Purple Tomato FAQ

Compiled by Peter Boches and Jim Myers, Department of Horticulture, Oregon State University. 25 October 2006
Revised 22 April, 2009

1. But I thought that there were already purple tomatoes commercially available. What about heirloom varieties such as ‘Black Prince’ and ‘Purple Cherokee’?

With one exception, all of the “black” and “purple” varieties that we have examined in our field trials have the green flesh gene, which prevents normal chlorophyll breakdown, resulting in a brown compound called pheophytin. A muddy brownish purple color is produced when the brown of the pheophytin blends with the pink or red of the carotenoids (the normal pigment found in tomato fruit). The biochemical composition of the tomatoes that we have developed is fundamentally different. The single commercially available cultivar that has pigmentation similar to the material that we have developed is ‘Purple Smudge’.

2. What causes the purple pigment?

A class of compounds generally called anthocyanin. The specific anthocyanins present in the tomatoes are mainly petunidin, but malvidin and delphinidin are also present. The anthocyanins are modified by the presence of acyl (sugar) groups. Anthocyanins are a member of a larger class of compounds called flavonoids. Other members of this class include quercetin, kaempferol, naringenin, catechin, and isoflavones. Phenols or Phenolics are related compounds that differ in basic chemical structure, but have similar function. In our tomato lines many different kinds of phenolics and flavonoids are up regulated along with the anthocyanins.

3. How do the anthocyanin levels compare to other fruits and vegetables?

This is a difficult question to answer because the amounts found in fruit depends on many factors, including variety, growing conditions, and extraction and measurement methods. As a rough guide, the total anthocyanin levels of fresh purple tomato fruit are about 1/10 or 1/20 of that found in blueberries, (in mg/gram fruit). Blueberries are one of the richest sources of anthocyanins. Americans consume an average of 12.5 mg anthocyanin per day (blueberries have 1-3 mg/gram fresh weight, purple tomatoes have 0.1-0.3 mg/gram FW fresh weight, so a person would have to eat about 10 purple cherry tomatoes for an ‘average’ anthocyanin serving.).
While other fruits have a higher concentration of anthocyanin, tomatoes are consumed on practically a daily basis in the U.S. Americans eat about 90 pounds per person per year of fresh and processed tomatoes, second only to potatoes in consumption of fruits and vegetables. In contrast, Americans ate less than 1 pound of fresh and frozen blueberries per person per year in 2001.

4. *Is the anthocyanin distributed throughout the fruit?*

   No, it is mainly restricted to the skin and outer flesh.

5. *What are the reported health benefits of anthocyanins?*

   As Oregon State University Emeritus Professor Ron Wrolstad writes on his web page (http://lpi.oregonstate.edu/ss01/anthocyanin.html), “There is considerable anecdotal and epidemiological evidence that dietary anthocyanin pigments and polyphenolics may have preventive and therapeutic roles in a number of human diseases. Through the much publicized “French paradox”, the public has become aware that certain populations of red-wine drinkers in France and Italy have much lower rates of coronary heart disease (CHD) than their North American and Northern European counterparts. It is widely accepted that red wine phenolics contribute at least partly to this beneficial effect…. The anthocyanin pigments of Bilberries (*Vaccinium myrtillus*) have long been used for improving visual acuity and treating circulatory disorders. There is experimental evidence that certain anthocyanins and flavonoids have anti-inflammatory properties, and there are reports that orally administered anthocyanins are beneficial for treating diabetes and ulcers and may have antiviral and antimicrobial activities. The chemical basis for these desirable properties of flavonoids is believed to be related to their antioxidant capacity—their ability to scavenge and trap free radicals that damage biomolecules.” Although the current popular theory is that the health benefits of anthocyanins are due to their antioxidant activity, some recent research suggests that anthocyanins may not act directly as antioxidants, but may produce health benefits in a more complex manner.

6. *Do purple tomatoes have the carotenoids found in regular tomatoes?*

   Yes, you can still see the underlying carotenoid pigment in the purple fruited types. The red pigment in tomatoes is lycopene. Orange tomatoes have beta-carotene or prolycopene, while yellow ones may have other carotenoids such as delta-carotene. Carotenoids have antioxidant properties and are thought to have health benefits similar to flavonoids.
7. **Why do the tomatoes have areas of the fruit that are not purple?**

Anthocyanin is produced only in those areas of the fruit that are exposed to sunlight. Where the fruit is shaded by a leaf or the calyx, or on the base of the fruit, anthocyanin does not develop. If you pick a fruit and expose the non-purple area to sunlight, the purple pigment will form in about a week.

8. **Does the anthocyanin affect the taste of the tomato?**

Some of the lines with extremely high anthocyanin have a strong flavor. We don’t know whether this is due to the presence of anthocyanins or other changes in chemical composition of the fruit. We have evidence to suggest that at least one of the genes involved is a regulatory gene that interacts with several biosynthetic pathways; so, it is possible that multiple changes in the chemical composition of the tomato have taken place, possibly in order to accommodate the increased anthocyanin production.

The taste of the tomatoes in the breeding program could also be influenced by the presence of other ‘wild’ genes that were carried along on the chromosome with the genes that activate anthocyanin production. By crossing extremely high anthocyanin lines to tomato cultivars known for their good taste, we have recovered individual plants that produce tomatoes with moderate amounts of anthocyanin and acceptable flavor. We anticipate being able to produce stable lines with good flavor and moderate amounts of anthocyanin from these individual plants or others like them.

9. **Were Genetic Engineering techniques used to develop these lines?**

No, conventional crossing and selection techniques are being used. This is perhaps the most misunderstood aspect of this project, and we will say it again: These tomatoes are NOT GMO.

10. **What are the genes involved and where did they come from?**

* Aubergine ((Abg)), Anthocyanin fruit tomato (Aft) and atroviolaceae (atv) are genes introgressed from the wild species *Solanum lycopersicoides*, *S. chilense*, *S. cheesemanii*, respectively. The original introgression from wild species into cultivated tomato was done by other researchers. We discovered that when you combine these genes, you get an intensification of the pigment. The ‘Purple Smudge’ variety has a gene similar to *Aft* but it comes from a different wild species (*S. peruvianum*).

11. **Tell me about the breeding process. When will varieties be ready?**
We have stabilized a ‘high purple’ line by combining the above genes and are using it as a source of purple color in crosses aimed at improving the flavor and appearance of the tomatoes. The first tomato variety should be released in 2010. Additional varieties with different fruit size and flavor as well as differences in flesh color will follow.

12. What happens when you cook the tomatoes or make juice from them?

Anthocyanins are water soluble, and will leach out of the skin when the fruit is cooked. Juice made with a red fruit with purple skin is very similar in appearance to normal tomato juice. However, we are only beginning to explore the possibilities of products developed from these tomatoes.

Sources for the information presented above:


