Advances in Engineering Research, volume 209
International Joint Conference on Science and Engineering 2021 (IJCSE 2021)

Helium-Neon Laser Exposure to Extracts of Seven Variations of Bananas Through Fiber-Optic to Determine the Potassium Content in Bananas

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ABSTRACT
The purpose of this study was to obtain instruments and methods developed to obtain more accurate measurement results of potassium concentration in bananas, so an instrument that has high sensitivity is needed. One of these instruments utilizes the principle of electromagnetic wave phenomena which is made by an optical sensor system equipped with the use of optical fiber for waveguides to maintain the stability of its intensity. The fiber optic instrument bundles in the optical sensor system to determine the potassium concentration in the hope that this instrument can provide accurate measurement results and better sensor sensitivity. Samples of various banana extracts, namely Great Banana, Cavendish Bananas, Green Banana, Kepok Banana, Plantain, dan Ulin Banana, dan Milk Banana. The sample of potassium solution in the lower vessel has a flat mirror reflecting laser light which has been through the absorption process by the sample solution. The reflected helium-neon laser beam is channeled through the optical fiber receiver to measure the change in wave intensity using an optical detector. The intensity of the reflected laser beam is read by an optical detector and converted to an electrical energy display by measuring the maximum voltage using a digital voltmeter. The results showed that the order of potassium content obtained from this measurement from the highest to the lowest was Great Banana, Cavendish Bananas, Green Banana, Kepok Banana, Plantain, and Ulin Banana, and Milk Banana. Cancer is one of the leading causes of death globally, claiming ten million lives in 2020.

Keywords: *He-Ne Laser, Fiber Optic, Potassium, Banana.*

1. INTRODUCTION

This Potassium is one type of electrolyte that has an important role in body health. The function of potassium, among others, is to maintain the balance of fluids and electrolytes in the body, ensure the function of the brain, nerves, muscles, and heart to work normally. Potassium is one of the important nutrients that the body needs, so it needs to be consumed regularly. Foods that contain potassium are very easy to get and can be added to the daily diet.

The recommended consumption of potassium for adults is more than recommended from food. If you want to take potassium supplements, you should first consult with your doctor. Several types of high-potassium foods that can be consumed daily are found in several types of bananas [1].

The potassium content in bananas is well known to the public. This is because from infancy to adulthood, they have consumed bananas to meet the needs of potassium in the hope of maintaining the balance of fluids in the body to remain in a healthy condition. There are several potential benefits of new fermented raw banana powder as a food ingredient for immune enhancement [2]. Potassium deficiency can be experienced by a person and can be avoided by eating foods containing high potassium and paying attention to the daily diet.

Each banana contains about 420 mg of potassium. The content of complex carbohydrates and fiber in it is also able to make the stomach feel full longer and help increase energy. In addition, bananas also contain other important nutrients, such as antioxidants, vitamin B6, and vitamin C. However, there are many types of bananas, and they have different nutrients and benefits. Most people will think all bananas are the same, when in fact bananas have many species. The types of bananas include kapok bananas, milk bananas, green bananas, and plantains.

There are many ways to research to determine potassium levels with various techniques using certain

instruments and sensors. The development of tools and methods developed to obtain more valid and accurate measurement results of potassium levels must require an instrument to have a measurement output with high sensitivity. The development of the method by utilizing the principle of the phenomenon of laser light through an optical sensor system assisted by fiber optics. Optical fiber is an electromagnetic wave transmission line which uses very fine glass and plastic materials to transmit light waves. Light sources often use laser beams such as the Helium-Neon Laser.

The application of optical sensors has been developed by several researchers to determine the content of certain substances in food in the form of powder or solution. As in fiber optic sensors based on the intensity of the waves to determine calcium [3]. Optical sensor with optical fiber variation for the waveguide to determine honey purity [4]. Development of a multimode sensor design using taper fibers to determine glucose [5]. There is also a sensor using two fiber bundles for the level of a substance in solution with high sensitivity [1,6-7]. The study determines the concentration of potassium based on the character of the laser beam on the potassium solution material through a fiber optic shift sensor using a plane mirror which is a modulation of the intensity of the laser beam. The light beam that enters the fiber optic receiver and is processed by the optical detector becomes an electrical signal that will be displayed on a digital voltmeter. The experimental results will obtain a linear relationship between the sensor output peak voltage as a function of variations in potassium concentration and will measure the sensor parameters and performance which include linear range, sensitivity, and linearity.

