Manufacture and Characterization of Sensor for Optimizing the Manufacture of Resistance Sensor for Pure Orange Drink and Unpure Orange Drink

Siti Annisa Widyaningrum*, Ratri Ismawati, Frida Agung Rakhmadi

Program Studi Fisika, Universitas Islam Negeri Sunan Kalijaga, Jl. Laksda Adisucipto 519739, Indonesia.
Email*: sitiannisawdyn@gmail.com

Abstract. This research was purposed to design and analyze a resistance sensor. This research was done by three steps which are designing, manufacturing and characterizing of resistance sensor. Sensor design was done by using Fritzing software. The tools we used in manufacturing sensor were PCB, resistor, and copper wire. The tools we used in sensor characterizing were power supply, CRO and samples of pure orange drink and unpure orange drink. Sensor characterizing was done by varying samples of 50 ml and 100 ml. Data acquisitiom for each samples were repeated five times. Data generated from the sensor in the form of voltage. The data result of measurement were calculated by its average and its uncertainty. For pure orange drink 50 mL (2.274 ± 1.137); 100 mL (1.688 ± 0.844) and for unpure orange drink 50 mL (2.582 ± 1.291); 100 mL (1.852 ± 0.926). Therefore in the future we can make quality control system of orange drink by optimizing the manufacture of resistance sensors with high-grade characteristics

Keywords: Orange drink, sensor resistance

INTRODUCTION

Orange is a flowered plant, family of the Citrus clan from *Rutaceae tribe* (oranges tribe). The family is tree shaped with fleshy fruit with sour fresh taste, however many among the family which has sweet taste. Sour taste comes from content citric acid which indeed contained in all of the family.

Orange also is one of fruit that many people like because of its freshness. Many family of orange which being used by human as food resource, perfume, as well as industrial. Orange is a source of vitamine C and fragrance or perfume. Because many people like orange some of them find easier way to enjoy this fruit by making drink using orange as the main ingredient. There are at least 10 benefits of orange for health such as stroke.

However, if in its packaging are not good for health, it can cause a few problems. In the market, there are many orange drinks being sold. But there are many orange drink in market are not good for health. Because of that we did this research to understand the different resistance of orange drink.

Although there are composition in the packaging, however there are still one or two term that impossible to understand. Moreover, the hygiene grade also cannot be certain. The production process can decrease the nutritions of the orange.

MATERIALS AND METHODS

This research was done by three steps which are designing, manufacturing and characterizing of resistance sensor. Those three steps are explained down below.

Designing sensor, this step aims to simplify in creating the resistance sensor. The target of this stage is to make layout of resistance sensor. Manufacturing sensor was done by analyzing tools and materials which used to create resistance sensor so the next we could make series scheme of resistance sensor using Fritzing software.

Manufacturing sensor, this step aims to create resistance sensor. The target of this stage is a resistance sensor. In manufacturing resistance sensor done by printed the series scheme resistance sensor in PCB. The PCB then dissolved in catalyst liquid called ferri chloride. After being printed, the components that needed installed in PCB by soldered.

Characterizing sensor, this step aims to test or characterizing resistance sensor. The target of this stage is to find out characterization sensor includes, average, uncertainty and repeatability. Characterizing sensor was done by using samples of pure orange drink and unpure orange drink. Measurement was done by repeating five times every volume variations. Samples of pure orange drink and unpure orange drink volume varied by 50 mL and 100 mL. Those samples put into a beaker glass and measured the voltage. Measuring voltage in those samples was done by using CRO.

After the datas gathered, data analysing was done by determining the average voltage value using equation down below:

$$\bar{V} = \frac{\sum vi}{n} \tag{1}$$

$\bar{V}$ is average resistance value and *n* is the total repeating measurement. After obtained an average voltage value, followed by determining uncertainty value using equation (Morris et al., 2014)

$$\Delta V = \frac{1}{n} \sqrt{\frac{n \sum Vi^2 - \sum Vi^2}{n-1}} \qquad (2)$$

To obtain repeatability value, find repeatability eror value first using equiation (Fraden, 2016)

$$Repeatability\ Eror = \frac{\Delta}{\bar{v}\bar{s}} \times 100\% \qquad (3)$$

then,

$$Repeatability = 100\% - \delta$$

The value of "a" represents zero offset (it slip), i.e. the output signal when the input signal is zero using equation,

$$a = \frac{\sum Vi \sum Xi^2 - \sum Xi \sum XiVi}{n \sum Xi^2 - (\sum Xi)^2} \qquad (4)$$

The value of "b" represents the slope (the slope of a straight line), which was often also called sensitivity and resolution is using equation,

$$b = \frac{n \sum XiVi - \sum Xi \sum Vi}{n \sum Xi^2 - (\sum Xi)^2} \qquad (5)$$

Where $\bar{V}$ is the average value of voltage and ΔV is the uncertainty value. To obtain the accuracy value using equation,

$$\beta = \left| \frac{V - \bar{V}}{V} \right| \times 100\% \qquad (6)$$

$$Accuracy = 100\% - \beta \qquad (7)$$

RESULTS AND DISCUSSION

The result of designing resistance sensor using Fritzing sotfware showed in Figure 1. This sensor used a voltage of 9V as source which connected to Vcc and Ground, then measure the voltage value using CRO in Vo. Sensor would dipped in the samples AB. Samples would become mediator of electric current that move from A to B which later be measured the voltage value. The result of manufacturing sensor seen in figure 2.

