**Coconut Oil Heat Capacity**

**1\*Bardan Bulaka, 2\*Syarifuddin, 3\*Eko Harianto**

1Department of Physics Education, Universitas Sembilanbelas November Kolaka

2Department of Physics Education, FKIP Halu Oleo University Kendari

3Department of Agribusiness, FTS Universitas Terbuka Kendari

e-mail: [79syarifuddin@gmail.com](mailto:79syarifuddin@gmail.com)

Received:…………..; Revised:…………; Published: …………..

**Abstract**

Heat is energy transferred between a system and its surroundings due to the temperature difference that exists between them. Phase changes of coconut oil can be seen at temperatures between 20°C–100°C. To calculate the incoming heat using the equation Q = m.c.ΔT. Where Q in the experiment is calculated by the equation Q = V.I.t. So to calculate the specific heat of heat (c) = Q/(m.ΔT). The heat capacity is obtained from the equation C = m.c. The method in this practicum is used heater with AC current. The heater used has a voltage of 220 Volts, with a power of 350 Volts. Because the heating voltage is too large, a variable ac (variac) is used to lower the voltage. The voltage used is 20 volts. The material used is coconut oil which is labeled "Barco". The heater directly interacts with the oil. So that the oil can be directly heated homogeneously. Then it is bounded by adiabatic walls. The temperature in this study was controlled, ranging from 150C-500C. the heat of fusion of coconut oil at 28°C. After that, the liquid phase is above 28 °C to 63 °C. This is in accordance with the oil label which states that the melting temperature (melting) is around 26 °C. This difference is due to a leak or air entering the adiabatic wall.

**Keywords**: heat, heat capacity, coconut oil.

***How to Cite:*** First author., Second author., & Third author. (20xx). The title. *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, vol*(no), xx-yy. doi:<https://doi.org/10.33394/j-ps.vxxiyy>

|  |  |
| --- | --- |
| <https://doi.org/10.33394/j-ps.vxxiyy> | Copyright*©* 2019, First author et al  This is an open-access article under the [CC-BY License](http://creativecommons.org/licenses/by/4.0/).  [Creative Commons License](http://creativecommons.org/licenses/by/4.0/) |

**INTRODUCTION**

Coconut (Cocos nucifera L) is one of Indonesia's agricultural products that is quite potential. In Southeast Sulawesi, Coconut is one of popular agricultural product in the landuse that main sector in this area (Deris & Ramli, 2019; Nursalam et al., 2019; Sejati et al., 2020). Almost all parts of the plant can be used for human needs, as used by the Bajo tribe in some areas, coconut wood for boats and the leaves can be used as roofs for houses. According to (HL et al., 2020) Bajo Tribal Houses have shaped houses made of ironwood, coconut wood and dominant houses are wooden and thatched roofs like coconut leaves. Beside that, Many uses can be obtained from coconut and one way to use coconut is to process it into edible oil or cooking oil. Judging from the color, virgin coconut oil is much clearer than palm oil (Cristianti & Prakosa, 2009).

In addition, the water content and free fatty acids are small, and the content of soluble acids is high. Pure coconut oil contains free anti-oxidants so that it can maintain immunity. The process of making virgin coconut oil does not use organic chemicals and oil solvents at all. From a process like this, the resulting oil tastes soft with a unique coconut smell. If the oil freezes, the color of this coconut oil is pure white. According to (Setiana et al., 2018) coconut oil can functionate as a traditional medicine.

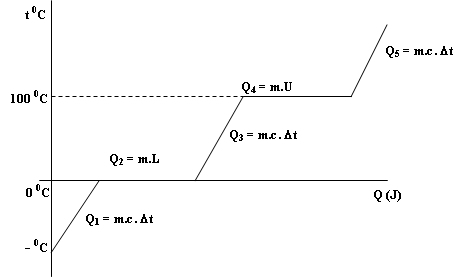
Meanwhile, if liquid, VCO is colorless (clear). Pure coconut oil is not easily rancid because the content of saturated fatty acids is high so that the oxidation process does not easily occur. However, if the quality of the VCO is low, the rancid process will run earlier. This is caused by the influence of oxygen, the presence of water, and microbes that will reduce the fatty acid content in the VCO into other components. Coconut oil contains Lauric Acid, Myristic Acid, Capric Acid, Palmitic Acid, Caprylic Acid, Caproic Acid, Oleic Acid, and Palmitoleic Acid (Cristianti & Prakosa, 2009).