Optical fiber is a transmission line or a kind of cable made of glass or plastic that is very fine and smaller than a hair, and can be used to transmit light signals from one place to another. In principle, optical fiber can reflect and refract some of the light that propagates in it. Meanwhile, the efficiency of optical fiber is determined by the purity of the glass or the constituent glass. Experimental results show that the purer the glass material, the less light is absorbed by the optical fiber. [2, 8-9].

Based on the description of the exposure to potassium content in bananas, the researchers developed an optical sensor to determine potassium levels by using a flat mirror reflecting field to display accurate measurement results and better sensor sensitivity.

Research to determine potassium levels in bananas was carried out using an experimental method with an initial test using a standard potassium solution with a sample of 0 ppm to 10 ppm and continued with the banana extract sample stage by selecting the equation with the highest linearity. The results of this standard potassium test use a sensor with a plane mirror reflecting plane. Sensors with this reflected plane are used to determine the results of linearity equations that are more accurate and valid and have high sensitivity. The application of optical sensors to determine standard potassium levels using the Helium-Neon laser absorption principle as a source of electromagnetic waves. The helium-neon laser beam propagates through the optical fiber to reduce the intensity of the scattering. The optical fiber guides the propagation of the laser beam to maximize the intensity of the source hitting the sample solution through the receiving optical fiber.

2. METHODS

The study was conducted to determine the potassium content in the banana extract solution using a He-Ne laser with a wavelength of 632.5 nm, a power of 5 mW. The helium-neon laser propagates and anticipates a reduction in the intensity of the scattering guided by optical fiber to maximize the intensity of the propagation wave. The standard potassium solution in this study contained six variations of samples with concentrations of 10 ppm, 8 ppm, 6 ppm, 4 ppm, 2 ppm, and 0 ppm. Capture and reception of laser signals reflected by plane and concave mirrors using an optical detector.

Potassium level research was carried out by adjusting the shift distance between the optical fiber of the receiving bundle and the sample of potassium solution placed close to the flat and concave reflecting mirrors starting with zero shift. The optical fiber bundle is placed on a micrometer position shifted every 50 m. Shifting a certain position will get the maximum output voltage detected by the optical detector and measure the intensity of the reflected wave through the optical fiber receiver by changing the output voltage of the detector as a function of the shift of the fiber beam.

2.1. Sample Preparation

The measurement was counducted on all samples with six concentration variations, including 10 ppm, 8 ppm, 6 ppm, 4 ppm, 2 ppm, and 0 ppm. The next step was continued for the extract solution of plantain, milk, ironwood, kapok, agung, cavendish, and green banana.

The extract samples of seven variations of bananas were obtained through the following process:

1. 500 grams of banana (Great Banana, Cavendish Bananas, Green Banana, Kepok Banana, Plantain, dan Ulin Banana, dan Milk Banana) which has been peeled and chopped.
2. Put the chopped bananas into the oven at 45ºC for 3 x 24 hours.
3. Bananas that have been dried and then mashed with a blender

4. The banana powder obtained was then weighed 50 grams and put into a bottle to be macerated with 150 mL of 70% technical ethanol solvent for 1 x 24 hours.
5. The obtained maceration results were filtered with a vacuum pump and the filtrate was ±100 ml.

The design of the experimental tool to determine the potassium content in the extract of seven variations of bananas is shown in Figure 1.

