

Ask Proctor



What causes syrup to be light or dark at different parts of the season?

Maple producers understand that syrup undergoes changes in color and flavor during the season, generally progressing light-colored and light-flavored syrup in the early part of the season to darker and stronger tasting syrup towards the end. At some points, syrup may get light again before continuing the trend towards darker syrup. So what are the dominant factors that affect these changes?

Without getting too buried in the chemistry, there are two major factors involved: changes in sap (especially sugar) composition due to microbes and degree of caramelization during evaporation.

The sugar that comes out of maple trees is predominantly sucrose, which is a large polysaccharide containing 12-carbon units. Microbes that are present in the environment, especially those in sap buckets, tubing, collection tanks, and filters feed upon the sugar in sap to fuel their own metabolic and reproductive processes. The higher the temperature of the sap, and the longer sap sits before processing, the higher the microbial load becomes. During feeding, the microbes break down 12-carbon (sucrose) molecules into two 6-carbon sugars, glucose and fructose. Breaking the chemical bond holding the two 6-carbon units together releases energy that the microbes can use. As the microbes continue to feed, a portion

of the sucrose is converted into glucose and fructose, also called "invert" sugars (known as such due to the way polarized light passes through them). Even in fairly heavily contaminated sap, only a fairly small percentage of sucrose is actually hydrolyzed into glucose and fructose, most of the sugar in sap remains as sucrose.

"Invert" sugars are more active in many types of chemical reactions that can occur in sap prior to boiling. The interaction of these sugars with naturally-occurring amino and organic acids in sap can create some color and flavor (or off-flavor) development, and also lead to reactions that occur during boiling.

It turns out that, when boiled, pure sucrose solutions undergo very little color change and develop very little flavor (other than sweet). As the invert level of sugar in the solution increases however, there is considerably more color and flavor development. This is mostly due to the fact that invert sugars caramelize at temperatures that are considerably lower than the caramelization temperature of sucrose. Therefore, the higher the invert level, the higher the degree of color and flavor development.

So how does syrup color get lighter at times during the season? This happens because cold temperatures can kill some of the microbes in the lines and slow growth in those that remain (growth and reproduction of microbes

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is highly influenced by temperature). High sap flows also reduce the concentration of microbes in sap, resulting in less invert sugar development (at least for a period of time). So after a couple of good runs, the syrup may lighten somewhat.

That explains the general way that light or dark syrup is made, but why does syrup that has already been produced get darker as you boil it longer or even as it sits for a long period of time in a plastic jug. Even though sucrose caramelizes at a high temperature, prolonged boiling can darken syrup. This occurs due to very tiny particles of burnt sugar and sugar sand on the bottom of the pan which create hot spots in the pan. Sucrose trapped in those small spots can be boiled hot enough to caramelize, thus causing syrup that is reheated or boiled for a long time to con-

tinuously get darker. In plastic syrup jugs, a small amount of oxygen can permeate through the container, resulting in oxidation (a process similar to rusting of metals), which also causes syrup to darken. Newer styles of coated jugs are less prone, but not completely immune to this problem.

If we wish to make light syrup, the key factors in doing so are fairly straight-forward. Keep sap clean (filter well immediately upon collection), keep it cold, and process it quickly.

Dr. Tim

Ask Proctor is a new feature in the Maple Syrup Digest, where researchers from the University of Vermont's Proctor Maple Research Center will answer questions about sugaring. If you have questions you'd like to submit for consideration for use in this column, please send them to editor@maplesyrupdigest.org.



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