Heat is energy transferred between a system and its surroundings due to the temperature difference that exists between them. The heat capacity (C) of a given sample of a substance is defined as the amount of energy required to raise the temperature of the sample by 1°C (Halliday & Walker, 2011).From this definition, the specific heat (c) of a substance is the heat capacity per unit mass, Thus, if heat (Q) is transferred to a sample with mass (m) and the sample changes (ΔT), the value or magnitude of the heat capacity will be obtained (Serway, 2004). This research was conducted with a modified experiment. The previous experiment used a heater with a DC voltage, while this experiment used a heater with an AC voltage source equipped with an AC variable (variac) by adjusting the incoming voltage to the heater to be small.

**METHOD**

Phase changes are divided into 3 types, namely solid, liquid and gas phases. The graph of the change in phase, temperature against time in theory in water is as follows

.



**Figure 1**. Graph of Temperature against timeby Novitasari (2014)

Changes in the oil phase can be seen at temperatures between 20°C–100°C. Based on experiments that have been carried out by previous researchers that the solid to liquid transition phase is in the range (Fasina and Colley, 2008).

The amount of heat can be calculated using the following equation

(1)

Where

Q = Heat absorbed (calories)

m = Coconut oil mass (grams)

c = Specific heat (kal/g°­C)

ΔT = Temperature change (­°C)

If the energy Q produces a certain temperature change in the sample (ΔT), then

(2)

dimana

Q = Heat absorbed (calories)

C = heat capacity (kal/°­C)

ΔT = Temperature change (­°C)

Kalor yang diserap (Q) pada eksperimen dihitung dengan persamaan berikut

(3)

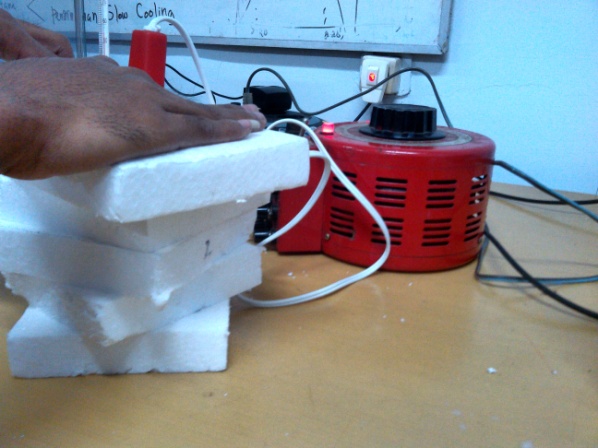
The method in this experiment uses a heater with AC current. The heater used is 220 volts, 350 volts. Because the heater voltage is too large, a variable ac (variac) is used to lower the voltage. The voltage used is 28.16 volts.

The ingredients used are organic PCM or coconut oil labeled "Barco". Coconut oil labeled “Barco” is an oil obtained from extraction In the treatment, the coconut oil was frozen in a container (glass beaker). The experiment was conducted at the Photonic and Magnetic Physics Laboratory, Bandung Institute of Technology (ITB). In this experiment, coconut oil is given heat that comes from the heating process from a heat source with AC voltage (alternating current). The heater directly interacts with the oil. So that directly the oil can be heated homogeneously. Then it is bounded by adiabatic walls. The temperature in this study was controlled, ranging from 150C-500C. According to (R et al., 2019) coconut oil analyze by medical laboratory.

**RESULTS AND DISCUSSION**

This section discusses the provision of heat or heat energy given to coconut oil (Organic PCM) for drying processes on agricultural produuct. According to (Ngkoimani et al., 2017) drying of agricultural and food products is one of the most energy intensive processes. These products are dried to inhibit quality decay. On this research, where the process of giving this heat is given at AC voltage but the voltage that enters the heater is set in such a way that the voltage that enters the device is 28.16 Volts. While the current flowing in the heater is about 0.177 Ampere

.



**Figure 2**. Experimental Series of Coconut Oil Heat Capacity

In Figure 2, it can be seen that the frozen oil is placed in an adiabatic wall in the form of styrofoam. It is expected that the ambient temperature does not affect the temperature changes contained in the adiabatic wall.

In data collection, it was found that the values ​​of several phases of coconut oil are as follows.

.

**Figure 3**. Graph of the Relationship between Temperature and Time in Coconut Oil for Solid, Transitional (latent) and Liquid Phases.

In Figure 3, it can be seen that the phase change of coconut oil in the solid phase ranges from 10-27°C. Phase transition (latent) at 28 °C. The liquid phase ranges from 29-63°C.

**Gambar 4.** Grafik Hubungan antara Temperatur Terhadap Waktu pada Minyak Kelapa untuk Fase Padat

In Figure 4, it can be seen that in the initial condition phase at a temperature of 100C, this coconut oil experienced a solid phase. The practitioner deliberately takes data at that temperature. Because at that temperature, based on the theory, coconut oil undergoes a solid phase. This is done so that the determination of the heat capacity can clearly see the phases which are sensible liquids.

