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Acrylamide Detection in Food Using Near Infrared Spectroscopy

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Abstract

Acrylamide is a suspected carcinogen required to be listed on food labels in California and products commercially traded within the European Union. Foods like potato products, coffee, cereals, etc., are produced at high temperatures, which provide conditions that convert the amino acids, *Asn, Arg* and *Lys*, in combination with reducing sugars, into acrylamide via the Maillard reaction. Current methods to detect and quantitate acrylamide in food are complicated, time consuming, and dependent on expensive scientific instrumentation. The purpose of this study is to establish a simple and fast standard method for the quantitative detection of acrylamide in food using Fourier transform near infrared (FT-NIR) spectrometry. Analysis will be conducted upon fryer oil to monitor free fatty acids, total polar materials, p-anisidine, and triglycerides. All of these compounds will be analyzed using FT-NIR, but other standard methods will be required to analyze unique characteristics of each compound. These results will be analyzed to determine oil degradation factors that potentially contribute to acrylamide production. Acrylamide extractions from potato products will be monitored by FT-NIR and the results validated using gas chromatography mass spectrometry. This method will provide a fast and economical alternative to traditional food safety and security industry standards.

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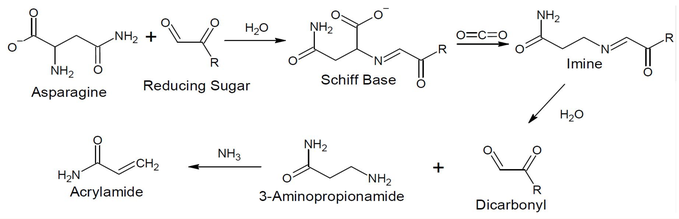
Introduction

Acrylamide is formed under conditions where temperatures exceed 120 ° C in foodstuffs containing asparagine and reducing sugars. The *Maillard reaction* is responsible for acrylamide production.

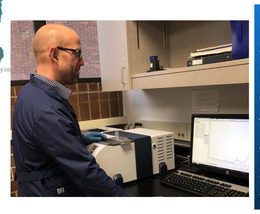


Hypothesis

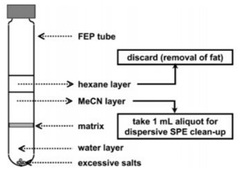
California is the fifth largest economy in the world and Proposition 65 requires that acrylamide as a suspected carcinogen be listed on food product labels for consumers.

Rodent tests at three orders of magnitude higher acrylamide concentration than the parts per billion level found in cooked foods led to the '*suspected carcinogen*' designation.

Idaho is the number one grower and processor of potatoes in the country. Current methods for acrylamide quantitation require expensive instrumentation, employee training, and time.



Fourier transform near infrared (FT-NIR) is fast, easy to use and would be a practical quantitation method for industry use.



OR

Potato or other food samples can be analyzed by NIR as liquid extract or solid matrix conditions.

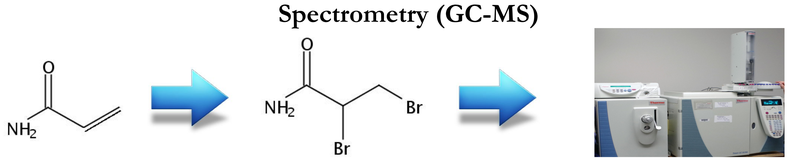
References

1. https://oehha.ca.gov/proposition-65/general-info/acrylamide accessed
2. Adedipe, O. E., et al (2017). MCJ 1851-1854
3. Razia, S., et al (2016). IFRJ 23(5), 2188-2189
4. Surma, M., et al (2016). JAFC 131, 99-100
5. Mastovska, K et al (2006). JAFC

