

TuKoKe Presentation:

Effect of Frying on Nitrate, NO_3^- , levels (%) in Potato Tubers, Analyzed by Spectrophotometry

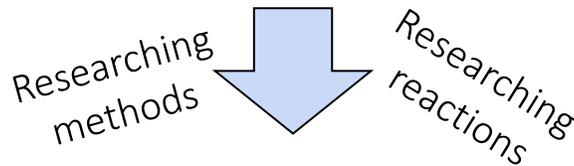
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Introduction

I wanted to focus on chemistry, and especially on something that I can see in my daily life.

Compounds containing nitrates, NO_3^- are also found in a lot of vegetables and produce, including potatoes, a staple food in Finnish (and global) cuisine. Nitrates are not directly carcinogenic or bad, but their reactions in the body can result in carcinogenic compounds.



Research Question:

How does frying time (min) affect the nitrate, NO_3^- , levels in potatoes (%), measured using spectrophotometric methods?

Background Research

- 1 Microbes in mouth: nitrate (NO_3^-) \rightarrow nitrite (NO_2^-)

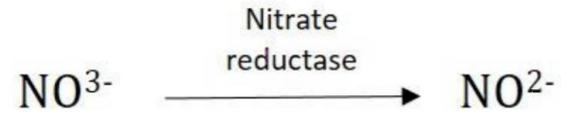
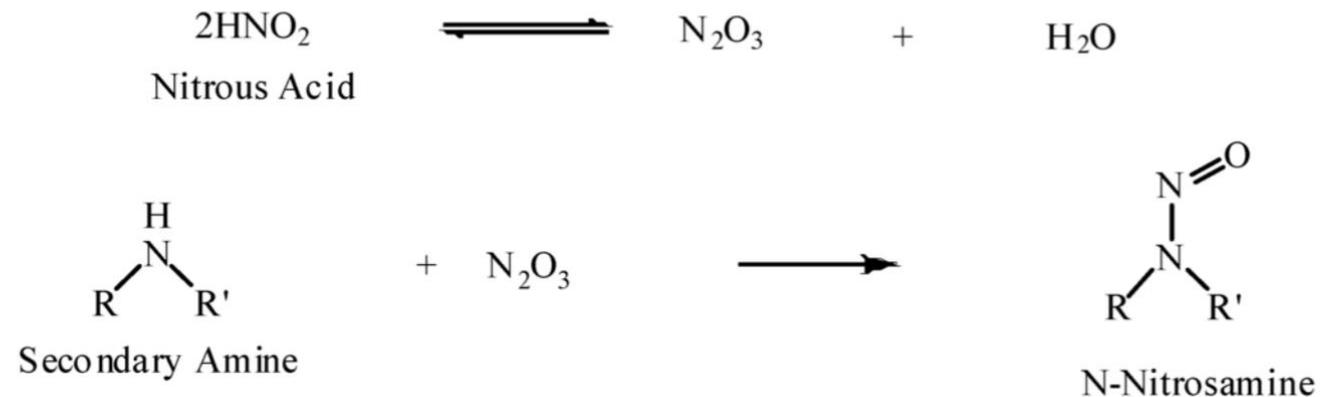


Figure 1. Nitrate reduction

- 2 Acidic stomach: $\text{NO}_2^- \rightarrow$ nitrous acid (HNO_2)

- 3 HNO_2 and amines \rightarrow nitrosamines



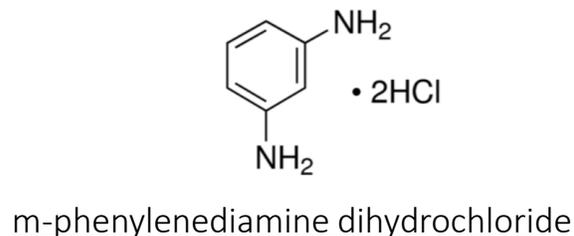
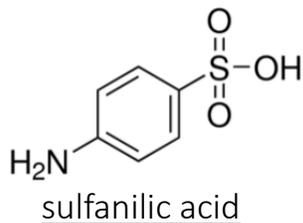
Methodology

In general, this method revolves around spectrophotometry: the intensity of the color of the solution (absorbance) describes how much nitrate there is in the solution. The color is produced by a diazotization reaction with sulfanilic acid and m-phenylenediamine dihydrochloride.



