



Opinion

Volume 26 Issue 1 - June 2021
DOI: 10.19080/ARTOAJ.2021.26.556324

Agri Res & Tech: Open Access J

Copyright © All rights are reserved by Haixia Zhang

Fruit Ripening and Senescence Regulated by Ethylene and Melatonin



Pengfei Zhao, Yuxing Zhang, Haixia Zhang*

Hebei Agricultural University, Baoding, China

Submission: June 18, 2021; **Published:** June 18, 2021

***Corresponding author:** Haixia Zhang, College of Horticulture, Hebei Agricultural University, China

Abstract

Fruit ripening and senescence are two important stages of fruit development, during which many physiological and biochemical changes going on. Hormones play critical roles in fruit ripening and senescence, and among them, ethylene is the most outstanding one. It could promote climacteric and non-climacteric fruit ripening and senescence and the regulating mechanisms have been much clearer. Melatonin is a bioactive substance existing in nearly all kinds of plants and it is involved in most growth and development processes of plant. Recent researches showed that melatonin can promote fruit ripening by increasing ethylene production, pigment and aroma/taste, and decreasing cell wall sickness et al. While it can inhibit fruit senescence by eliminating excessive reactive oxygen species (ROS). However, the specific regulating mechanism is still not clear, and further studies are urgently needed.

Keywords: Fruit; Ripening; Senescence; Ethylene; Melatonin; Regulating mechanism

Introduction

Fruit ripening and senescence

After pollination and fertilization, the fruit forms and it will generally experience fruit setting, fruit development, fruit maturity and fruit senescence under natural conditions. Among them, fruit maturity and senescence are the last two stages. The ripening process is irreversible and during which the synthesis and degradation of substances take place simultaneously [1]. And senescence comes after the fruit mature changes are basically over. The content of soluble solids increased and the ratio of sugar to acid increased during fruit ripening. Sugar transporters are the main carriers of sucrose from the source tissues to the fruit tissues and they play a leading role in the accumulation of fructose. In addition to the transport and metabolism of sucrose in fruit, starch degradation is another important mechanism of sugar accumulation. Starch is mainly accumulated in the developing fruit and hydrolyzed to soluble sugar during ripening by amylase activity [2]. Changes in cell wall structure include decrease of cell wall thickness and permeability of plasma membrane, hydration of cell wall, decrease in structural integrity, and increase in intracellular space [3]. The change of fruit texture is an important event in the softening process during fruit ripening and it is strictly regulated. The activities of enzymes that catalyze cell wall decomposition were greatly enhanced during fruit ripening, which

is consistent with the changes of the transcription level of genes encoding them [4-6].

Regulation of fruit ripening and senescence by ethylene

Ethylene, as a plant hormone, functions in many aspects of plant growth and development, and it is typically known as a regulator during fruit ripening. According to whether there are ethylene release peak and respiration peak during fruit ripening, fruits are divided into climacteric fruits and non-climacteric fruits. The climacteric fruit had enhanced respiration and changed metabolism at maturity, and released a large amount of ethylene, while non-climacteric fruits have no respiratory climacteric during ripening. Early studies suggest that ethylene is only related to fruit ripening, but recently more and more researchers believe that ethylene also plays a role in non-climacteric fruit ripening [7]. And its regulating mechanism is relatively clear [8].

Regulation of fruit ripening and senescence by melatonin

Melatonin is a bioactive small molecule substances widely existing in animals and plants and it was first discovered in plants in 1995 [9]. Researches have shown that melatonin plays an important role in anti-oxidation, resistance to abiotic stresses, and delaying senescence by scavenging ROS [10]. Although fruit

ripening and senescence is hard to be distinguished, melatonin has a positive regulatory effect on fruit ripening, while has an inhibitory effect on fruit senescence [11-13].

