

## An Effect of Oregano on Oxidative Stability of Soybean Oil Via Microwave and Induction Cook Top Heating

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### Abstract

The main objective of this study is to evaluate the antioxidant properties of oregano on refined soybean oil as a result of microwave and induction cook top heating. Oxidation changes were determined by common traditional parameters such as acid value, free fatty acid value, peroxide value as well as by Fourier transform infrared (FTIR) spectroscopy. It has been observed from studies that oregano has powerful antioxidant effect in microwave heated oil samples whereas it does not show any antioxidant properties on induction cooktop heated samples.

**Keywords:** Fourier transform infrared spectroscopy; Peroxide value; Free fatty acid; Microwave induction cook top

### Introduction

Oil and fats are important parts of the healthy human diet as they are also used as food preparation and flavoring. Edible oils are vital constituents of our daily diet, which provide energy, essential fatty acids and serve as a carrier of fat soluble vitamins [1-3]. Fats and oil belongs to a group of biological substances called lipids. Lipids and triacylglycerol naturally occur in oils and fats. Their chemical composition contains saturated and unsaturated fatty acids and glycerides. India is sixth largest producer of Soy oil in the world (Figures 1-3). Soybean oil is 61% polysaturated fatty acid (PUFA) and 24% monounsaturated fatty acid (MUFA) which is comparable to the total unsaturated fat content of other vegetable oil (~ 85%). Literature survey shows possible effect of oregano in corn oil via thermal and ultraviolet exposure to oil, no research paper is available related to antioxidant effect of oregano on edible oil via microwave and induction cooktop heating. So it was decided to carry out research via both microwave and induction cooktop heating.

### Materials and Methods

Both Samples of refined oil (50 ml) with and without oregano were placed in stainless steel pan having diameter of 20 cm at 240°C (at 1600 W) on induction cooktop heating. Similarly oils samples (50 ml) were heated with and without oregano in microwave oven LG for 30 minutes in a petridishes (8 cm diameter) temperature during after 30 min heating reached to 186°C. In this experiments oregano was added to oil concentration used was 0.05% w/w [4-6]. Oil samples were cooled for the analysis and kept in glass vial till the analysis. All the reagents were AR grade and acid value peroxide value determination were performed by use of 10 ml burette (grade 'A' with graduation intervals of 0.05 ml) as the graduation level of the commonly used burette (50 ml capacity) was found to insufficient to capture the reading accurately or precisely (Figures 4 and 5).

### Oils

Refined soybean oil of fortune brand of Adani wilmer company and Oregano were purchased from local market.

### Determination of Free Fatty Acid (FFA) and acid value

The acid value and FFA content was determined by directly titrating the heated oil samples in an alcoholic medium against standard Potassium hydroxide solution (Figures 6 and 7).

$$\text{Acid value} = \frac{56.1 \times NV}{W}$$

where, AV=1.99 × FFA; V=Volume in ml standard KOH; N=Normality of KOH solution; W=Weight in gm of the oil; FFA conc. in the heated oils is calculated as percent oleic acid.

### Determination of peroxide value

Peroxide value determination was done according to AOCS standard methods. The values were expressed as meq of peroxide O<sub>2</sub>/ Kg oil and mg KOH /gm oil respectively [7-10].

$$\text{Peroxide Value} = \frac{10 \times V}{W}$$

where, V=Volume of 0.01 N Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> solution; W=Weight in gm of the oil; \*MWO (Microwave heated oil with oregano), MWWO (Microwave heated oil without oregano), IHO (Induction heated oil with oregano), IHWO (Induction heated oil without oregano).

