

NORTH AMERICAN
GOOD MANUFACTURING PRACTICES
TO AVOID LEAD CONTAMINATION OF MAPLE SYRUP



International Maple Syrup Institute
Final Copy
March 2015

INDEX

| | Page |
|---|------|
| Good Manufacturing Practices to Avoid Lead Contamination of Maple Syrup | 1 |
| Critical Points | 1 |
| Sap Collection | 1 |
| Sap Storage | 2 |
| Processing | 2 |
| Filtering | 2 |
| Maple Syrup Packing and Storage | 3 |
| Other Sources of Lead | 3 |
| Testing for Lead..... | 3 |
| Background Information on Lead | 3 |
| References..... | 4 |



Technical Contributors:

Mr. Dave Chapeskie, Executive Director, IMSI
Dr. Tim Perkins, Director, UVM Proctor Maple Research Centre
Mr. Tim Wilmot, UVM Extension Specialist
Dr. Luc Lagacé, Researcher, Centre Acer
Mr. Paul Bailey, Risk Identification and Management Coordinator, OMAFRA
Éric Prud'Homme, Principal Program Officer, Maple, Canadian Food Inspection Agency
Henry J. Marckres, Consumer Protection, Chief, Vermont Agency of Agriculture, Food & Markets
Angela Wheeler, Maple Consultant

GOOD MANUFACTURING PRACTICES TO AVOID LEAD CONTAMINATION OF MAPLE SYRUP

Lead in maple syrup, originating from sap collection or syrup production, storage or packaging processes, is readily preventable with producer knowledge and use of good manufacturing practices. The ultimate goal is for all equipment and materials containing lead to be phased out of production. This should be done as quickly as possible to ensure that no lead-bearing surfaces come into contact with maple sap or syrup. Lead-containing equipment removed from production must not be sold for use with maple syrup or any other food product. For equipment to be classified as lead free, all sap and syrup contact surfaces must be made of stainless steel and/or food grade materials, as set forth in the NSF/ANSI 51-2012 standard, section 4.1.2.

Good manufacturing practices should be aimed at preventing lead from contaminating maple sap, maple syrup and all maple products at every point in the collection, production and packaging processes. Any recommendations in this document for minimizing contact of sap and syrup to lead-containing equipment are meant strictly to help during a transition period but are not a long term solution. It is recommended that all lead-containing equipment be identified and removed from maple syrup operations as soon as possible.

Critical Points of Good Manufacturing Practices to Avoid Lead Contamination of Maple Syrup

- ❖ **When purchasing, manufacturing or repairing equipment, ensure that all materials are food grade and lead free. Refer to LMEA Standards (standards for maple equipment manufacturers) for more information at:**
www.internationalmaplesyrupinstitute.com/uploads/7/0/9/2/7092109/___lmea_-_standards_on_maple_equipment.pdf
- ❖ **Phase out any lead-containing equipment, including items with lead soldering (e.g. evaporator pans and galvanized tanks, buckets and storage barrels, bronze gear pumps, etc.).**
- ❖ **The length of exposure time to lead-containing equipment greatly increases the risk and amount of lead contamination. It is critical to minimize the contact/residency time of sap or syrup to any lead-containing equipment or containers that have not yet been replaced, especially:**
 - **Lead-soldered pans, particularly flue pans**
 - **Lead-containing sap buckets**
 - **Lead-containing sap tanks**
 - **Lead-containing syrup storage drums and containers**
- ❖ **Proper filtration of maple syrup is very important for the removal of lead that may be concentrated in sugar sand.**

SAP COLLECTION

Contamination of maple sap by lead is an important factor as it can be concentrated anywhere from 30 to 100 times in the maple syrup.

Spiles – Spiles should be aluminum, stainless steel, or food grade plastic. Old tin or terneplate spiles, in particular, can contribute up to 1,700 ppb of lead to sap (Wilmot, 2000).