The method consisted of:

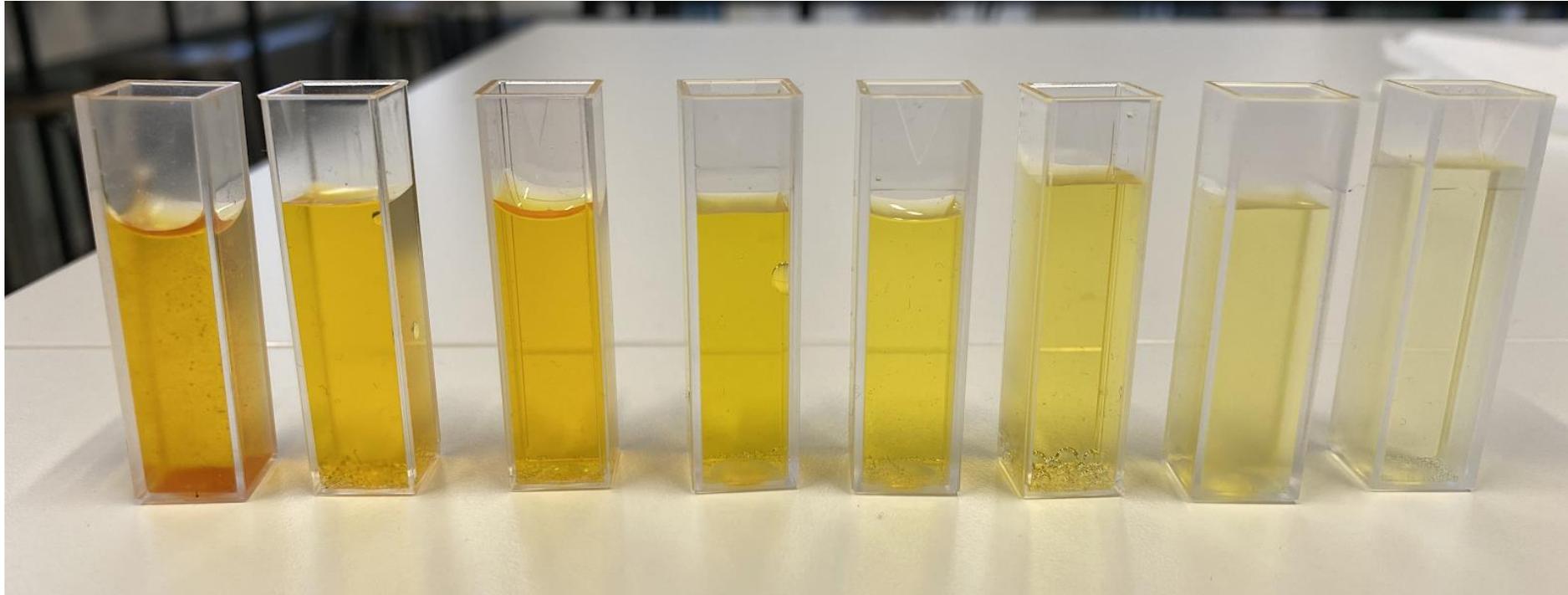
- 1 Creating a standard curve for the using sodium nitrate
- 2 Weighing, frying and dissolving the potatoes in water
- 3 Adding the chemicals that produce the color in the solution



The nitrosating agent (N_2O_3), is derived from nitrate, then been reduced to nitrite, forming NO (nitrous acid), and then forming the nitrosating agent, N_2O_3 . The nitrosating agent produces a diazonium ion (intermediate) when in contact with sulfanilamide. The ion then couples with the phenylenediamine dihydrochloride to form an azo dye, which produces a color with intensity representing the amount of nitrate in the sample.