### Results and Discussion

Gullien and Cabo developed respective methods which is based on Fourier transform infrared spectroscopy FTIR and assumes that frequency changes in specific band allow the differentiation of stages of the oxidation process and detection of the oxidation level of the heated oil sample. FTIR spectra of soybean oils heated with and without oregano on microwave and induction heated oils sample shows different intensities on different wave length. The result obtained by measuring the intensity of FTIR absorption at different frequency for heated refined soybean oils via two different methods of heating are presented in Table 1. It is clear from data that sample heated with oregano in microwave prevents oxidation of oil accelerated by high temperature while in case of Induction heating it had not happened as percentage transmittance of oil heated with oregano increases and absorbance decreases. Same results are obtained by titration methods where free fatty acid and peroxide formation was more in sample which was heated without oregano and less in sample heated with oregano in a microwave heating. Surprisingly, it was observed by data that sample heated in induction with oregano shows reverse result as compare

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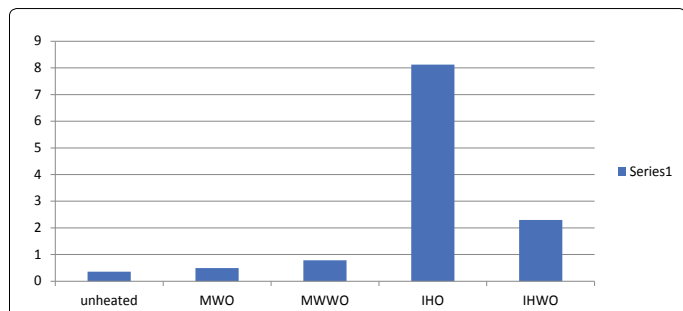


Figure 1: Acid value of microwave and induction heated oils sample (with or without oregano).

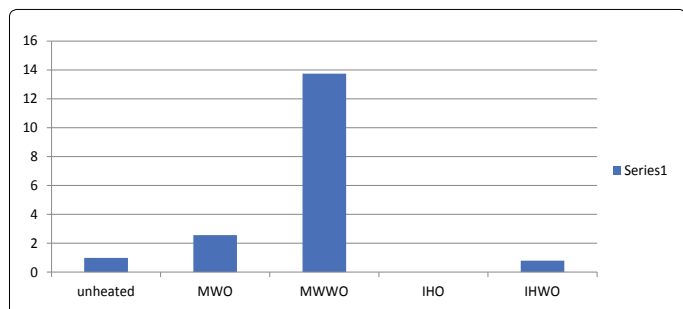


Figure 2: Peroxide value of microwave and induction heated oils sample (with or without oregano).

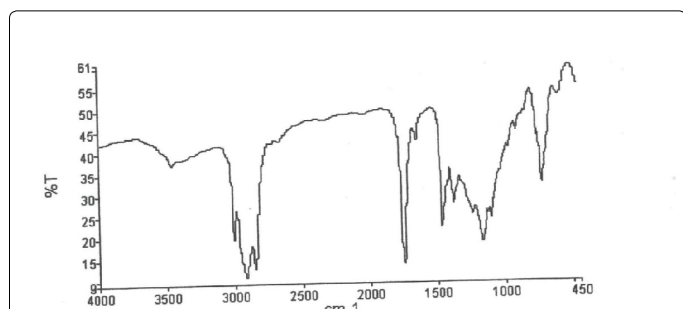


Figure 3: IR spectra of unheated soybean oil.

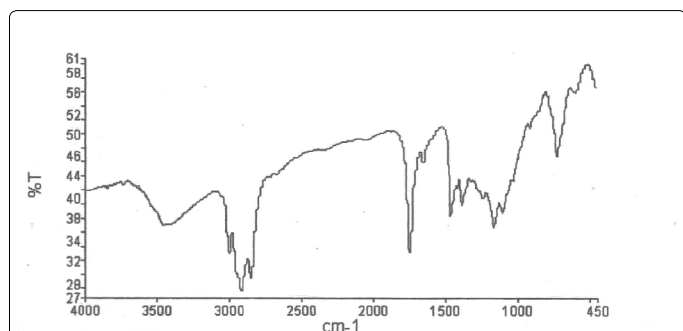


Figure 4: IR spectra of soybean oil MWO.

| Wave No. cm <sup>-1</sup> | 3670 | 3009 | 2925 | 2854 | 1745 | 1654 |
|---------------------------|------|------|------|------|------|------|
| Unheated                  | -    | 0.71 | 0.9  | 0.98 | 0.88 | 0.37 |
| MWO                       | -    | 0.48 | 0.56 | 0.53 | 0.48 | 0.34 |
| MWWO                      | 0.37 | 0.66 | 0.79 | 0.75 | 0.7  | 0.38 |
| IHO                       | 0.43 | 0.49 | 0.59 | 0.56 | 0.5  | -    |
| IHWO                      | -    | 0.51 | 0.63 | 0.59 | 0.59 | -    |

Table 1: FTIR Absorption for nonheated and heated Soybean oil samples.

