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News from the University of Vermont Proctor Maple Research Center

Patterns of maple syrup density in online sales

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MORRISVILLE, Vt.—Grade A pure maple syrup sold in the retail marketplace is required to comply with both federal and/or state regulations.

The legal standards for syrup density utilize the Brix scale and are in place to ensure uniform and standardized acceptable products reach consumers.

Brix is defined as the % sucrose in a solution of pure sucrose in water. While there are other dissolved solids present in pure maple syrup, their concentration is negligible and allow the Brix scale to serve as an acceptable approximation.

The Federal standards for Grade A pure maple syrup in the U.S. are overseen by the USDA and require syrup to be no less than 66 ⁰Brix and no more than 68.9 ⁰Brix.

These density standards are shared across all States with grading regulations except for Vermont and New Hampshire which have a lightly higher minimum density (66.9 ⁰Brix).

While the explanation for the difference in minimum density is not well documented in the literature, it is likely rooted in the fact that the Vermont grading standards used the Baumé scale (based on a salt solution rather than sucrose) when they were adopted nearly 100 years ago.

The legal range for syrup using the Baumé is 36 ⁰Baumé to 37 ⁰Baumé.

The two scales do not line up evenly and when 36 ⁰Baumé is converted to ⁰Brix the value is 66.9. Vermont Maple Products Regulations (CVR 20-011-002) state that "it shall be unlawful to sell, exchange, offer for sale, or expose for sale packaged maple syrup which does not meet the density requirements of the regulations."

This means that syrup offered for sale in Vermont (including through online sales) must meet Vermont grading regulations.

The most common instrument used for determining maple syrup density is the hydrometer.

Hydrometers are popular since they can be used with hot syrup at the time of production, are relatively inexpensive and if used properly, can produce accurate measurements of density.

Hydrometers work on the principle of displacement can be described as sealed, thin glass tubes, with precise weights and a scale used to determine where a sample of syrup falls along a range of density.

Given the viscous nature of pure maple syrup, knowing the temperature of a given sample is critical to making accurate measurements.

All commercially available maple syrup hydrometers are calibrated to be used with 60 ⁰F syrup.

If syrup is at a different temperature, a correction factor (offset) must me applied to account for the difference in how the hydrometer floats. A standard maple syrup hydrometer will float 0.5 ⁰Brix lower for each 10 ⁰F above 60⁰ F.

UVM Extension researchers have conducted two separate rounds of syrup grading research, one round in 2021 and the most recent round in Summer 2023.

For each round of research, pure maple syrup was purchased from over thirty different online sellers and tested for color, clarity, density and flavor.

SUGARMAKERS ARE ENCOURAGED to pay close attention to density this season, using a properly calibrated hydrometer. A recent survey by UVM Ext. found that many online syrup purchases were out of density compliance in Vermont.

"THE RESULTS DEMONSTRATE THAT NEARLY 1 IN 4 CONTAINERS (22%) PURCHASED ONLINE IN VERMONT FAILED TO MEET THE MINIMUM DENSITY STANDARD (66.9° BRIX) FOR PURE MAPLE SYRUP."

The purpose of this research is to determine how much of the pure maple syrup, marketed online to consumers meets grading regulations. This report will cover the results for density testing in two rounds of syrup samples purchased (2021 and 2023).

Methods: An online search (Google) was initiated using the terms "Golden maple syrup purchase" and "Dark maple syrup purchase" from an IP address in Vermont and shipped to a Vermont address.

Purchases were made from vendors starting at the top of the search results until the goal of sourcing syrup from thirty businesses was achieved.

Three pints (16 fl. oz.) of Golden and Dark grade were purchased from each business. Additional searches were completed when more businesses were needed to meet the sample target for each syrup grade.

Syrup was received and analyzed at a University of Vermont Extension facility by the authors who have more than 30 years of combined experience grading pure maple syrup.

Maple syrup sugar content (± 0.1⁰Brix) was measured using a PA203X, temperature compensated, digital refractometer (Misco, Cleveland, OH, USA).

Descriptive statistics (Maximum, minimum, and mean values) were generated using statistical analysis software (GraphPad Prism v10.0.3) and reported as pooled values across both Golden and Dark samples for each year of sampling (2021 and 2023).

Results: A total of 166 samples were tested in 2021 and 182 samples were tested in 2023. Of

the samples obtained in 2021, 49% of the vendors were located in Vermont, 24% New York, 16% New Hampshire and the remaining 11% distributed across Massachusetts, Maine and others.

This is a similar distribution to what was found in 2023 with 50% of samples coming from vendors in Vermont, 20% from New York, 10% New Hampshire and the remaining samples from a variety of other states including Connecticut, Michigan, Massachusetts, West Virginia and others.

The mean value in the 2021 samples was 67.02 ^{0}Brix (SD 0.99) and mean value of the 2023 samples was 67.19 ^{0}Brix (SD 1.03). Values in 2021 ranged from 63.3 ^{0}Brix to 71.0 ^{0}Brix.

The values in 2023 ranged from 63.60 ^{0}Brix to 69.1 ^{0}Brix (Figure 1).

Using the density range of legal maple syrup outlined in Federal and State regulations the results demonstrate that in 2021, 7% of the samples were below the 66.0 ^{0}Brix limit and 22% were below the 66.9 ^{0}Brix limit that applies to Vermont and New Hampshire.

