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(Summarized version of #18 .)

Treatment of Sugar Maple Sap with In-Line Ultraviolet Light

by M. F. Morselli and M. L. Whalen

Since the early 1900s, people have known that UV light could destroy bacteria and yeast in water (1). The first study of UV-treated maple sap dales back to 1960 (2). In 1970 researchers of the Agricultural Research Service, USDA (Philadelphia Lab), reported a 3-year study on the effect of overhead and in-line UV lamps in controlling microbial populations in bulk stored maple sap (3). The authors vaguely refer to "depletion of germicidal pellets" as one source of contamination in late-season sap. However, Sipple (4) clearly states, in a "brief and unofficial report on proceedings to date" of those field experiments, that "all taps contained taphole sterilizing pellets."

Sipple et al (3) reported that in-line UV-light treatment of sap before storage (at a flow rate of 18 gpm) combined with overhead UV lamps on the storage tank, curbed microorganism growth in sap stored for one interval of 5 days in noncontrolled temperatures (32° to 54°F). The UV-treated sap produced syrup of quality equal to the syrup made from the untreated sap. Even if the majority of producers in the '70s were using buckets, they could have used in-line UV-light irradiation before the sap was stored in the tanks. However, Bell (5) stated that high costs made the UV-light equipment "impractical for the average maple producer." Presently, most Vermont maple producers have discontinued the use of PFA pellets that damage maple wood (6), and use tubing collection systems that lend themselves to the use of in-line UV lamps as a means of sap sanitation before storage.

Therefore, last spring we initiated a controlled test of the effect of in-line UV light on the microorganisms in free-flowing sugar maple sap that had not been treated by PFA pellets at the taphole. We also wanted to test the effect of temperature-controlled sap storage for five intervals up to 7 days (167 h) prior to processing to syrup. We have recently published our study (7) and are summarizing our findings in this article.

We tested a UV-light unit loaned to us by Mr. Charles Ogg, Sap Treatment Systems Co., Brandon, VT, who in part funded our project'. The unit consists of a stainless steel chamber containing a vertical UV light bulb enclosed in a quartz tube. The capacity of the unit when the quartz tube is in place is about 4 liters (1 gal.). The UV unit requires standard house current. The sap flow through the UV unit was kept to a maximum of 8 gpm by the insertion of a flow control mechanism at the outlet of the UV unit.

The unit was installed at the Proctor Maple Research Farm in Underhill, VT, in the tubing on the discharge side of the vacuum receiver tank and transfer pump. Sap samples were collected from three sap flows representing the early, mid-, and late season. The mid-season UV-treated and untreated sap was stored in sterile beakers at 50°F (10°C) for up to 7 days and was sampled at five intervals. When the sap was collected and at every storage time interval, the samples were analyzed immediately for microorganisms (bacteria and yeast) and boiled to syrup in the Maple Research Laboratory.

Results indicate that the in-line UV-light treatment reduced bacteria by 99.4 and 98.5 percent and yeast by 75.0 and 62.5 percent in early and mid-season incoming saps, respectively. Such treatment also reduced bacteria by 86.2 percent and yeast by only 31.6 percent in late sap. The UV-light treatment was more effective in reducing bacteria than yeasts. Changes in sap biochemistry, brought about by microorganism increase mediated by temperature change, affect syrup grade. The microorganism reduction by UV light in the incoming late-season sap resulted in production of syrup one grade lighter than the syrup produced from the same untreated sap.

Bacteria and yeast count in control and UV light-treated saps stored over time in controlled temperature (50°F, 10°C) and the color grade of the syrups made from these saps were noted at each time interval on the curves shown in Fig. 1. Light amber grade syrup was still produced from UV treated sap stored up to 72 h.

The flavor of all syrups produced from UV-treated sap was as good as that of syrup produced from untreated sap.

We also report here an update on the refrigerated storage of syrups produced from UV-treated and untreated saps (6). After 5 months of cold (43°F) dark storage, all of the syrups from UV-treated saps have maintained their original color grade. In contrast, at both the 4- and 5-month intervals, one of the syrups from the untreated sap was graded one grade darker than when originally packed in glass.

Because the sap used in our study had not been exposed in the taphole to sanitizing PFA pellets that might already have initiated cell damage to the microorganisms, our results apply to non-PFA sanitized sap. Furthermore, our sap storage study was conducted at a 50°F controlled temperature, and sap was not exposed to a 22°F temperature range as in previous studies (3,5). Because of the constant temperature we can relate our results to other temperatures. We emphasize that the UV-light treatment was effective in reducing microorganism growth early in the sap collection system, preventing sap biochemical changes that would alter syrup grade. The UV light treatment was indeed useful in maintaining light color grade of syrup up to the end of the season.

We recommend that a reduced sap flow rate be used during a high temperature flow period to increase microorganism kill. We also recommend that one in-line UV light unit be used as close to the sugarbush tubings as possible, and another in the conduit prior to the storage tank. This double placement in a tubing system would minimize biochemical changes in

the sap prior to storage. Since sap. temperature may suddenly in-crease at any point in time during the sap season, UV light sap treatment would minimize these changes.

'Research Associate Professor and Re-search Technologist, respectively. Botany Department, Maple Research Laboratory. Vermont Agricultural Experiment Station. University of Vermont.

'The use of name of manufacturer does not imply endorsement by the Vermont Agricultural Experiment Station

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