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Results of the North Pole Garden Sampling Project: Testing of Early Harvest Plants for Sulfolane

Introduction

North Pole residents have been concerned about eating garden produce (fruits and vegetables) grown with sulfolane-affected well water. The scientific literature has limited information about sulfolane uptake in edible garden plants. The purpose of the North Pole garden sampling project is to provide feedback to gardeners, specifically those taking part in this sampling project, about the safety of eating their produce during this summer's growing season. The test results will tell us how much of the sulfolane that is in the water ends up in the parts of the plants that are sampled, and if present, whether those levels of sulfolane pose a health risk.

On July 13 and 14, 2010, plant samples from four local gardens were collected for testing. This fact sheet provides summary results and interpretation for six early harvest plants, and describes plans for sampling more plants later this summer.

The chemical sulfolane, an industrial solvent used to refine oil, was first detected in North Pole area wells in October 2009. More information about this garden sampling project and the ongoing site investigation of the sulfolane contamination in North Pole's groundwater is available on the Alaska Department of Environmental Conservation Web site. (See "Additional resources" on page 3.)

Test results for sulfolane in early harvest plants

The table below lists the plants, and which parts of the plants, that were sampled. The concentration, or level, of sulfolane found in each is shown in parts per billion (ppb). The sulfolane concentration in the well water that was used to grow each plant is also listed. For reference, one ppb is similar to one drop of water in an Olympic-size swimming pool.

Sulfolane Concentrations in Individual Samples by Plant Type and Part

Plant Type	Plant Part	Sulfolane concentration in plant part (ppb)	Sulfolane concentration in well water (ppb)
Cucumber	Fruit	ND	118
Leaf lettuce #1	Leaf	25.0	51.6
Leaf lettuce #2	Leaf	41.4	118
Radish	Root	ND	118

Rhubarb #1	Stem	ND	118
Rhubarb #2	Stem	ND	132
Rhubarb #1	Leaf	57.8	118
Rhubarb #2	Leaf	ND	132
Sugar snap pea	Fruit	ND	89.7
Zucchini	Fruit	ND	89.7
Zucchini	Flower	ND	89.7

ND = not detected

In summary, the table shows that leaf lettuce from two gardens both contained sulfolane in the leaves (25.0 ppb and 41.4 ppb). In addition, one of the two rhubarb plants that were sampled had 57.8 ppb sulfolane, but only in the leaves (the non-edible part of the plant). Neither rhubarb plant had detectable levels of sulfolane in the edible stems. All the other plants (cucumber, radish, sugar snap pea and zucchini) had no detectable levels of sulfolane in the parts that were sampled. This finding makes sense, given what we know about sulfolane uptake in plants from other studies. (See second bullet point below.)

What the sulfolane test results of garden produce mean for human health

The testing of early harvest produce involved a very limited number of samples, and therefore should be interpreted with caution. The main goal of this effort is to provide direct feedback to the gardeners in this project. With only four gardens, one to two samples of each plant, and the large number of factors that could affect the final levels of sulfolane in the plants – such as the amount of rainfall and level of sulfolane in the water – we cannot draw broad conclusions for all gardeners about the safe use of sulfolane-affected water for growing fruits and vegetables. That said, the sampling results provide valuable information to share with North Pole gardeners. Early evidence from this round of sampling suggests that:

