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Active Optical Properties of Corn Oil Based on Change Polarization Angle

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ABSTRACT

This study aims to obtain the characteristics of active optical properties in corn oil, the most likely asymmetric triglyceride component. The samples used were corn oil 1 and 2 with different brands, and after being heated for 0, 2 hours, 4 hours, and 6 hours. To obtain the characteristics of active optical properties, changes in the polarization angle at various polarizer angles were measured using a laser with $\lambda = 532\ nm$. Determination of the most likely asymmetric triglyceride is done by identifying the asymmetric axes (maximum polarization angle), and the combination of triglycerides from GCMS (Gas Chromatography Mass Spectrometry) data. The results of the data on changes in the polarization angle vs. the polarizer angle show that the corn oil sample has active optical properties. The maximum polarization angle changes of 30º, and 60º respectively contribute to the most dominant asymmetric triglycerides TBCB and TCBC. The longer the heating, the higher the change in the polarization angle, so it can be said that the relative quality of the oil is decreasing.

Keywords: Optically Active Properties, Change Polarization Angle, Corn Oil

INTRODUCTION

Oil quality parameters include physical and chemical properties. The physical properties of cooking oil include color, odor, solubility, melting point, boiling point, slipping point, shot melting point, specific gravity, viscosity, refractive index, turbidity point, smoke point, flash point, and fire point (Sutiah. et al., 2008). Corn oil is a vegetable oil rich in unsaturated fatty acids (LIPI, 2009). In corn oil glycerol is obtained from a biochemical reaction, where if glycerol condenses with 3 fatty acids in an oil it will produce triglyceride molecules (Mulyani. et al., 2018).

Optical activity in oil is the ability of oil to rotate the polarized plane. In physics theory, cooking oil that has chiral or achiral C atoms is optically active. This is because, in each direction of the electric field of polarized light that hits the oil sample, a change in the polarization angle is produced. The maximum change in the polarization angle produced at a certain angle is the most dominant asymmetric triglyceride of the oil. This has been proven by Nababan (2022). In this study, it was found that each direction of the electric field of polarized light hitting various samples of palm cooking oil produced a change in the polarization angle with the most dominant fatty acid components of the oil being saturated fatty acids and monounsaturated fatty acids.

Heated oil can cause a decrease in the quality (degradation) of the oil which causes an increase in the change in the polarization angle of the oil. This indicates that changes in the polarization angle can

describe a decrease in the relative quality of the oil (Safitri (2023).
Based on the above studies, a study was conducted on the use of natural polarization to identify triglyceride molecules in heated corn oil as a degradation parameter.

MATERIALS & METHODS

In Figure 1, the analyzer is made perpendicular to the polarizer before the sample is inserted using the concept of Malus' law. The analyzer and polarizer that are perpendicular to each other will produce maximum dark intensity. After the maximum dark intensity is obtained, the sample is placed on the holder. When the random electric field from the light source (laser) passes through the polarizer, the direction of the electric field from the light source will be parallel to the polarizer. When the electric field is polarized from 0º - 90º with an increase of 10º regarding the corn oil sample, there will be a change in the polarization angle. Then, the electric field that has been deflected is forwarded to the analyzer. In the analyzer, the dark intensity captured by the detector will be different from the maximum dark intensity before the corn oil sample is inserted. The existing dark intensity will be converted to the maximum dark intensity by moving the controller on the analyzer until the maximum dark is obtained on the detector. The maximum dark intensity produces a polarization angle value that is displayed on the analyzer screen. The difference in the polarization angle value when the oil sample is inserted, and when the oil sample has not been inserted is called the change in the polarization angle.

