When you shop for maple syrup, how do you choose? Do you want a golden yellow syrup? A warm amber? Or are you looking for a darker, richer shade of brown? For most of us, color is the primary marker by which we evaluate syrups, each hue indicating a unique history and flavor. In fact, the color of maple syrup is so critical that in the United States it is the primary determinant of grade and in Canada it is the sole determinant. However, for many years, the USDA grading standards for maple syrup were out of step with more sophisticated systems, creating confusion among consumers and frustration for producers. To address these concerns and harmonize North American markets, the USDA recently released new standards that redefine syrup color classification, and which rely on spectrophotometric color measurement to place each product within its appropriate grade.

Determinants of Color

The maple syrup season begins in the cold of late winter when sap begins to flow. Initially, the sap is transparent, nearly colorless, and composed of water and sucrose.[1] However, as snow thaws and temperatures rise, so too does the microorganism count in the sap, creating an enzymatic reaction that converts sucrose into invert sugars (glucose and fructose). Over the course of the season, microorganism populations continue to grow, leading to an ever-increasing proportion of invert sugars. Meanwhile, amino acid activity increases alongside these sugars as the trees prepare for the growing season.

Once harvested, the sap is processed to create a syrup concentrate through heat-induced evaporation.[2] All sap, regardless of harvest time, is treated in the same manner. But the nonenzymatic browning reaction—the chemical changes that give the syrup its unique color and flavor – caused by processing will vary depending on the qualities of the raw sap. The higher the ratio of invert sugars, the more profound the browning reaction will be. A magic of this phenomenon is the Maillard reaction, the chemical process by which amino acids and invert sugars react under heat to produce richer colors and flavors. The specific response of the raw sap to manufacturing practices determines the final color of the syrup.

Misleading Categorization

Maple syrup color acts as a kind of edible biography of each product, indicating when in the season it was harvested, how reactive it was during processing, and what flavor qualities can be expected. However, for years the USDA's grading terminology made misleading distinctions between colors, labeling lighter syrups Grade A with the lightest of all being subcategorized as Grade A – Fancy, while syrups with darker hues were relegated to Grade B. The insinuation in many consumer's minds was that the quality of darker syrups fell short. As a result, Grade B syrups could not demand the premium price of Grade A products, despite the fact that Grade B was not an indication of inferior quality and many consumers prefer the rich maple flavor of deeper colored syrup.[3] Not only was the nomenclature prejudicial, but color grading depended on visual comparison of a syrup to glass or plastic visual references, relying on the subjective color perception of the viewer, requiring controlled viewing conditions, and leaving manufacturers vulnerable to imprecise grading.

Spectrophotometric Color Grading

The new USDA classification system corrects these issues in two ways. First, it expands the Grade A category to include Grade B syrups and replaces value-laden terminology like "Fancy" with four chromatic descriptions (Golden, Amber, Dark, and Very Dark). Next, it follows in Canada's footsteps by replacing visual color assessment with spectrophotometric analysis of light transmission properties. The categories are as follows:

- S. Grade A Golden (delicate taste, ≥75.0 percent light transmittance (%Tc))
- S. Grade A Amber (rich taste, 50.0-74.9%Tc)
- S. Grade A Dark (robust taste, 25.0-49.9%Tc)
- S. Grade A Very Dark (strong taste, <25.0%Tc)

The new guidelines also offer detailed instructions for sample preparation to ensure accuracy and repeatability:

The four color and flavor classes of maple syrup will be determined by using a spectrophotometer that provides a measure of percent of light transmission using matched square optical cells with a 10 millimeter (mm) light path at a wavelength of 560 nanometers (nm), with the color values expressed in percent of light transmission as compared to analyticalreagent glycerol fixed at one hundred percent transmission, and symbolized by %Tc values.[4]

The precise quantification of light transmission offered by spectrophotometric instrumentation make them ideal tools for the analysis of translucent and transparent liquids and allow for the highest level of quality assurance.

Full article with photos available here:

https://www.hunterlab.com/blog/color-food-industry/spectrophotometric-analysis-takes-center-stage-in-new-maple-syrup-grading-system/