Buckets – Lead-containing sap buckets can be a significant source of lead and should be replaced with

aluminum, stainless steel or food grade plastic buckets. Terneplate and galvanized buckets with lead solder contain lead and should not be used. “Tin” buckets have been found to contribute the most lead, making them the worst offenders (UVM Proctor, 2006). If buckets that may contain lead are being used, it is essential that sap be gathered every day, even on low flow days to minimize contact time.

Collection Tanks – Collection tanks should be food grade, manufactured without lead. If galvanized and lead-soldered collection tanks are still in use, contact

time with sap should be minimized. Tanks that are corroded or were previously used to hold hazardous materials should never be used for sap.

Tubing – Use only food grade tubing. Tubing is rarely a source of lead contamination but some older tubing or non-food grade piping may have stabilization agents or other additives containing lead.

Connectors – All connectors and fittings that come into contact with sap should be stainless steel or food grade plastic.

Sap Pumps – Sap pumps, including fittings and gears, should be constructed of food grade materials. Bronze and brass gear transfer pumps may contribute lead to sap, particularly when sap is pumped excessively, and should not be used (UVM Proctor, 2006).

SAP STORAGE

Tanks – Sap storage tanks should be stainless steel (no lead soldering), glass-lined or food grade plastic. Galvanized or lead-soldered tanks should be replaced as they may contribute significant amounts of lead to sap, particularly with prolonged storage time.

PROCESSING

Evaporator Pans – The most serious risk of lead contamination comes from very old evaporator pans. Old galvanized pans are the worst offenders but even older stainless steel pans (prior to 1994) with lead solders are problematic. It is important that lead containing pans are replaced as soon as possible with welded or soldered stainless steel pans free of lead soldering. If these pans have not yet been replaced, maple sap/partially processed syrup must not be left in pans for extended periods (e.g. overnight) (Wilmot *et al.* 2003).

- **Flue Pans** – A lead-soldered back pan adds more lead than a lead-soldered front pan due to the many solder seams. If flue pans containing lead have not yet been replaced, boil sap vigorously to shorten exposure time and drain sap into food grade containers at the end of each boil.
- **Syrup Pans** – The risk of lead contamination is greatly increased with a lead-soldered front pan if the syrup is scorched or the pan boils dry due to melting of the lead in the soldering (Wilmot, 2000).

Niter in Pans – Any lead that may be in syrup will be concentrated in the niter (sugar sand). Niter should be cleaned regularly from the syrup pan due to the potential for re-absorption of lead into the syrup. The greater the amount of niter, the greater the opportunity for lead release.

Do not clean lead-soldered seams to a bright shine to minimize lead exposure and leaching of lead into the syrup (UVM Proctor, 2006). Make sure products used for cleaning pans are lead free.

Add-on Units – Ensure any pre-heaters, piggyback and/or Steam-Away units and air injection systems are constructed of stainless steel and contain no lead bearing solder or fittings.

Valves, etc. – Only stainless steel or lead-free brass valves, connectors, joints and level controls should be used at or near the evaporator and finishing pans.

Reverse Osmosis – Ensure that the sap contact areas of reverse osmosis machines are manufactured from lead free materials. Pumps, fittings, gears, membranes, tubing and filters should be constructed of food grade materials.

FILTERING

Filtration has been found to reduce lead levels in maple syrup (VAAF, 1995; Dumont *et al.* 1996). Lead that is contained in sugar sand can be removed through filtration but any lead that is dissolved in the maple syrup will remain (Wilmot, 2014). Because of this, effective filtration is very important but cannot be relied upon to remove all lead.

Sugar Sand (Niter) – Sugar sand can contain very high levels of lead, particularly in circumstances where lead-containing equipment is still in use and temperatures during evaporation are high and uncontrolled.

Temperature – Always filter syrup hot to ensure proper filtration. Temperatures for filtering should be a minimum of 85°C (185°F).

Filter Units – Filter units must be constructed of food grade materials (cast aluminum or stainless steel for plate filter presses and stainless steel for canister pressure filters). Pumps should be constructed of food grade materials, avoiding the use of brass and bronze alloys. Filter presses must be used properly, according to manufacturer instructions.

