OPEN ACCESS Freely available online

ISSN: 2319-5584
Global Journal of Biology, Agriculture & Health Sciences

Commentary

Tomato Cultivation and Post-Harvest Challenges: The Role of Anthocyanins in Extending Shelf Life and Disease Resistance

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DESCRIPTION

According to data collected and updated in December 2022 by the FAO, total world tomato production for both processing and fresh consumption in 2021 amounted to just over 189.1 million metric tonnes, up 2% from the 184.8 million mT grown in 2020 and 4% from the average (182.7 million mT) of the previous three years (2018-2020). According to these figures, annual tomato production has reached or exceeded the million-tonne threshold in a large number of countries. With about 1.1 million mT, Cameroon and Indonesia produced three times less than Iran (3.4 million mT) and six times less than Italy (6.6 million mT). Turkish production (13 million mT) was double that of Italy, but represented only one fifth of China's crop (67 million mT), which alone accounted for nearly 36% of the worldwide harvest. In radically different growing conditions from those of processing tomatoes, record yields have been recorded for fresh tomatoes in the Netherlands and Poland. In addition to these countries, Portugal, USA and Morocco ranked higher than Spain, Türkiye and Brazil. Globally, yields are the same in 2020 at 36.6 Mt/ha.

FAO data also show a significant difference in the growth rates of the two categories, which is very beneficial for growing tomatoes for the fresh market. In the last 30 years (1991-2021), the growth of tomatoes for raw consumption has increased at an annual rate (CAGR) of 3.5%, but the average annual growth of production for processing it is only 1.85%. In the shorter term, from 2001 to 2021, growth is lower, about 3% for fresh market tomatoes and 2.6% for processed tomatoes. Over the past ten years (2011-2021), the new product market will continue to grow at a CAGR of more than 2%, while employment will grow in processing unit to an annual rate of 0.4%.

The major challenges for tomato cultivation are post-harvest disease and reduced quality due to fruit aging and disease. Many tomatoes grown for fresh food are stored at low temperatures while still firm and green and exposed to external ethylene to color and ripen before reaching the supermarket shelf. Although these methods are effective in reducing post-harvest diseases, they adversely affect tomato taste, aroma and texture. Mutants used during ripening have similar negative effects on taste. In the last two years, genetic engineering has been used to increase the life of tomatoes by reducing the activity of cell wall degrading enzymes and increasing the level of specific metabolites. Anthocyanins are water-soluble pigments responsible for the red, purple and blue colors of many flowers and fruits. Plants do this to attract predators and seed dispersers. Anthocyanin production is often inhibited under conditions of stress and infection by pathogens. In addition to their physiological functions in plants, anthocyanins are associated with protection against certain cancers, cancers, and other serious human diseases.

In addition to their high nutritional value, purple tomatoes have twice the shelf life of anthocyanin, a result of a combination of increased resistance to beneficial pathogens and slower ripening. These factors affect the anthocyanin concentration in tomatoes. Anthocyanins significantly modulate the spread of ROS damage produced as part of necrotrophic disease and reduce susceptibility to *B. cinerea*. The accumulation of anthocyanins leads to a high hydrophilic antioxidant capacity, which reduces the increase in ROS levels that occur at the end of fruit development, and the reduction of ROS can eliminate the components after ripening. The association of slower ripening and increased hydrophilic antioxidant capacity of fruits presents new but general objectives for farmers to increase the shelf life of fruits after harvest. In addition, anthocyanins can be used to reduce the susceptibility of ripening fruits to *Botrytis cinerea*, the most important fungal pathogen of soft fruits.

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Received: 23-Oct-2024, Manuscript No. GJBAHS-24-27247; **Editor assigned:** 25-Oct-2024, PreQC No. GJBAHS-24-27247 (PQ); **Reviewed:** 08-Nov-2024, QC No. GJBAHS-24-27247; **Revised:** 13-Oct-2025, Manuscript No. GJBAHS-24-27247 (R); **Published:** 20-Oct-2025, DOI: 10.35248/2319-5584.25.14.279

Citation: Hanaka C (2025) Tomato Cultivation and Post-Harvest Challenges: The Role of Anthocyanins in Extending Shelf Life and Disease Resistance. Glob J Agric Health Sci. 14:279.