**Figure 5.** Graph of the Relationship between Temperature and Time in Coconut Oil for the Transition Phase

Figure 5 shows where the latent phase occurs at a temperature of 280C. This is not in accordance with the theory, due to the higher leakage rate of styrofoam as its adiabatic wall. In addition, this discrepancy can also be caused by environmental factors, where the position of gravity also affects the rate of the temperature increase process it self.

.

**Figure 6.** Graph of the Relationship between Temperature and Time in Coconut Oil for Liquid Phase

.

In Figure 6 the graph explains that the temperature changes occur more briefly. In this case, it is a liquid phase.

The absorbed heat (Q) is calculated using equation (3). The value of V in the experiment is 28.16 volts. The value of A in the experiment is 0.177 amperes. The t value in the experiment is 10,200 seconds. Then Q = 50840.064 calories. The value of C can be obtained from the equation C = Q/ΔT = 50840.064/(63-10)= 50840.064/48 = 1059.168 cal/°C

**CONCLUSION**

The heat of fusion of coconut oil is at 28°C. After that, the liquid phase is above 28 °C to 63 °C. This is in accordance with the oil label which states that the melting temperature (melting) is around 26 °C. This difference is due to a leak or air entering the adiabatic wall

.

**RECOMMENDATION**

In future research, the authors hope to conduct experiments on other types of labeled coconut oil and also the oil produced by palm oil so that it can find out the difference in the heat capacity of several types of cooking oil.

The problem faced in this experiment can be seen from the observations that can be seen in Figure 5. In Figure 5 it shows where the latent phase occurs at a temperature of 280C. This is not in accordance with the theory, due to the higher leakage rate in the styrofoam used as the adiabatic wall. In addition, this discrepancy can also be caused by environmental factors, where the position of gravity also affects the level of the temperature increase process itself.

.

**ACKNOWLEDGMENT**

The author would like to thank the Photonic and Magnetic Physics Laboratory of the Bandung Institute of Technology (ITB) for the equipment assistance in this research and Pak Warya for the equipment assistance. The author also thanks Inge M. Sutjahya for her guidance during this research and useful discussions

**REFERENCES**

Cristianti & Prakosa. (2009). *Pembuatan Minyak Kelapa Murni (Virgin Coconut Oil) Menggunakan Fermentasi Ragi Tempe*. Surakarta: Universitas Sebelas Maret.

Deris, D., & Ramli, R. (2019). KESESUAIAN PENGGUNAAN LAHAN PERMUKIMAN DI KECAMATAN KATOBU DAN KECAMATAN DURUKA KABUPATEN MUNA BERBASIS SIG. *Jurnal Penelitian Pendidikan Geografi*, *4*(3), 20–30. https://doi.org/10.36709/JPPG.V4I3.8338

HL, N. I., Saputra, I. G. P. E., Sejati, A. E., & Syarifuddin, S. (2020). Developing Teaching Material Bajo’s Local Wisdom Sea Preservation Thomson-Brooks/Cole Model. *JPI (Jurnal Pendidikan Indonesia)*, *9*(3), 355. https://doi.org/10.23887/jpi-undiksha.v9i3.23234

Ngkoimani, L. O., Megawati, Saputra, G. P., Cahyono, E., Aripin, H., Suastika, K. G., & Sudiana, I. N. (2017). Fast Drying of Agriculture Commodities by Using Microwave. *Journal of Physics: Conference Series*, *846*(1). https://doi.org/10.1088/1742-6596/846/1/012023

Nursalam, L. O., Harianto, E., Hasan, M., & Sejati, A. E. (2019). Nilai-nilai dalam aktualisasi peningkatan karakter kepedulian lingkungan mahasiswa. *Tunas Geografi*, *8*(2), 151–160. https://doi.org/10.24114/tgeo.v8i2.17190

R, D. N., Natalia, A., Lukmanto, F., Ani, I., & Tarigan, I. L. (2019). Analysis quality characteristics of virgin coconut oil (VCO): comparisons with cooking coconut oil (CCO). *Medical Laboratory Analysis and Sciences Journal*, *1*(1), 30–36. https://doi.org/10.35584/melysa.v1i1.20

Sejati, A. E., Karim, A. T. A., & Tanjung, A. (2020). The Compatibility of a GIS Map of Landslide-Prone Areas in Kendari City Southeast Sulawesi with Actual Site Conditions. *Forum Geografi*, *34*(1). https://doi.org/10.23917/forgeo.v34i1.10582

Setiana, F. D., Jumari, J., & Hastuti, E. D. (2018). Kelapa Sebagai Komponen Bahan Ramuan Obat di Karaton Ngayogyakarta Hadiningrat dan Pura Pakualaman. *Jurnal Penelitian Dan Pengembangan Pelayanan Kesehatan*, *2*(1), 23–28. https://doi.org/10.22435/jpppk.v2i1.40