Diatomaceous Earth – It is critical that diatomaceous earth used for filtering is food grade, not pool grade.

Filter Tanks - Filter tanks must be stainless steel (TIG or MIG welded), using food grade fittings and tubing to connect the equipment.

MAPLE SYRUP PACKING AND STORAGE

Batch Code – Ensure that all maple syrup is properly batch coded.

Filling Unit – Bottling units should be stainless steel (TIG or MIG welded). Stainless steel units manufactured before 1995 may contain lead solder. Syrup pumps, including fittings and gears should be constructed of food grade materials.

Syrup Storage – Because maple syrup may sit in barrels or other bulk syrup containers for extended periods of time, the choice of container is very important. Use stainless steel, glass lined or food grade plastic barrels for syrup storage. Galvanized barrels should be phased out of use. Any syrup filled into galvanized barrels should be emptied first to minimize contact time.

Never use barrels with rust stains, unusual dents or obvious repair marks to store or transfer maple syrup.

Old milk cans or other lead bearing or non-food grade containers must never be used for maple syrup.

OTHER SOURCES OF LEAD

Water – Water can also be a source of lead contamination. Make sure that water used for cleaning complies with maximum limits for lead established by national or local authorities. (Codex, 2003)

Lead Based Paints – Ensure that all processing areas are free of any lead based paints.

Maple Product Equipment – Ensure that candy pigs and other equipment used to produce maple products are lead-free. Equipment, including stainless steel equipment, manufactured before 1995 may contain lead.

TESTING FOR LEAD

- Lab results can determine the effectiveness of good management practices and facilitate informed decisions about the product.
- Verify the lab is certified to test agricultural and food products and employs accepted methodology for testing maple syrup.

Background Lead Information

- Lead (Pb) is an odourless, bluish-gray heavy metal with many industrial uses but no known nutritional benefits. It occurs naturally in the environment and has been used in the manufacture of many items over the years. The most critical effect of low-level lead exposure is reduced cognitive and intellectual development in children (Codex, 2004). Chronic exposure to lead at relatively low levels can also result in damage to the kidneys and liver and to the reproductive, cardiovascular, immune, nervous, and gastrointestinal systems.
- Maple syrup is typically a neutral substance with a pH ranging from about 5.5 to 8.5 (Perkins and van den Berg, 2009) that, in the presence of oxygen, can react with many metal surfaces. Lead can leach into the sap or syrup through contact with any lead-containing equipment.
- Considering its presence in nature and the many potential sources of lead, it is vital that producers of any food, including maple syrup, follow good agricultural and good manufacturing practices to minimize or eliminate lead contamination.
- Some common sap collecting and syrup making materials that contain lead, include:
 - 50/50 solder used before 1995 for evaporators (Leader Evaporator switched to lead-free in 1991), tanks and some buckets
 - Galvanized equipment made before 1994
 - Most brass and bronze
 - Terneplate, a tin/lead alloy used in some older equipment