- Edible garden plants can take up sulfolane that is present in water. People can be exposed to (come in contact with) sulfolane by eating produce grown with sulfolane-affected water, but that depends on which part of the plant is eaten.
- Sulfolane concentrates in the leafy parts of plants, and not in the roots, stems, fruits or flowers. The lettuce and rhubarb leaves were the only samples that tested positive for sulfolane content. All the other plants, where the part of the plant we normally eat was sampled (root, stem, fruit or flower), tested negative for sulfolane content. This finding supports other studies in the published literature that showed sulfolane uptake from water concentrates in the parts of plants where water transpiration (water vapor leaving the plant) is most active – typically the leaves. However, more sampling scheduled for later this summer will tell us if we get similar results with other types of produce.
- The levels of sulfolane in the two samples of lettuce leaves (25.0 ppb and 41.4 ppb) are low, and should not cause any health effects in people who eat them. This is based on very conservative (meaning very protective) risk assessment calculations that assume: the fruits and vegetables you eat all have levels of sulfolane like those in the lettuce leaves above; you eat a lot more produce than the average person in your age group (ie. in the 95th percentile); and you eat them almost every day (350 days per year) year after year. For adults, the screening value we calculated for sulfolane intake from fruits and vegetables is 233 ppb. In other words, a level of sulfolane below 233 ppb in these foods is unlikely to pose a health risk. For infants, the screening value we calculated is 62 ppb. Thus, the levels of sulfolane in the sampled lettuce leaves fall below the screening value

for even the most sensitive group. Keep in mind that these results only reflect sulfolane levels in lettuce from two gardens, and do not suggest that lettuce from other gardens would have similar results.

Note that these screening values for sulfolane exposure from fruits and vegetables are not the same as the “action levels” for sulfolane exposure from drinking water recommended by the Agency for Toxic Substances and Disease Registry, or ATSDR, within the U.S. Department of Health and Human Services. (See link for *DHSS Companion Guide to the ATSDR Health Consultation on Sulfolane* below.) ATSDR’s action levels are 25 ppb for infants and 87.5 ppb for adults. This is mainly because we consume much more water than fruits and vegetables.

Next steps

We will continue to collect more garden samples through this year’s growing season, to include late harvest produce like beets, broccoli and carrots. Individual results will be given to gardeners taking part in this sampling project; summary results will be shared with the community in a fact sheet like this one. The Alaska Division of Public Health will also write a health consultation that evaluates the potential health risks from other ways that people may be exposed to sulfolane.

The Technical Project Team (TPT) overseeing this sampling project (as part of its oversight of the North Pole refinery investigation and cleanup of sulfolane groundwater contamination) is also planning a more in-depth, controlled, scientific greenhouse study. The greenhouse study, which will be a multi-year effort, will provide more conclusive answers on the safety of gardening with sulfolane-affected water. The TPT includes experts in toxicology, environmental chemistry, botany, hydrology and engineering.

Gardeners who are interested in taking part in the garden sampling should contact Nim Ha at the Alaska Division of Public Health. (See below for contact information.)

Please contact us with your questions and concerns

Alaska Division of Public Health, Environmental Public Health Program:

- Nim Ha, health educator, nim.ha@alaska.gov, (907) 269-8028
- Lori Verbrugge, toxicologist, lori.verbrugge@alaska.gov, (907) 269-8086

Additional resources

Previous fact sheets and other resources are available online, or you can call us for a copy:

- North Pole Garden Sampling Project Participant Q&A Sheet (July 14, 2010):
<http://dec.alaska.gov/spar/csp/sites/north-pole-refinery/docs/factsheets/QA%20Sheet%20-%20FH%20Garden%20Sampling%20Project.pdf>
- DHSS Community Health Concerns about Sulfolane (April 22, 2010):
<http://www.epi.hss.state.ak.us/eh/sulfolane/CommunityHealthConcernsSulfolane.pdf>
- DHSS Companion Guide to the ATSDR Health Consultation on Sulfolane (Feb. 9, 2010):
<http://www.epi.hss.state.ak.us/eh/sulfolane/DHSSSulfolaneHCCompanion.pdf>
- DHSS Sulfolane Health Fact Sheet (Jan. 12, 2010):
<http://www.epi.alaska.gov/eh/sulfolane/SulfolaneHealthFactSheet.pdf>
- DEC North Pole Refinery Site Summary (May 14, 2010):
<http://dec.alaska.gov/spar/csp/sites/north-pole-refinery/>