# A Preliminary Study of Hydrogenation of Oils Using Terahertz Time Domain Spectroscopy

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***Abstract*—This paper presents a preliminary investigation to determine the extent at which terahertz time domain spectroscopy is able to detect the hydrogenation of unsaturated fats and oils within a simulated home cooking environment.**

## I. Introduction And Background

HYDROGENATED trans fatty acids in saturated fats pose significant health concerns with frequent prolonged consumption. Long-term consumption of hydrogenated trans fatty acids can lead to significant health problems such as high cholesterol and heart disease.[2] These concerns are particularly prevalent when cooking food using such fats or oils. In addition to this, unsaturated fats and oils may become saturated during the cooking process in which heat may be a significant factor.[1]

The aim of this study is to perform a preliminary investigation into the hydrogenation of fats and oils, by heating them and performing THz time domain spectroscopy (TDS) to discern changes in the oil from an unheated reference to the samples. In particular, we aim to compare the samples with known trans fatty acids and analyze any differences found. We examine the ability for terahertz to be used in the evaluation of saturated fats in oils after heating and expand upon the work of Li.[3]

## II. Methodology

Common off-the-shelf oil was used in these experiments. The oils were taken directly from the bottle as a baseline reference sample for comparison between oils that had undergone additional heating. Both the heated and unheated samples were placed into a freezer to allow for easier preparation of sample, and were then added to a 1:1 weight ratio with polyethylene powder. The mixture was combined to form a slurry, which was then allowed to return to room temperature before being injected into a liquid cell with a thickness of 580 µm. Finally the liquid cell was placed into the THz-TDS system and data was collected.

The heated samples were treated by heat from a flying pan heated on a conventional gas stove top. The frying pan was first preheated, then the oil was placed into the pan and heated for 5 minutes. The oil was then allowed to cool back to room temperature before sample preparation, and all subsequent steps are identical to the preparation of the unheated oil.

## III. Results & Discussion

Our results with heated and unheated peanut oil are shown in figure 1. As with Li et. al.[4] we observe a number of absorption peaks at frequencies between 1 and 1.6 THz. Of particular note is that our observed results were present within 5 minutes of heating rather than 10 minutes as observed by Li. The heated peanut oil samples did not show any discernable differences in viscosity, color or smell. Therefore, the possible higher temperature that the oil is heated with, as our heating environment differs from that of Li. Additionally, the higher absorption observed in the heated sample of peanut oil suggests that the composition of the oil has undergone changes, and further investigation is required to fully comprehend the obtained results.

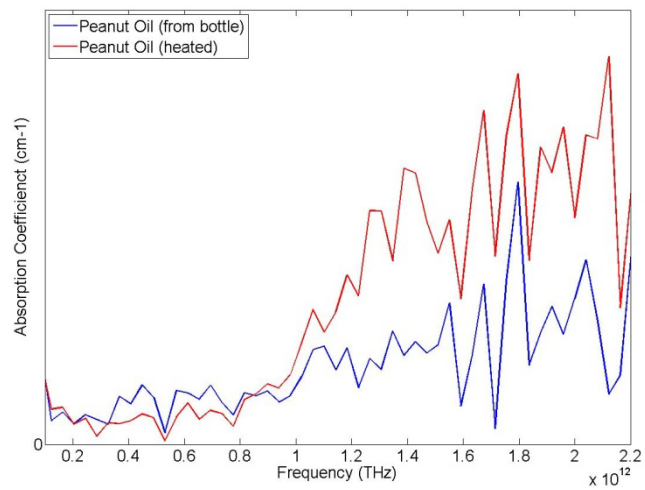


**Figure 1:** Absorption of heated and unheated peanut oil. Note the greater absorption present at frequencies between 1 and 1.6 THz.

## References

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