Development of electrooptic devices by strengthening electromagnetic fields using colloidal silver solutions

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Abstract. The development of electrooptic devices by strengthening the electromagnetic fields using colloidal silver has been carried out. This tool works based on the electrooptics method. The samples used were aquabides and a solution of aquabides mixed with colloidal silver with various concentrations. The light source used is a green laser with a wavelength of 532 ± 10 nm. Measurements are made by observing changes in the natural polarization angle and the electrooptical polarization angle. The test results show that at a concentration of 0-0.25 there is a significant change in the polarization angle to the increase in the external electric field (0-9 kV). While at a concentration of 2.5-1 there is a tendency that there is no change in the polarization angle.

1. Introduction
The many parameters that must be tested along with the very varied methods add to the complexity of cooking oil testing. In addition, most existing equipment is expensive. For this reason, it is necessary to build a simple but reliable equipment system that can be used for quality testing on cooking oil that is easier, shorter, more accurate, at relatively cheaper prices. So far it has never been realized that light polarization can be used to distinguish the quality of various types of cooking oil. Although the change in the polarization angle produced is relatively small, the value of the change can still be measured manually with a pair of polarizers [1-3]. This method is not only simpler but also more practical and provides early detection capabilities. Which is more reliable than the SNI standard test [4-5].

Sugito et al [6] have carried out integrated polarisation design for the detection of lard contamination in cooking oil. The integrated polarizers consist of a light source, analyzer, analyzer, cuvette, electrode, and camera that works based on the transmission polarization method. The sample used is palm oil that has been contaminated with chicken oil and lard. The results showed that palm oil contaminated with lard had the largest change in polarization angle compared to virgin coconut oil. The results showed that integrated polarizers can be used to detect lard contamination in cooking oil. Evaluation of cooking oil quality with integrated polarizers based on the fluorescence polarization method shows that expired cooking oil has a greater polarization angle change compared to cooking oil that is still suitable for use.

Cooking oil quality testing is carried out by giving heat treatment to cooking oil in a variety of times. Measurements are made by observing changes in the angle of fluorescence polarization that occur when there is no external electric field and with an external electric field generated by applying a voltage of 0-9 kV on a metal plate. The results show that the change in the polarization angle will increase in proportion to the increase in heating time.

In this research, an electro-optic design was carried out by strengthening the electromagnetic field using colloidal silver.

2. Methods
Components of the tools used in this study are: 1) Light source, using a green laser with a wavelength of 532 ± 10 nm which functions as a polarized energy source, 2) Polarizer with a scale of 0° to 360° that serves to choose the direction of the electric field from the laser beam which is passed on the sample, 3) the analyzer, serves to measure changes in the polarization angle of the light after passing through transparent material, 4) cuvette with an optical path length of 3 cm as a sample container, 5) a camera
to capture a beam of laser light after interacting with the sample and passing through the analyst. This camera is connected to a computer. While the materials used are aquabides and colloidal silver.

3. Results and discussions

Figure 1 shows the results of the design of the development of an electrooptic device by strengthening the electric field using colloidal silver.

![Diagram of electrooptic device](image)

**Figure 1.** The design of the development of an electrooptic device by strengthening the electric field using colloidal silver.

The difference between the existing electrooptics and the electrooptics in this study is the addition of the colloidal silver solution with the location flanking the sample. The laser beam that strikes the sample as well as after passing the sample before it is captured the analyst will first pass through the colloidal silver solution.

This tool works based on the electro-optical method, the measurement is done by calculating the change in the polarization angle. Before the tool is used to test the sample, the mallus law test is first performed as an initial step to calibrate the tool to ensure the appropriateness and accuracy of the tool by adjusting the angle of the polarizers and the analyst in order to obtain the minimum intensity value. After the mallus test is done, the next step is testing the instrument on the aquabides sample. Colloidal silver used in the variation of concentration with a concentration value of 0-1\%. Samples were tested by natural polarization and electrooptic polarization methods. The results of tests with natural and electrooptic polarization are shown in figure 2.
Figure 2 The results of tests with natural and electrooptic polarization figure 2

Figure 3 shows the change in electro-optic polarization angle to changes in concentration due to an electric field of 0-9 kV

Figure 3 The change in electro-optic polarization angle to changes in concentration due to an electric field of 0-9 kV
The greater the electric field, the greater the value of the change in the polarization angle. The greater the concentration, the greater the value of the change in the polarization angle. But after the concentration of 0.3 saturation occurs as indicated by the value of a constant change in the polarization angle. At low concentrations, there are two optimal polarization peaks at intervals of 0.06-0.07.

4. Conclusion
The method is simpler and easier to study the interaction of light with a matter for special conditions. Results of the design tools are expected to replace equipment existing standard spectrometers are mostly foreign-made that the price is very expensive. In the future, this design device and method of polarization will be a reliable method for evaluating the quality of cooking oil and can be used to test halal ingredients and food products in liquid form.

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