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# Sugar Concentration in the tree sap of five species of Minnesota trees

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## Introduction

- The purpose of this study was to investigate the concentrations of sugar in the tree sap of sugar maple (*Acer saccharum*), box elder *(Acer negundo*), red maple (*Acer rubrum*), paper birch (*Betula papyrifera*), and ironwood (*Ostrya virginiana*), species native to central Minnesota
- Tree sap can be boiled down to sweet-tasting syrup. The most familiar example of this is maple syrup, created from the saps of various species of maple. The sap is tapped from trees in the spring (late February-early May), and contains mostly water, sugar, and various types of minerals. When higher amounts of sugar are present in the sap, lower amounts of sap are required to produce syrup (Heiligmann et al., 2006,). Trees with higher sugar contents could be tapped by syrup producers, limiting the cost of extracting the sap and maximizing profits and sugary goodness.
- Various authors have stated that sugar maples have the highest percentage of syrup (generally 2-4%), followed by red maple (2-4%), and paper birch (studies on related American and European birch species have 0.5-2%) Box elder and ironwood trees have not been studied much in previous literature. Various authors have also shown that sugar concentration generally increases during the tapping season.
- We hypothesized that sugar maples would have the highest sugar concentration, followed by red maple, box elder (because they are in the maple family of trees), paper birch, and finially ironwood trees.

## Methods

- Two trees of each species were tapped on March 21 in the Saint John's University Arboretum.
- Sap was collected from March 21-March 29.
- Volume was measured with a graduate cylinder.
- Sugar concentration was measured using a maple syrup refractometer

## Results

- Box elder had the highest average sugar concentration (2.59%), followed by red maple (2.2%), and sugar maple (1.72%).
- No significant difference was found in sugar concentration between the three tree species
- Sugar concentrations did not show a clear increase or decrease during the tapping season.
- Ironwood and paper birch trees did not produce any sap and so could not be measured.

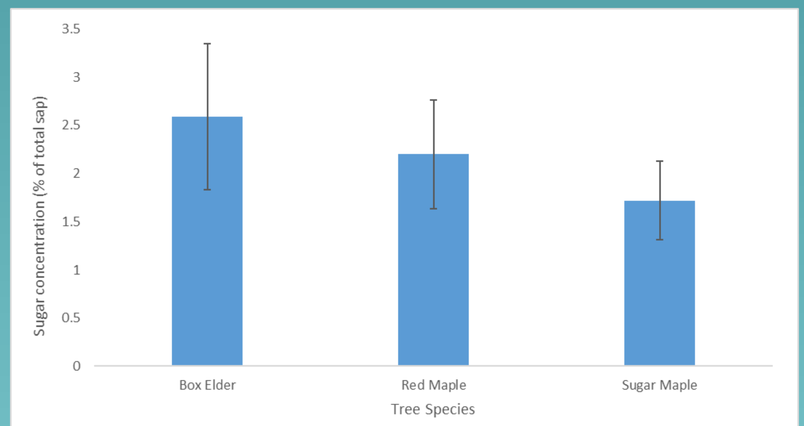


Figure 1. Average sugar concentrations measured in percentages of tree sap from sugar maple (*A. saccharum*), box elder (*A. negundo*), and red maple (*A. rubrum*) trees tapped from March 22-29. Error bars represent standard deviation (95%).

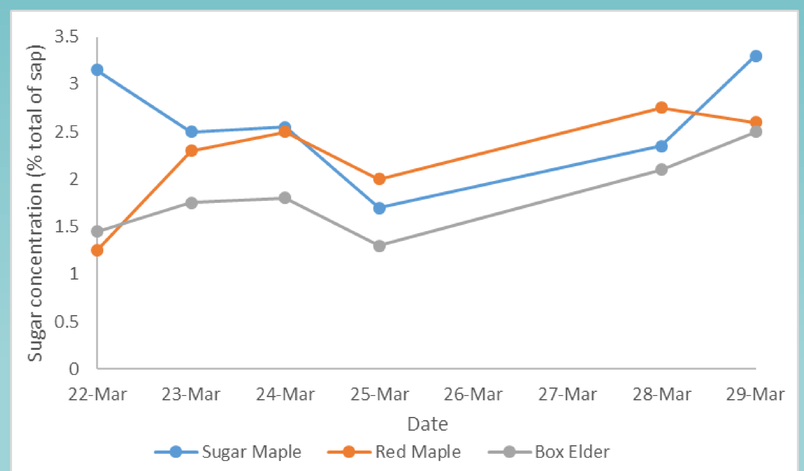


Figure 2. Average sugar concentrations of tree sap for each day of testing from sugar maple (*A. saccharum*), box elder (*A. negundo*), and red maple (*A. rubrum*) trees tapped from March 22-29.

Pictures of some of the trees that were tested: sugar maple is on the left, red maple in the middle, and box elder on the right.

## Discussion

- The trees did not differ significantly in their sugar concentration.
- However, it was surprising that the box elder had the highest overall mean. The average concentrations were the opposite of our prediction, with sugar maple coming behind both box elder and sugar maple.
- Red maple and sugar maple both are both of commercial value to syrup producers, with percentages close to those found by previous authors.
- Box elder could possibly be a valuable source of sap for syrup producers. The trees tested had consistently high sugar concentrations, and volume, although not reported in this poster, was much higher for the box elder than for red maple or sugar maple.
- We would not recommend box elder for syrup production, however, because a taste test of the sap revealed it to have an unpleasant leafy and weedy taste. Perhaps, though, boiling down the sap would remove such unpleasant tastes.
- The saps of the three tree species seemed to decrease during the middle of the testing period, and rise again near the end.
- The short time period of testing, however, prevent the trends found to be of much value.
- Errors of the testing include not collecting samples on all days of testing, small sample sizes (only two trees were tested per species), and contamination of the saps from measuring equipment.
- Further experiments could test the species over a longer length of time, or increase the sample sizes of each species in order to provide a more accurate estimate of sugar concentrations.