Methods

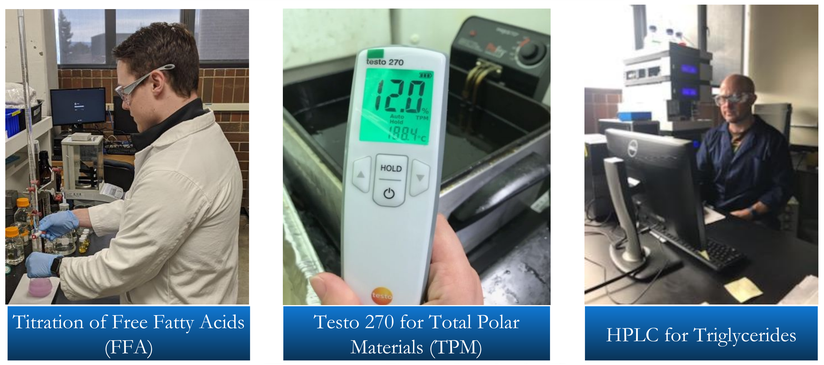
Acrylamide Detection

- **This method is being verified by Gas Chromatography-Mass Spectrometry (GC-MS)**



- **Derivatization of acrylamide by bromination is implemented to prevent polymerization during gas chromatography**

Oil Analysis



Titration of Free Fatty Acids (FFA)

Testo 270 for Total Polar Materials (TPM)

HPLC for Triglycerides

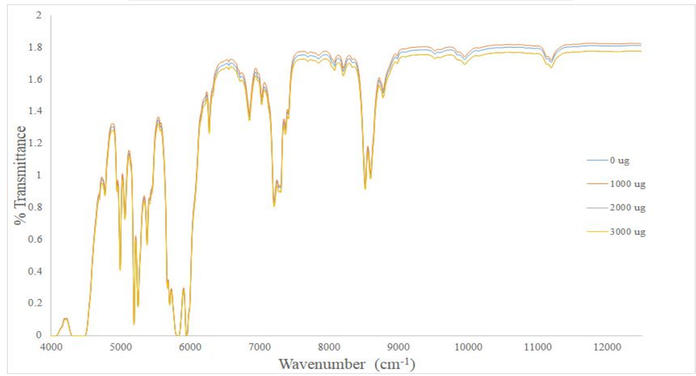
UV-Vis for *p*-anisidine

Research Question:

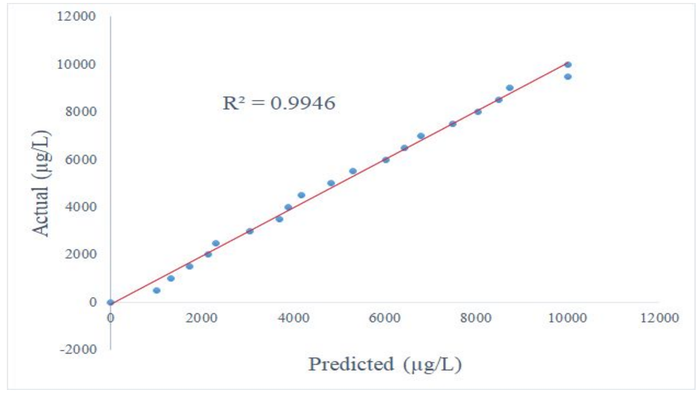
Does oil degradation lead to an increase in acrylamide production?

Results

Acrylamide Detection

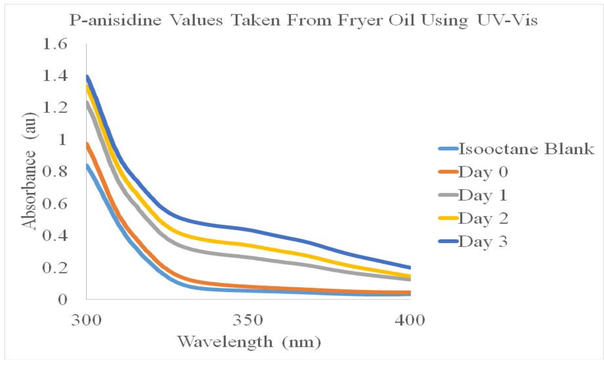


- **NIR spectrum of acrylamide standard where each series denote the varying concentration as described in the methods.**



- **Standard curve of acrylamide liquid standard acquired using partial least squares computational software that converts spectral overlay to a linear standard curve.**

Oil Analysis



- **UV-Vis spectra of fry oil solutions over the course of a five day frying period to measure the change in *p*-anisidine concentration over time.**