

## Analysis of the Utilization of Refractometer Tools to Test the Quality of Cooking Oil

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### Key Words

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The study of optics in the industrial field in everyday life is the use of a refractometer to test the quality of cooking oil. The purpose of this study is to analyze the use of a refractometer to test the quality of cooking oil. The variables used are in the form of data from experiments that have been carried out previously by researchers. Tested oil of several different types and brands. The experiment uses the principle of light refraction and uses the value of the refractive index to measure the quality of cooking oil. Data collection is done through a review of journals related to the theme of the article. The results obtained in the form of a large refractive index value indicate that the quality of the cooking oil is poor and vice versa. A small refractive index value indicates that the quality of the cooking oil is good.

### INTRODUCTION

Pangandaran Regency, West Java Province ranks third at the provincial level as an area that has extensive coconut plantations. West Java has a plantation area of more than 178 thousand hectares and a production output of not less than 106 thousand tons of copra equivalent per year. This is recorded in data from the Directorate General of Plantations (2017). In 2015 a land area of 178,027 Ha with a production level of 106,408 tons of copra equivalent, in 2016 a land area of 177,867 Ha with a production level of 106,184 tons of copra equivalent and in 2017 a land area of 177,398 Ha with a production level of 106,078 tons of copra equivalent (Abidin et al, 2018).

Cooking oil is the result of refining the parts of animals and plants that can be used for frying food. Cooking oil is divided into two categories, namely bulk and packaged cooking oil. Bulk cooking oil is not branded and marketed in kilograms. While packaged cooking oil has a brand and is marketed in

plastic packaging, bottles, jerry cans in liter units (Elisa and Juliana, 2015)

Cooking oil is included in the category of basic needs for the people of Indonesia. There are many brands of cooking oil. Of course, the quality of cooking oil from various brands is different. Some have very good quality, bad, even very bad. The quality of cooking oil is also seen from the basic ingredients of using cooking oil. There is a tool to test the quality of cooking oil, namely a refractometer.

A refractometer is a tool that functions as a measuring device for the level or concentration of dissolved substances. For example sugar, salt, protein, acid etc. This tool works using the principle of light refraction (Rosmini et al, 2017: 77). The concentration of the solution affects the angle of refraction. For example, a straw is dipped in a glass of water and another in a glass of sugar solution. The straw will look bent in the water and more bent in the sugar solution. This is due to the refraction of light. The higher the concentration of dissolved material (density of the solution),

the greater the bending angle (Tarigan, 2019: 86).

Abbe refractometers are used to measure the refractive index of liquids, solids in liquids with a refractive index of 1,300 to 1,700 and percentage of solids from 0 to 95%. This measurement is based on the principle that light entering and then passing through a prism, light can only pass through the upper plane between the liquid and the prism with definite angles at certain limits determined by the angle of the boundary between the liquid and the base (Solarbesain and I. Pudjiastuti, 2019).

Refraction is the bending of light through a medium of different density. The basic concept of refraction is known as Snell's Law. Snell's Law I "The incident ray, the refracted ray, and the normal lie in the same plane". While the sound of Snell's Second Law "If a ray comes from a less dense medium to a denser medium, then the ray is bent closer to the normal line. And vice versa if the ray comes from a denser medium to a less dense medium, then the ray is bent away from the normal line". That's the equation

$$n_1 \theta_1 = n_2 \theta_2 \quad (1)$$

$n_1$  is medium 1 and  $n_2$  is medium 2 (Elisa and Juliana, 2015)

The refractive index is the ratio between the speed of light in air and the speed of light in the material. The benefit of the refractive index

is to measure the concentration of the solution, knowing the quality of the solution, for example cooking oil. The equation is written

$$n = c/v \quad (2)$$

Information:

$n$  = refractive index

$c$  = speed of light in air (m/s)

$v$  = speed of light in the material (m/s)

(Elisa and Juliana, 2015)

Measuring the angle of deviation of the solution can use a laser refractometer. It can be used to measure concentration, temperature, and wavelength depending on the refractive index of the liquid. The equation used to determine the value of the refractive index of a liquid using a laser refractometer is as follows.

$$n = n_0 \sin \theta \sqrt{1 + \left[ \frac{\cos \theta}{\sin \theta - \Delta/d} \right]^2} \quad (3)$$

Information:

$n$  = refractive index of the liquid in the cuvette

$n_0$  = refractive index of air (empty cuvette)

$d$  = width of cuvette

$\Delta = \delta - \delta_0$  = relative displacement from the Gaussian center for a cuvette with liquid to an empty cuvette

$\theta$  = angle of incidence

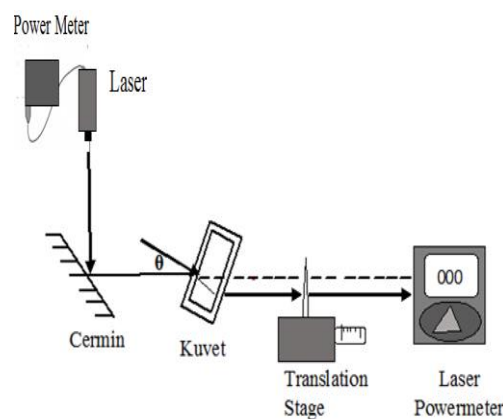


Figure 1. Laser Refractometer Design (Widianti and Minarni, 2019).