Methodology

Standard solution

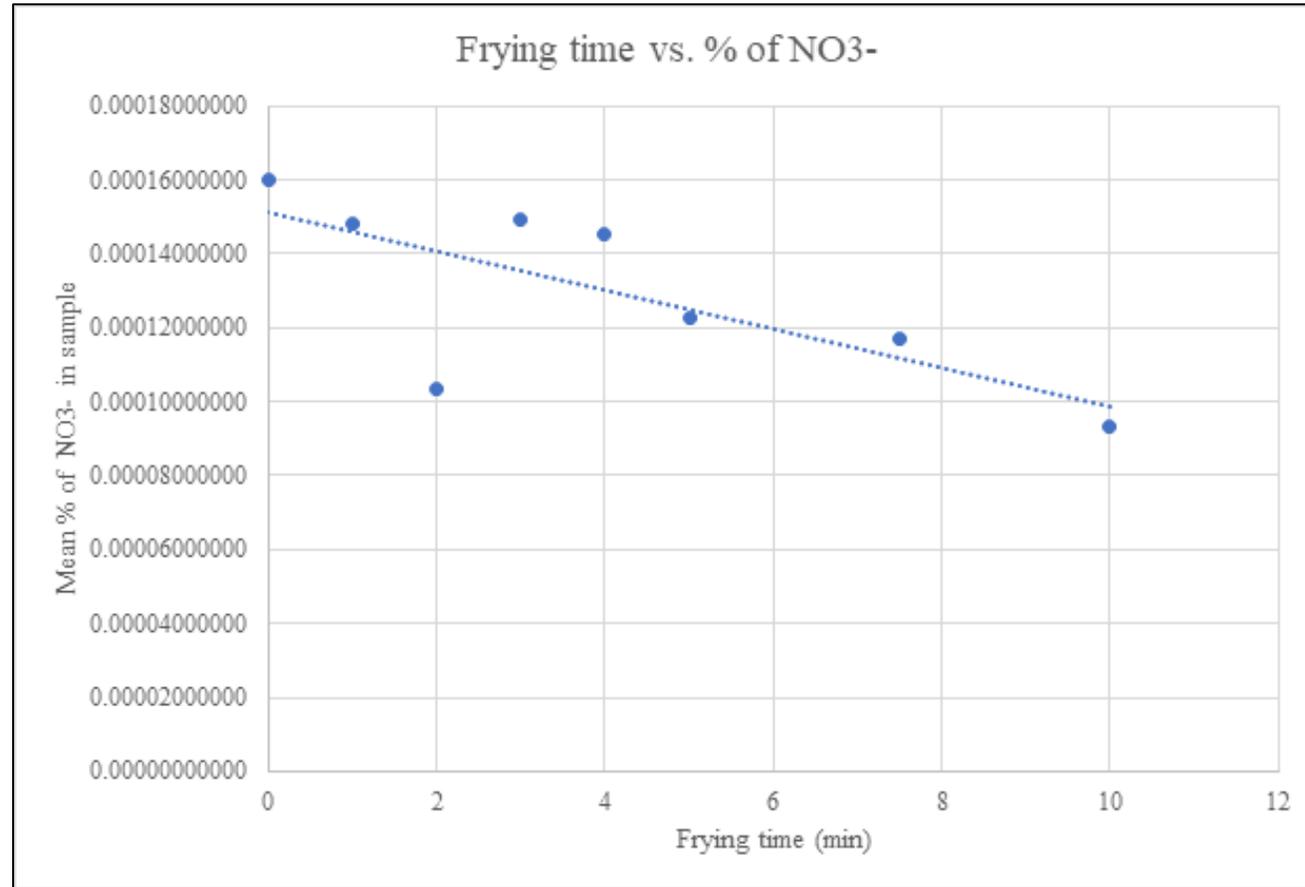


High nitrate %



Low nitrate %

Results



As the frying time increased, the nitrate percentage in the potatoes decreased, with negative linear correlation.

Conclusion and Evaluation

The percentage of NO_3^- in potatoes got smaller as they were fried for longer, and it could be due to the high heat causing the nitrates to turn into nitrosamines, but this only happens to a small amount of the nitrates. A more plausible explanation is that some nitrates evaporated from water inside the potato, which they were dissolved in.

Even at the start, the nitrate levels were very low, so unless potatoes were to be consumed in extreme amounts, they do not pose a big health risk.

There were errors in the experiment, including the variable surface area of the potatoes, the use of a spoon that came with the aquarium chemical package to measure the reactants as well as possible measuring errors in the standard curve (small masses were measured).

Sources

BioTek. *Conversion of Nitrate to nitrite by the action of Nitrate Reductase*; 2012.

Bryan, N.; Grisham, M. Methods To Detect Nitric Oxide And Its Metabolites In Biological Samples. *Free Radical Biology and Medicine* 2007, 43 (5), 645-657

Dowden, A. The truth about the nitrates in your food. <https://www.bbc.com/future/article/20190311-what-are-nitrates-in-food-side-effects> (accessed Nov 3, 2019).

Lewis, D.; Mama, J.; Hawkes, J. *The reaction of a secondary amine with dinitrogen trioxide (via nitrous acid) to form an N-Nitrosamine. R, R' may be alkyl groups, aryl groups or carbon atoms in a ring structure.*; 2013.

<https://www.mdpi.com/1996-1944/6/2/517/htm>

m-Phenylenediamine dihydrochloride. <https://www.sigmaaldrich.com/catalog/product/aldrich/78450?lang=fi®ion=FI> (accessed Apr 25, 2020).

N-Nitrosodimethylamine (NDMA); World Health Organization: Geneva, 2008

Sulfanilic acid. <https://www.sigmaaldrich.com/catalog/product/sial/s5263?lang=fi®ion=FI> (accessed Apr 25, 2020).

The Daily Meal. 2011. <https://www.thedailymeal.com/dutch-oven-potatoes-0-recipe>

Thank you!