Conclusion

So far, the mechanisms of ethylene regulating fruit ripening and senescence have been relatively clear. As to melatonin, on the one hand, it can promote fruit ripening, and on the other hand, it can delay fruit senescence. Therefore, it may be a balance mechanism. However, the specific regulatory mechanism is unclear, and it is necessary to be further studied. In addition, it is very interesting to carry out research on if ethylene and melatonin have synergism or antagonism on fruit ripening and senescence.

Acknowledgements

Thanks for the financial support of Special Fund for Talent Introduction of Hebei Agricultural University (YJ201960, KY201902).

Conflict of Interest

There is no conflict of interest exists.

References

1. Minoia S, Boualem A, Marcel F, Troadec C, Quemener B, et al. (2016) Induced mutations in tomato SLEP1 alter cell wall metabolism and delay fruit softening. *Plant Sci* 242: 195-202.
2. Zahid M, Arif M, Rahman A, Singh K, Mujahid M (2018) Solvent extraction and gas chromatography-mass spectrometry analysis of *Annona squamosa* L. seeds for determination of bioactives, fatty acid/fatty oil composition, and antioxidant activity *J Diet Suppl* 15(5): 613-623.
3. Redgwell RJ, Harker R, Hallet L, Fischer M, Perry J, et al. (1997) In vivo and in vitro swelling of cell walls during fruit ripening. *Planta* 203(2): 162-173.
4. Thompson DS, Davies WJ, Ho LC (1998) Regulation of tomato fruit growth by epidermal cell wall enzymes. *Plant Cell Environ* 21(6): 589-599.
5. Smith DL, Abbott JA, Gross KC (2002) Down-Regulation of Tomato Galactosidase 4 Results in Decreased Fruit Softening. *Plant Physiol* 129(4): 1755-1762.
6. Wen B, Ström A, Tasker A (2013) Effect of silencing the two major tomato fruit pectin methylesterase isoforms on cell wall pectin metabolism. *Plant Biology* 15(6): 1025-1032.
7. Chervin C, El-Kereamy A, Roustan JP, Latché A, Lamon J, et al. (2004) Ethylene seems required for the berry development and ripening in grape, a non-climacteric fruit. *Plant Sci* 167(6): 1301-1305.
8. Ju CL, Yoon GM, Shemansky JM, Lin DY, Ying ZL, et al. (2012) CTR1 phosphorylates the central regulator EIN2 to control ethylene hormone signaling from the ER membrane to the nucleus in Arabidopsis. *PNAS* 109(47): 19486-19491.
9. Dubbels R, Reiter RJ, Klenke E (1995) Melatonin in edible plants identified by radioimmunoassay and by high performance liquid chromatography-mass spectrometry. *J Pineal Res* 18(1): 28-31.
10. Arnao MB, Hernández-Ruiz J (2014) Protective effect of melatonin against chlorophyll degradation during the senescence of barley leaves. *J Pineal Res* 46(1): 58-63.
11. Sun Q, Zhang N, Wang J, Cao Y, Li X, et al. (2016) A label-free differential proteomics analysis reveals the effect of melatonin on promoting fruit ripening and anthocyanin accumulation upon postharvest in tomato. *J Pineal Res* 61(2): 138-153.
12. Aghdam MS, Fard JR (2017) Melatonin treatment attenuates postharvest decay and maintains nutritional quality of strawberry fruits *Fragaria×anannasa* cv. Selva by enhancing GABA shunt activity. *Food Chem* 221: 1650-1657.
13. Gao H, Zhang ZK, Chai HK, Cheng N, Yang Y, et al. (2016) MT treatment delays postharvest senescence and regulates reactive oxygen species metabolism in peach fruit. *Postharvest Biol Tec* 118: 103-110.



This work is licensed under Creative Commons Attribution 4.0 License
DOI: [10.19080/ARTOAJ.2021.26.556324](https://doi.org/10.19080/ARTOAJ.2021.26.556324)

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
(Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission
<https://juniperpublishers.com/online-submission.php>