**METHOD**

The research method used is article review. Several international articles or journals were used as references in the process of compiling this article. The articles related to the title, namely "Analysis of the Use of Refractometer Tools to Test the Quality of Cooking Oil" were selected by the authors.

**RESULT AND DISCUSSION**

In an experiment conducted by Elisa and Juliana (2015) testing the quality of cooking oil with the parameters of the refractive index of bulk cooking oil and Sunco cooking oil. The experiment was conducted at the Physics Laboratory of the Physics Education Study Program, Faculty of Teacher Training and Education, Syiah Kuala University. The tools and materials used are clear curves in the form of a beam, red laser light, measuring cup, bow, pencil, ruler, HVS paper, bulk cooking oil and Sunco cooking oil.

Table 1 showed that if the refractive index value of bulk cooking oil is smaller than the refractive index value of Sunco cooking oil.

The factors that affect the refractive index are the viscosity of the liquid, the speed

of light, temperature and wavelength. The thicker the solution, the higher the refractive index value. But if the solution is getting dilute, the value of the refractive index is getting smaller. At the speed of light the refractive index is inversely proportional. If the value of the speed of light is small, then the value of the refractive index is getting bigger. The relationship between temperature and refractive index is inversely proportional. The higher the temperature, the lower the refractive index value. The relationship between the wavelength and the value of the refractive index is inversely proportional. The larger the wavelength, the smaller the refractive index.

According to Elisa and Juliana (2015) the quality of Sunco cooking oil is better than bulk cooking oil. This is because the refractive index value of Sunco's cooking oil is higher. So it can be ascertained that Sunco's cooking oil is of better quality.

The experiment conducted by Nasir (2020) is a comparison of the quality of branded palm oil and coconut oil using viscosity and index parameters. However, in this article, we choose to discuss the refractive index of branded palm oil and coconut oil in new conditions.

Table 1. Data on the difference in the refractive index of bulk cooking oil and Sunco cooking oil from the experimental results of Elisa and Juana

Oil Type	Refractive Index		
	20°	40°	60°
Bulk Oil	1,35	1,32	1,35
Sunco	1,44	1,37	1,36

Table 2. Data on The Difference in The Refractive Index of New Branded Palm Oil and New Coconut Oil From Nasir 'S Experiment

Oil Type	Refractive Index
Palm Oil	1.5031 ± 0.0078
Coconut Oil	1.4967 ± 0.0024

Table 3. Data on The Difference in Refractive Index of New Bulk Cooking Oil and Used Three Times Used Bulk Cooking Oil

Oil Type	Refractive Index
Bulk Oil	1.5152 ± 0.0002
Bulk Oil (After 3 Time Used)	1.5402 ± 0.0001

Table 2 showed the refractive index value for new branded palm oil is 1.5031 with a relative error value of 0.0078. As for the new coconut oil, the refractive index value is 1.4967 with a relative error value of 0.0024. Based on the experimental results, the refractive index value of new coconut oil is smaller than that of new branded palm oil. It can be concluded that new palm oil has better quality than new branded palm oil. Thus the quality of cooking oil can be determined using a simple refractometer by measuring the refractive index.

Experiments conducted by Idris et al (2017) used a simple refractometer, a hollow prism. The experiment determines the refractive index of new bulk cooking oil and has been used 3 times. It is used to determine the quality of cooking oil. In addition to the hollow prism, other tools or devices needed are He-Ne laser, screen, beaker and ruler. A hollow prism is formed with each side 10 cm x 10 cm with an angle of 60°. Tests for new bulk cooking oil and used bulk cooking oil three times are presented in the following Table 3.

Table 3 showed the refractive index of new cooking oil is 1.5152 with a relative error value of 0.0002. Meanwhile, the refractive index of used cooking oil 3 x is 1.5402 with a relative error value of 0.0001. It can be concluded that the value of the refractive index will increase when the quality of the oil decreases. Thus to determine the quality of cooking oil can use a simple refractometer in the form of a hollow prism.

## CONCLUSION

From several experiments that have been carried out, the use of a refractometer is quite efficient to determine the quality of cooking oil. The value of the refractive index greatly affects the quality of the oil. The greater the value of the refractive index, then the quality of the cooking oil is poor. On the other hand, if the

value of the refractive index is small, the quality of the cooking oil is good.

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