Sensor using PCB, resistor 2200 Ω and wires. This PCB printed as the layout as seen in Figure 1. The print out is lines in PCB separated by 2 cm. Based of Figure 2, the white and red wires connected to CRO. Meanwhile the black and blue wires connected to power supply as power source. The bottom part and black and blue wires which dipped in the samples of pure and unpure orange drink. When it connected to power source and PCB dipped in samples of orange drink and the series connected so voltage divider principle happened. Voltage divider happened because there are two resitance which is in resistor and samples. Resistance characteristic of pure and unpure orange drink shows in table 1.
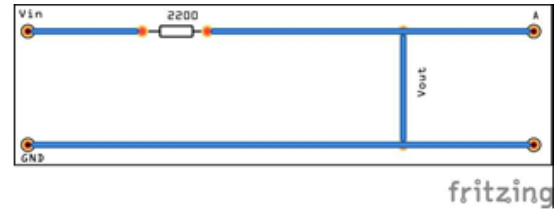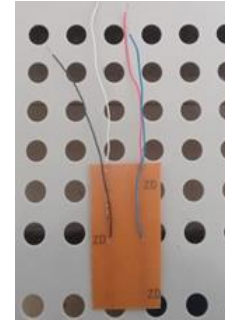

Figure 1. Sensor circuit.

Figure 2. Resistance sensor.

Table 1. Result of Resistance Sensor Characterization in pure and unpure orange drink.

Volume	Pure Orange Drink	Unpure Orange Drink
50 ml	2.274 ± 1.137	2.582 ± 1.291
100 ml	1.688 ± 0.844	1.852 ± 0.926

The repeatability was obtained by 98.81% for pure orange drink and 99.79% for unpure orange drink. The result from these data processing can be determined resistance of sensor by transfer function was V = 1.4390x + -0.0009015 for pure orange drink and V= 1.613x + -0.001046 for unpure orange drink. The accuracy of result is 93.2% and the resistance sensor made was trusted.
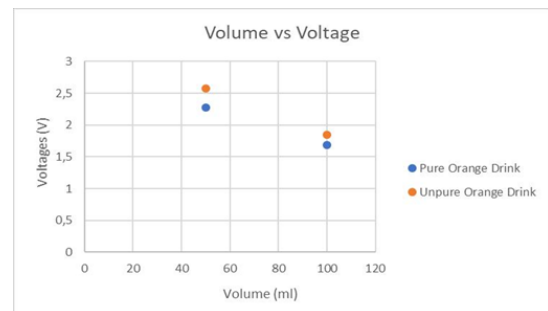

Figure 3. Difference resistance between pure orange drink and unpure orange drink.

From Figure 3, we can see that difference resistance value between pure and unpure orange drink are dissimilar. In Figure 3 concludes that the samples are not intersect. In the Figure 3, also shows the difference value of sample resistance of pure orange drink which lower than unpure orange drink. Data processing result from used samples that is pure and unpure orange drink

besides the characteristic from the sensor, colors of both drinks are different. Unpure orange drink tend to darker and thicker, meanwhile pure orange drink tend to clearer and yellowish. Pure orange drink has many benefits for health because this drink has not tainted with other materials. One of example is people used to consume unpure orange drink which caused cough. From this research we can develop detection device for other orange drink based on resistance value.

CONCLUSIONS

The data result of measurement were calculated by its average and its uncertainty. For pure orange drink 50 mL (2.274 ± 1.137); 100 mL (1.688 ± 0.844); and for unpure orange drink 50 mL (2.582 ± 1.291); 100 mL (1.852 ± 0.926).

REFERENCES

Fraden J. 2016. Handbook of Modern Sensors. Springer, Switzerland.

Fimela. 2015. Dampak Negatif dari Konsumsi Jeruk. https://m.fimela.com/lifestylerelationship/read/2383832/4-dampak-negatif-dari-konsumsi-jus-jeruk [7 Desember 2015]

Morris AS, Langari R. 2014. Measurement and Instrumentation. Elsevier, India.

Rizky J. 2017. Jeruk atau Limau adalah Semua Tumbuhan. http://rizkyjeerte.blogspot.com/2017/11/jeruk-atau-limau-adalah-semua-tumbuhan.html?m=1 [21 November 2017]