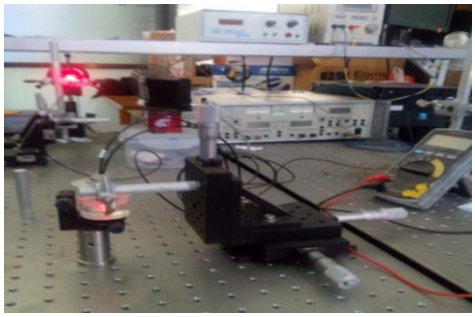

Figure 1 The experimental design determines the potassium content in bananas.

3. RESULTS AND DISCUSSION

The results of the optical fiber sensor research determine the potassium concentration to determine the intensity profile of the optical fiber shift sensor output light beam which is detected in the form of an output voltage through experiments carried out using a plane reflecting plane mirror. Figure 2 shows the relationship between changes in potassium concentration variations to the maximum output voltage at each concentration. To indicate, the higher the cholesterol concentration, the lower the measured detector output voltage.

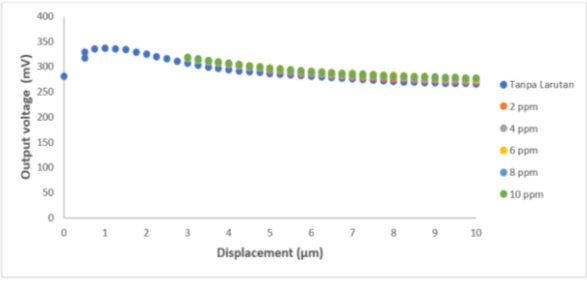

Figure 2 Graph of detector output voltage as a function of fiber optic shift to determine potassium content in bananas.

The detector output voltage detection data starts when the fiber bundle is placed close to the mirror, namely at a shift of z = 0. The fiber bundle is placed on a micrometer and the position is shifted every 50 m. At each position, the output voltage shift of the detector is measured so that data is obtained, namely the detector output voltage as a function of the shift of the fiber beam, which will then obtain the maximum output voltage for each variation of potassium. The maximum output stress value from the variation of potassium concentration is shown in Table 1.

Table 1 Maximum output stress value from the variation of potassium concentration

No	Potassium (ppm)	Voltage output (mV)
1	0	349.4
2	2	349.1
3	4	349.0
4	6	348.8
5	8	348.4
6	10	348.2

Based on the data on the potassium content of the output voltage of each of the seven variations of bananas, it will be analyzed to obtain a linear equation. The linear equation that becomes the reference is taken from the results of the equation on the optical sensor reflecting plane of a plane mirror with the consideration that the linearity value is higher and accurate with the equation y = -0.1186x + 349.41. The results of measuring the maximum output voltage with an optical detector on the optical sensor system obtained voltage values for the seven banana variations as shown in the following Table 2.

Table 2. The value of the maximum output voltage and potassium content of the seven banana variations

No	The seven banana variations	Output Voltage (mV)	Potassium (mg)
1	Milk Banana	355.2	307.28
2	Green Banana	349.9	307.91
3	Kepok Banana	350.2	307.88
4	Great Banana	348.3	308.10
5	Plantain	351.2	307.76
6	Cavendish Bananas	349.4	307.97
7	Ulin Banana	352.2	307.64

The potassium content in the seven variations of bananas, in order from highest to lowest, is Great Banana, Cavendish Bananas, Green Banana, Kepok Banana, Plantain, and Ulin Banana, and Milk Banana.

4. CONCLUSION

The instrument's principle of electromagnetic wave phenomena is made by an optical sensor system equipped with the use of optical fiber for waveguides to maintain the stability of its intensity. In addition, the fiber optic instrument bundle in the optical sensor system for determining potassium concentration can provide accurate measurement parameters and better sensor sensitivity. The results showed that the order of potassium content obtained from this measurement from the highest to the lowest was Great Banana, Cavendish Bananas, Green Banana, Kepok Banana, Plantain, and Ulin Banana, and Milk Banana.

AUTHORS' CONTRIBUTIONS

Mohammad Budiyanto: conceptualization, method, and drafting manuscript. Elok Sudibyo: Review and editing of manuscript. Wahyu Budi Sabtiawan and Tutut Nurita: data curation, data visualization, and editing.

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