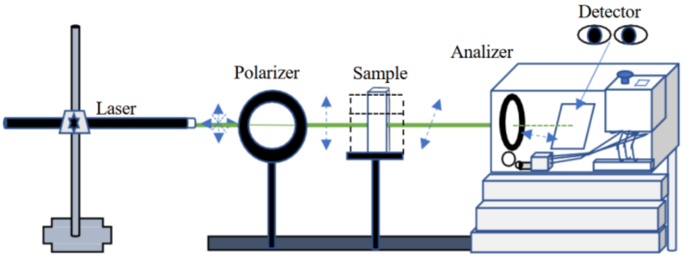

Figure 1 Research tool scheme

RESULT AND DISCUSSION

The changes in the polarization angle from various directions of the electric field, which can be seen in Figure 2 and Figure 3, prove the characteristics of the active optical properties of corn oil samples 1 and 2.

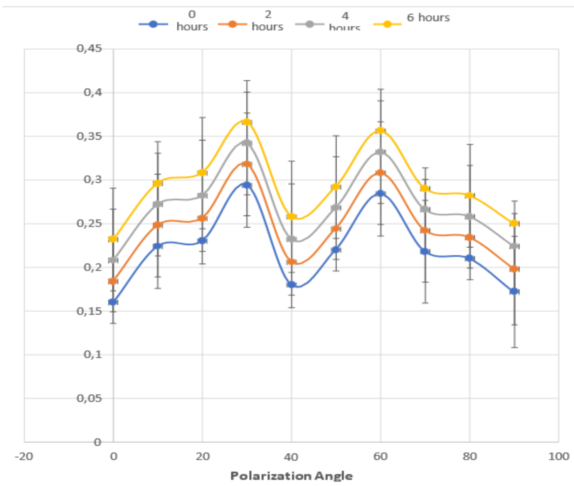

Figure 2 Changes in Polarization Angle on Corn Oil Sample 1 with Green Laser (λ = 532 nm) Heating Variations 0 hours, 2 hours, 4 hours, and 6 hours

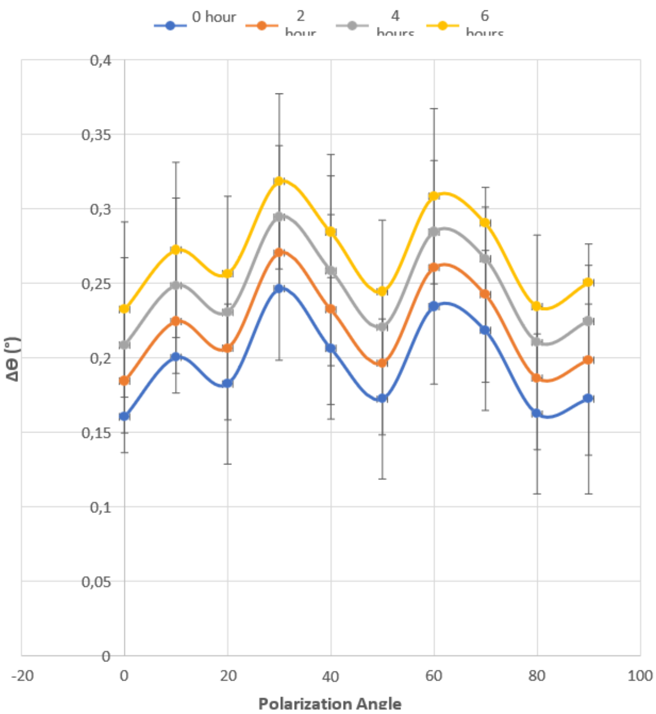

Figure 3 Changes of Polarization Angle on Corn Oil Sample 2 with Green Laser (λ = $532\ nm$) Heating Variations 0 hours, 2 hours, 4 hours, and 6 hours

