

# MICROBIAL CONTAMINATION IN MAPLE SYRUP

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## INTRODUCTION

Occasionally, maple syrup becomes contaminated with floating masses or surface mold. **See Figure 1.** The University of Maine Co-operative Extension has been sent samples that have originated from many locations in North America. Conventional practices have been to discard obvious mold growths, re-boil and then consume the syrup. This practice may be risky, especially with the increasing number of food borne illness outbreaks with other food products and the resulting negative publicity surrounding these outbreaks.

Some mold species are known to produce toxins, called mycotoxins, which are compounds produced by fungi that are potential toxins or carcinogens to humans. Some mycotoxins are heat stable, such as patulin, and cannot be destroyed by cider pasteurization temperatures.

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**Figure 1. Contaminated syrup samples with floating masses.**

The objectives of our research were:

1. To determine if floating masses from contaminated syrup samples are fungal in origin.
2. To determine if any fungal species identified in the samples presented a risk to human health.
3. To recommend safety practices to reduce any potential risk.

## METHODS

Potential fungal samples were submitted to the University of Maine Cooperative Extension - Somerset County Office and then transported to the University of Maine for analyses. The floating masses were sampled and streaked onto Sabouraud and Malt Extract Agar plates. Plates were then incubated at 20°C. Isolated colonies were then grown further on the same agar. Colonies were then observed under a microscope and identified to genus and then to species using DNA analysis. Syrup samples were also analyzed for pH, water activity and degrees Brix.

## RESULTS & DISCUSSION

A variety of fungal species were isolated from the majority of the bottle

samples. These species included fungi that are common air contaminants, and some that are known to be able to survive high temperatures and produce mycotoxins. Some of the same species we isolated were also identified in Whalen and Morselli's work in 1984.<sup>4</sup>

The pH, water activity and Brix levels of the contaminated maple syrup samples were within normal boundaries of maple syrup production. The Brix levels typically found in maple syrup did not prevent fungal growth, which was not previously thought to be possible. The pH levels found in the syrup were well within ranges of typical fungal growth. The fungi varied from fast to slow growing on typical nutrient medium and also appeared to vary in how fast they grew in maple syrup. Some of the fungal species are known xerophiles in nature meaning that they can persist in high sugar or high salt concentrations.

We also found that many of the fungi can survive short periods of time at typical bottling temperatures of 82° Celsius (180° Fahrenheit). Further research is being conducted to identify the fungi, determine their ability to survive high temperatures and determine whether they produce mycotoxins. Preliminary work indicates one fungal species is able to produce a mycotoxin under optimal conditions in maple syrup. Whether any other of the isolated fungal

species also produce mycotoxins is being investigated.

The maple industry should be aware that food safety is of crucial importance when producing any food products. For example, researchers found that beef consumers want to know how modern production practices affect their family's long-term health<sup>5</sup>. This article also noted that negative messages can spread quickly and that consumers want to know that producers protect the environment while producing safe, healthy food. These concerns of beef consumers may reflect the concerns of other food consumers as well.

To protect the pure and natural image of maple syrup, producers should take steps to preserve the quality and food safety of their products. Ensuring food safety by documenting food production processes may soon become routine with various certification or licensing processes becoming the norm. Producers should be evaluating the biological, chemical and physical hazards of their production systems and looking for and correcting possible sources of contamination of their products. Many public and private jurisdictions have prepared best management practice manuals and certifications. Following these guidelines will help avoid potential problems that could result in food safety issues for the maple industry. Using clean, food grade

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<sup>4</sup>Fungi Associated with Pure Maple Syrup Packed at the Minimum Recommended Reheating Temperature. Whalen, Mary Lynn and Morselli, Maria Franca. Journal of Food Protection. Vol. 47. No. 9. 1984. p. 688-689.

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<sup>5</sup>What a Consumer Wants. John Maday, Managing Editor, Drovers CattleNetwork. <http://www.cattlenetwork.com/e-newsletters/drovers-daily/What-a-consumer-wants-187801931.html?page=2> accessed June 13, 2013.

equipment, checking processing times and ensuring adequate bottling temperatures will help avoid microbial contamination.

Preliminary canning studies suggest that syrup packed in smaller than quart size containers may not have enough mass of hot syrup to maintain high enough heat, above 82° Celsius (180° Fahrenheit), for a sufficient period of time to destroy all microbes.

## CONCLUSIONS

These results found that maple syrup contamination can be fungal in origin. A variety of fungal species were isolated from contaminated maple syrup samples submitted to the University of Maine Cooperative Extension. Some of the identified fungi have the potential to produce toxic compounds such as mycotoxins that have the potential to harm human health.

The previous assumption that boiling syrup to a minimum of 66 degrees Brix prevents microbial growth is in question. According to our findings, we recommend that contaminated syrup or syrup with questionable floating masses should not be consumed or sold to consumers since there may be a risk of fungal contamination and possibly the presence of mycotoxins.

Based on our preliminary results, we recommend that as maple producers order new plastic containers, they revise their labeling to delete the recommendation that if mold forms, it can be scraped off, syrup can be re-boiled and consumed safely. Evidence of fungal growth occurring in syrup and the potential for myco-

toxin production lead to serious questions about the safety of this practice.

## FUTURE WORK

Further research is being conducted to identify these fungi and determine if they produce mycotoxins in maple syrup. Canning studies and recommendations are being finalized and will be shared in another article. The North American Maple Syrup Council has helped in funding these research projects including the DNA sequencing and mycotoxin detection and identification.

## ACKNOWLEDGEMENTS

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## OOPS - We Stumbled

When we listed the Contributors to the North American Maple Council Research Fund in the February 2014 Digest, we left out a contributor.

That contributor was the Maple Producers Association of Nova Scotia. Although, Robert Frame the President of the Association said we did not need to take any corrective action - we feel that each and every contributor should be recognized.