most adorable fruit crop often characterized by its unique organoleptic properties and nutraceutical importance. Fresh slices of strawberry fruit are rich source of flavonoids, fibers, vitamins, potassium, and diverse array of phenolic acids such as hydroxycinnamic and hydroxybenzoic acids. Strawberry contains high content of anthocyanins, flavonols (myricetin and quercetin derivatives), flavanols (catechin, epicatechin, proanthocyanidin B1 and B2), dihydrochalcones (phloridzin). Fisetin (7,3′,4′-flavon-3-ol) is another novel flavonol biosynthesized in the strawberry fruit through branchy and intricate phenyl-propanoid pathway. Fisetin plays major role for improving antioxidant activity and anticancer ability by blocking PI3K/AKT/mTOR pathway. Poland has the largest area under strawberry cultivation; however, due to utilization of technological advances and advantage of climatic conditions. In India top 3 states are the largest producer of strawberry Haryana, Maharastra and Jammu & Kashmir. In these states Haryana producing more than 4,260 tons annually and the state accounts for 31.5% of the country's total strawberry output, Maharastra producing more than 3,280 tons annually and the state accounts for 24.25% of the country's total strawberry output and Jammu & Kashmir producing more than 2,830 tons annually and the state accounts for 20.93% of the country's total strawberry output. During post-harvest of strawberry average loss occurs 28 to 30% and maximum up to 50%.

Keywords: Introduction, edible and essential oil coatings, exogenous chemicals, control atmosphere, biochemical changes, quality and shelf life

Edible and essential oil coatings

Essential oils have strong antimicrobial activities and have been incorporated in edible coatings and films not only to improve texture of coatings but also as antimicrobial agents. Essential oils of clove, cinnamon, and oregano were used in paraffin coatings of paper packaging materials that totally inhibited the growth of Candida albicans, Aspergillus flavus, and Eurotium repens on strawberry fruits for 7 days at 4°C. In the recent years, numerous researches have been initiated for new alternative technologies to preserve foods which are prime interest to the fast-growing food industry. Essential oils of clove and/or mustard in vapor phase were evaluated in vitro and in vivo on strawberries against Botrytis cinerea. Essential oils showed good results in combination rather than individual application.

Essential oils exhibited inhibitory activity which is due to major compounds presented in the mustard and clove oils and reduction in the development of Botrytis cinerea. It has synergistic antifungal effect which is more effective in combination compared to individual essential oil application.

Exogenous chemicals

Strawberry is perishable fruit which is highly susceptible to different postharvest losses (50%) due to sudden attack of fungal diseases. For a decade, various kinds of synthetic chemicals have been utilized to increase postharvest life. 1-Methylcyclopropene (1-MCP) was applied on strawberry cv. Everest tended to maintain firmness and color, and higher level of disease was observed in fruit treated at higher application rates of 1-MCP. 1-MCP showed reduction in advance-ment of anthocyanin and phenolic contents and inhibited phenylalanine ammonia-lyase (PAL) activity. Higher level of 1-MCP application to strawberry fruits might lower disease resistance in strawberry fruits.

Control atmosphere

Generally, controlled atmosphere (CA) storage is characterized by increasing the concentration of Co_2 and decreasing that of O_2 in the ambient atmosphere of storage chamber. However, change in composition of atmosphere is always accompanied by low temperature and high humidity during long-term storage. CA storage slows down rate of respiration, microbial infestation, and fruit-softening process, whereas suboptimum gaseous levels during CA storage may cause production of off-flavors and skin discoloration.

Biochemical changes

The fluctuation in the profile of bioactive compounds also depends on environmental cues. Temperature is positively correlated with soluble solid contents (SSC) and vitamin C; however, harvesting of late-season fruits showed inverse relationship between SSC and temperature. Similarly, ascorbic acid decreased gradually during postripeningera. However, further studies have suggested that fluctuations in SSC content are independent from photosynthetically active radiation (PAR).This phenomenon advocates that these events are driven genetically. Microarray analysis has demonstrated that gene expression plays key role in ripening of red (60% upregulation) and green (40% downregulation) fruits.

Quality and shelf life

There are different method to enhance quality and shelf life of strawberries

1. Harvesting and handling management
2. Temperature management
3. Modified atmosphere packaging
4. Heat treatment
5. Use UV irradiation
6. Reduce the losses due to physical injury
7. Reduce the losses due to mechanical injury

Conclusion

Strawberry is a highly perishable fruit and subjected to several postharvest losses after harvest. There are several stages which are responsible for quick losses such as improper harvesting methods, developmental stage, improper picking time, sorting and packaging, transportation postharvest treatments, and storage conditions and as well as untrained labor. However, numerous pre- and postharvest studies were conducted to develop strategies for extension of strawberry shelf life such as harvesting methods, heat treatments, UV-C irradiations, coating, and essential oil applications. Furthermore, there is need a to study these

technologies on commercial scale to increase the net income. There is a need to develop ecofriendly alternative technologies to enhance the shelf life of strawberries.

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