Figure 2 and Figure 3 show that corn oil samples 1 and 2 have optically active properties. This is evidenced by the change in the polarization angle of samples 1 and 2 from the direction of 0º-90º with an increase of 10º. This is following previous research conducted by Nababan (2022). In this study, palm oil is optically active, due to a change in the polarization angle from the direction of 0º-90º with an increase of 10º. So based on this, it was found that the optically active properties of the oil sample are determined by the direction of the electric field, and the direction of the molecule indicating the concept of determining optically active properties based on chiral and achiral is not absolute. Based on research conducted by Nababan (2022), it was found that changes in the polarization angle in cooking oil occur due to the presence of asymmetric triglycerides. So based on this, the change in the polarization angle that occurs in corn oil 1 and 2 is suspected to be due to the presence of asymmetric triglyceride molecules in the oil. The most dominant asymmetric triglycerides in corn oil 1 and 2 can be determined by two maximum polarization peak angles or asymmetry axes. This is because the electric field polarized in the direction of 30º, and 60º produces the largest change in polarization angle than other electric field directions. In addition, the maximum change in polarization angle in the direction of 30º and 60º of samples 1 and 2 is different. The value of the maximum change in polarization angle of sample 1 in the direction of 30º and 60º is greater than that of sample 2. This is due to the difference in the composition of the dominant fatty acids of samples 1 and 2.

The most likely asymmetric triglycerides were determined based on the fatty acid composition data of samples 1 and 2 using GCMS shown in Table 1, and Table 2.

Based on Table 1, and 2, it is shown that the fatty acid composition of corn oil samples 1 and 2 that are most dominant are Monounsaturated Fatty Acids (C19:1), and Polyunsaturated Fatty Acids (C19:2). While the least fatty acid composition is Saturated Fatty Acids (C19:0).

The change in the polarization angle ($\Delta\theta$) in corn oil occurs due to the optically active properties of corn oil caused by the presence of asymmetric triglycerides in corn oil. The most likely asymmetric triglycerides, and have the greatest probability, can be determined by two peak angles of maximum polarization angle changes, or can be called asymmetric axes, and a combination of 3 fatty acids with different chain lengths between each other, namely TABC.

Table 1 Total Fatty Acid Composition in Corn Oil 1

Warm-up Time (Hours)	Fatty Acid Composition (%)		
	$C_{19:0}$	$C_{19:1}$	$C_{19:2}$
	A	B	C
0	14,46	35,96	48,99
2	14,86	33,88	50,25
4	14,82	32,46	52,04
6	13,03	37,11	43,51

Table 2 Total Fatty Acid Composition in Corn Oil 2

Warm-up Time (Hours)	Fatty Acid Composition (%)		
	$C_{19:0}$	$C_{19:1}$	$C_{19:2}$
	A	B	C
0	14,75	29,22	55,54
2	15,08	29,79	54,40
4	14,56	29,30	55,47
6	14,70	28,76	55,93

CONCLUSION

Based on the research that has been conducted, the following conclusions were obtained: The presence of optically active properties in corn oil is proven by the change in the polarization angle in each direction of the electric field, with maximum peaks at 30º and 60º, The most dominant combination of asymmetric triglycerides in corn oil, namely TBCB, and TCBC, each of which is centered on the asymmetric axis of 30º, and 60º.

Declaration by Author

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Conflict of Interest: The author declares no conflict of interest.

REFERENCES

1. LIPI. (2009). *Pangan & Kesehatan*. Jakarta: UPT-Balai Informasi Teknologi LIPI.
2. Mulyani, Agus Sujarwanta. (2018). *Lemak dan Minyak*. Metro: Lembaga Penelitian UM Metro.
3. Nababan, E.M. (2022). *Pengidentifikasian Molekul Asimetri Trigliserida Pada Minyak Goreng Sawit Menggunakan Metode Polarisasi Alami*. Semarang: Skripsi, Departemen Fisika, Fakultas Sains dan Matematika, Universitas Diponegoro.
4. Safitri, L. (2023). *Analisis Laju Perubahan Mutu Relatif Dari Minyak Wijen dan Bunga Matahari Dengan Metode Polarisasi Cahaya*. Semarang: Skripsi, Departemen Fisika, Fakultas Sains dan Matematika, Universitas Diponegoro.
5. Sutiah, K., Sofjan Firdausi, Wahyu Setia Budi. (2008). *Studi Kualitas Minyak Goreng Dengan Parameter Vsikositas Dan Indeks Bias*. Berkala Fisika, Vol.11, No.2., April 2008, hal 53-58.

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