REFERENCES

- Allard, Gaston B. Agr., Eng. 1999. A Few Rules to Reduce the Risks of Contamination of Maple Syrup Products by Lead Residues. Maple Syrup Factsheet No. 211b1094 (E). Quebec.
- Bailey, Paul (OMAFRA). 2010. Quality Assurance Programs for Maple Producers. Presentation at the NAMSC/IMSI/OMSPA Annual Meetings.
- Codex Alimentarius Commission. Joint FAO/WHO Food Standards Programme. Twenty sixth session. Rome, Italy, 30 June – 5 July, 2003. Report of the 35th session of the Committee on Food Additives and Contaminants. Arusha, Tanzania. 17 – 21 March, 2003.
- Codex Alimentarius. Code of Practice for the Prevention and Reduction of Lead Contamination in Foods. *CAC/RCP 56–2004*. 5 Pages.
- Dumont, J., Allard, G.B., Paillard, G., Boudreault, G., Colpron, É. 1996. Intégrité des produits d'érable: Identification des principaux contaminants potentiels, de leur teneur et des facteurs influençant cette teneur. Partie1: Le plomb, le cadmium, le cuivre, le fer et le zinc: apport naturel et technologique dans la sève et le sirop. Centre ACER, no. 95-1104-006-FIN-0596.
- Health Canada. 2011. Proposed Risk Management Strategy for Lead. 54 pages.
- Henderson, John (OMAFRA). 2004. Food Safety Practices in the Production of Pure, High Quality Maple Syrup. Ontario Maple Mainline. Ontario Maple Syrup Producers Association. pp 7-8.
- Henderson, John and Dave Chapeskie. 2004. Best Production Practices for the Safe Production of Maple Syrup. Ontario Maple Mainline. Ontario Maple Syrup Producers Association. pp 8-10.
- Henderson, John and Dave Chapeskie. 2004. Take the Lead and Ensure the Maple Syrup is Lead Free. Ontario Maple Mainline. Ontario Maple Syrup Producers Association. pp 10-11.
- Henderson, John. 2007. Testing for Lead in Maple Syrup. Ontario Ministry of Agriculture, Food and Rural Affairs. InfoSheet. 4 pages.
- Massachusetts Farm Bureau Federation, University of Massachusetts Extension and the Massachusetts Department of Agricultural Resources. 2007. Maple Syrup BMP's: A Handbook of Best Management Practices for Massachusetts Maple Farms.
- NSF International. Food Equipment Materials – American National Standard/NSF International Standard. 1997. ANSI/INSI 51.
- Ontario Maple Syrup Producers Association. 2011. Best Practices Manual. Binder.
- Ontario Ministry of Agriculture, Food and Rural Affairs. 2006. Food Safety Practices for the Production of Maple Syrup.
- Ontario Ministry of Agriculture, Food and Rural Affairs. 2007. Good Manufacturing Practices Program – Generic Model for Maple. Food Safety Initiative.
- Ontario Ministry of Agriculture, Food and Rural Affairs. 2006. Testing for Lead in Maple Syrup. InfoSheet.
- Ontario Ministry of Agriculture, Food, and Rural Affairs. 2002. Best Production Practices to Keep Lead Out of Maple Syrup. Factsheet. 1 page.
- Perkins, T.D. and A.K. van den Berg. 2009. Maple Syrup – Production, Composition, Chemistry, and Sensory Characteristics. pp. 102-144. In: S.L. Taylor (Ed.) *Advances in Food and Nutrition Research*. Volume 56. Elsevier, New York.
- Service Ontario. Produce, Honey and Maple Products. Ontario Regulation 119/11. Food Safety and Quality Act, 2001. e-laws - http://www.e-laws.gov.on.ca/html/reg/english/elaws_regs_110119_e.htm
- Stingelin, J., A. Davenport and L. Staats. Best Management Practices to Reduce Lead Levels in Maple Syrup.
- Allard, Gaston. 1995. A Few Measures to Use to Avoid Contaminating Maple Syrup with Lead Residues. Maple Bulletin.
- UVM Extension Systems in cooperation with The Vermont Maple Sugarmakers' Association. 1994. Producers to get the full scoop on lead at January meetings, etc. Maple Mainline.
- UVM Proctor Maple Research Center. 2006. Keeping Lead Out of Maple Syrup: A Guide to the Use of Sap Collection and Syrup Making Equipment.
- Vermont Department of Agriculture, Food & Markets. 1995. Maintaining the Quality of Vermont Maple Syrup.
- Vermont Maple Industry Council with the University of Vermont Extension System, the Vermont Department of Agriculture and the Vermont Maple Sugarmakers' Assoc. 1994. Producer Guidelines on Managing Lead Levels in Maple Syrup.
- Wilmot, Timothy. 2014. Personal Communication. UVM Proctor Maple Research Center.
- Wilmot, Timothy. 2000. Reducing Lead in Maple Syrup. Presentation. UVM Proctor Maple Research Center.
- Wilmot, Timothy, Mark Iselhardt and Timothy Perkins. 2003. Managing a small lead-soldered evaporator to keep lead out of syrup. Maple Syrup Digest 15A:20-23.