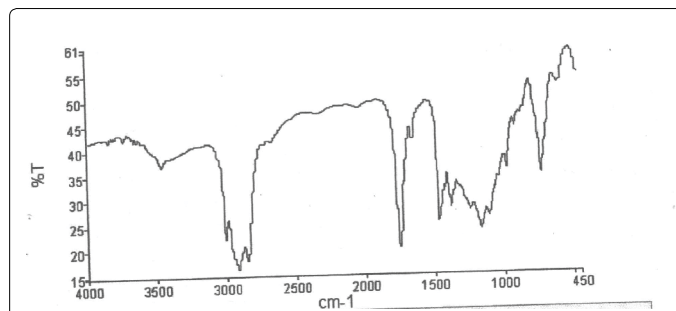


Figure 5: IR spectra of soybean oil MWWO.

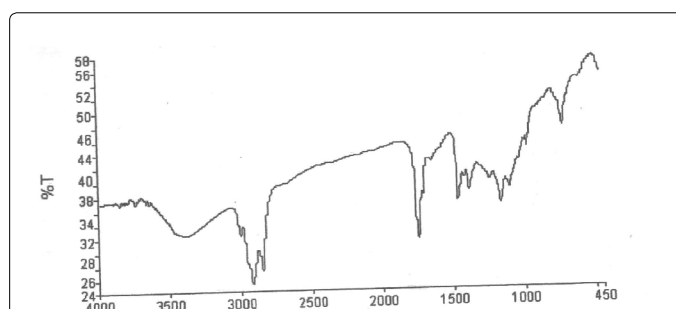


Figure 6: IR spectra of soybean oil IHO.

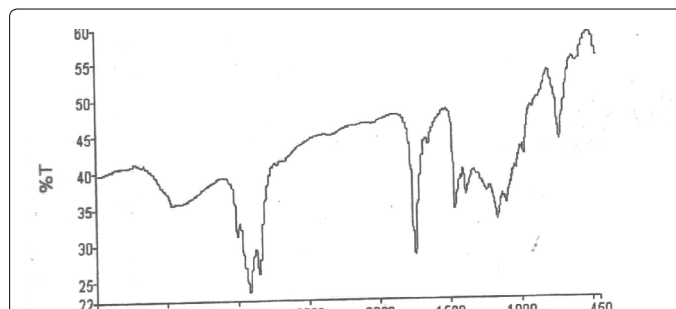


Figure 7: IR spectra of soybean oil IHWO.

to microwave sample that may be due to very fast heating of oil thus destroying antioxidant properties of oregano. One additional peak at 3670 cm<sup>-1</sup> corresponding to secondary oxidized product are observed in case of microwave heated sample without oregano and induction heated sample with oregano which indicates the starting of formation of free fatty acids due to primary oxidation products degradation. The primary oxidation products at high temperature rapidly decomposed to aldehydes, ketones, acids, esters, alcohols and short chain hydrocarbon.

## Conclusion

In this study soybean oil heated with or without oregano via microwave and induction cook top devices and some of its physiochemical parameters were determined by both conventional and spectroscopic methods. During induction cook top treatment in sample that was treated with oregano it can be observed that oil undergoes oxidative degradations and increase in free fatty acid value, while in microwave heated sample with oregano very well shows its antioxidant properties by preventing oxidation and results are found in good correlation with FTIR spectroscopic data. Main outcome of research suggests antioxidant like oregano can be used to prevent

oxidative degradation via microwave heating. In future study on other oils at different temperature via microwave can be carried out to evaluate the possible antioxidant properties of Oregano.

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