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Determination of Free Fatty Acid and Triglyceride Fatty Acid of Food Fats Using a Rapid Gas Chromatographic Method

Aubreyona Migliori
Utah State University, aubreyonamigliori@gmail.com

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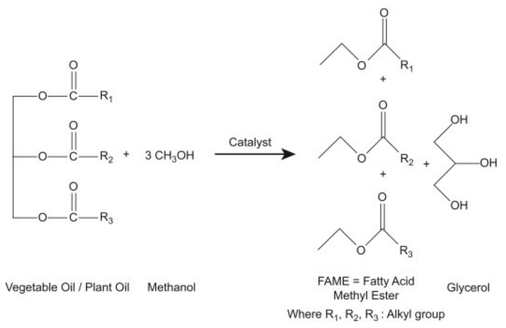
Introduction

Food fats are primarily triglycerides composed of esterified fatty acids on a glycerol backbone. To measure the fatty acid content of foods, a derivatization reaction is conducted which transfers the fatty acids from glycerol to methanol, forming a fatty acid methyl ester (FAME). FAMES are measured using gas chromatography with flame ionization detection (GC-FID). Free fatty acids in foods are a result of a degradation reactions and are considered a defect. This decreases consumer acceptance and expedites further deterioration which decreases the value of edible oils.

- We designed a novel method to measure free fatty acids in food fats that is a rapid and simple compared to other traditional methods and has potential to extend to commercial use.
- The goal of this study was to develop a rapid and sensitive method to simultaneously determine the free and esterified fatty acid content of soybean oil in the same GC-FID run.



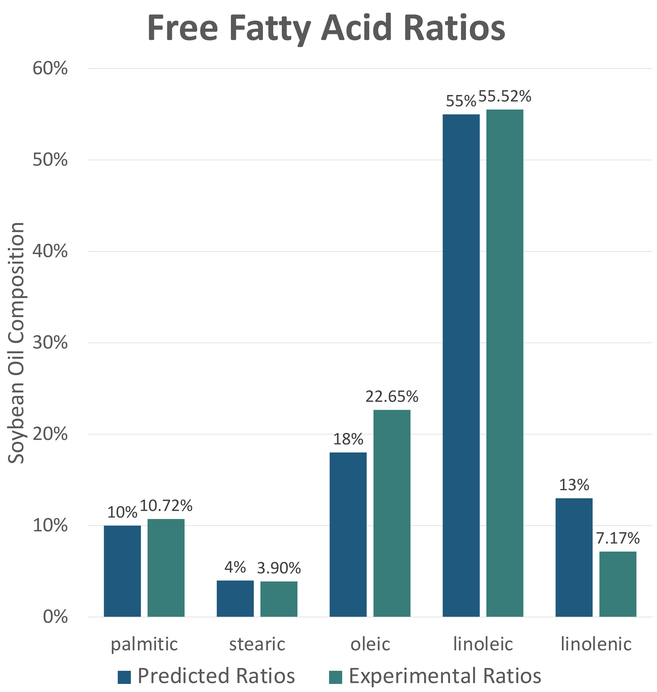
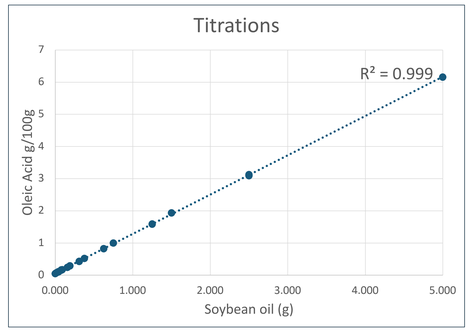


Figure 1: The experimental values of free fatty acids found in commodity soybean oil show similar ratios to literature values.



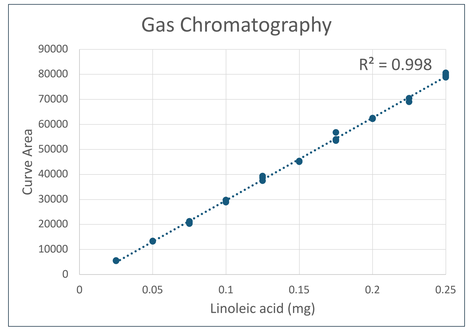


Figure 2: Standard curves between two methods showing variance between variables (r^2).

Methods

Traditional titration methods were compared to a refined gas chromatograph method.

- A series of oils containing specific linoleic acid ranging from 0.01-5% were assessed
- An esterification reaction, with base catalysis, was used to prepare the samples for gas chromatography.
- Reaction products were confirmed with thin-layer chromatography.

Results

- The experimental GC-FID method showed accurate proportions of the five main fatty acids of palmitic, stearic, oleic, linolenic, and linoleic acids that would be expected in soybean oil (Figure 1).
- Titration standard curves indicated that the free fatty acid content, measured as oleic acid, had a r^2 value of 0.999. Standard curves from gas chromatography showed an r^2 value of 0.998 of linoleic acid added in the sample (Figure 2).

Figure 3: Traditional titration technique performed manually.

Conclusion

Though there is similarity between the methods, the GC-FID method was able to directly measure linoleic acid which was more favorable for our study. It was noted that quantities less than 0.5% were unable to be detected in this novel method.

- This novel method can individually measure and distinguish between free fatty acids.
- Gas chromatography provides comparable accuracy to traditional methods.
- Future studies could extend this method's use to other food fats such as olive oil, and feta cheese to determine food quality.

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UtahStateUniversity

Aubreyona Migliori | *Utah State University*
Undergraduate Research Fellow
aubreyonamigliori@gmail.com

Robert Ward | *Utah State University*
Department of Nutrition, Dietetics, and Food Science