Only 2% of the samples from 2021 were above the USDA maximum 68.9 ^{0}Brix limit that applies across the U.S. Samples tested in 2023 included 8% that had ^{0}Brix values below the 66.0 limit outlined in Federal and State regulations (not including VT and NH) and 22% that failed to meet the 66.9 ^{0}Brix limit for VT and NH No samples in 2023 tested above the upper limit (68.9 ^{0}Brix) for pure maple syrup.

Discussion: The results demonstrate that nearly 1 in 4 containers (22%) purchased online in Vermont failed to meet the minimum density standard (66.9 ^{0}Brix) for pure maple syrup.

If the lower standard 66.0 ^{0}Brix, which applies to all states with grading regulations besides Vermont and New Hampshire is used, the percent of samples that fail to meet the standards is closer to 7-8%.

Given that 90-100% of samples that failed to meet density standards in both 2021 and 2023 fell below the minimum highlight the results point to issues with how syrup temperature is measured at the point of production or packaging for sale to consumers.

If syrup temperature has fallen below the 211 ^{0}F that corresponds to the "Hot Test Line" found on most hydrometers a producer could mistakenly believe the syrup is more dense than it actually is leading to syrup below the legal limit for density.

Producers can also consider adjusting their own target for density testing to allow for a margin of error that protects against selling low density syrup.

While there is a clear business incentive to package syrup at the minimum allowable density, it could be appropriate to shoot for a slightly higher target within the legal range.

Adjusting to a higher target density does come with the tradeoff of reduced revenue but the significance of this tradeoff may be tolerable at certain volumes in order to ensure the minimum standard is met.

Best practices for consistent and accurate readings with a syrup hydrometer includes only using hydrometers that have been tested for accuracy by a certified lab or trained individual with the appropriate equipment.

It is also good practice to have multiple hydrometers on hand to check when issues arise and to take multiple measurements.

Furthermore, it is critical to have precise and accurate measurements of syrup temperature, preferably from a smaller vessel such as a hydrometer cup.

Cold hydrometers, dirty hydrometers and hydrometers with broken or damaged glass can all lead to inaccurate measurements.

Mark Isselhardt

TESTERS FROM UVM EXT. conducted a study of syrup bought online last summer. Many failed for density and color.

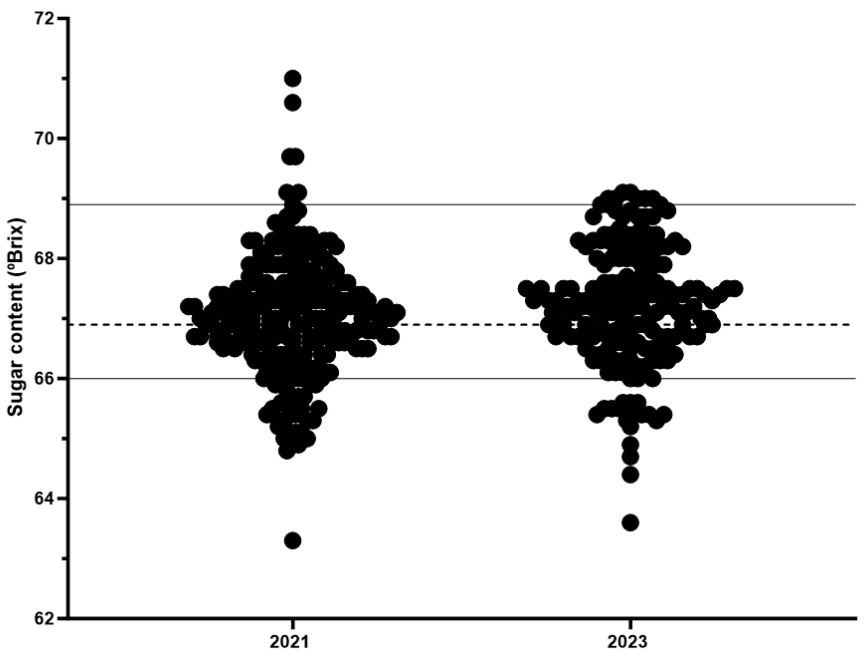

FIGURE 1: Sugar content (measured as ^{0}Brix) of individual syrup samples purchased from the online marketplace in 2021 (n=166) and 2023 (n=182). Dashed line represents the minimum legal density for syrup sold in Vermont and New Hampshire (66.9 ^{0}Brix). Fine horizontal line represents the minimum (66.0 ^{0}Brix) and maximum (68.9 ^{0}Brix) legal density for syrup according to USDA grading standards and all other states.

Mark Isselhardt

UVM EXT. RESEARCHERS bought syrup online last summer and conducted a study for quality and color, and showed many failed for defects.

Generally, anything that artificially adds mass to the hydrometer (calcium buildup, encrusted sugar, moisture soaked paper from cracked glass, etc.) will result in the hydrometer floating lower than it would otherwise.

This in turn could cause a producer to believe the syrup is less concentrated than it really is and would make syrup that is above the legal limit for syrup density.

If syrup is colder than the producers believes (211 ^{0}F at the "Hot Test Line" for example) the colder syrup will be able to hold the hydrometer higher than at the warmer syrup temperature.

This makes the syrup appear to be more dense than it actually is and the producer could end up packaging syrup below the legal standard for pure maple syrup.

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