Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
http://ojs.ikipmataram.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

June 2021. Vol. 9, No. 1
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 101-107

Coconut Oil Heat Capacity

[1*]Bardan Bulaka, [2]Syarifuddin, [3]Eko Harianto

[1]Department of Physics Education, Universitas Sembilanbelas November Kolaka, Jl Pemuda No. 339, Kolaka 93517, Indonesia

[2]Department of Physics Education, FKIP, Universitas Halu Oleo, Kampus Hijau Bumi Tridharma, Anduonohu, Kendari, Sulawesi Tenggara 93232, Indonesia

[3]Department of Agribusiness, FTS, UPBJJ-Universitas Terbuka Kendari, JL. A.H. Nasution, Kendari, Sulawesi Tenggara 93232, Indonesia

*Corresponding Author e-mail: bardanbul@gmail.com

Received: May 2021; Revised: June 2021; Published: June 2021

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: Bulaka, B., Syarifuddin, S., & Harianto, E. (2021). Coconut Oil Heat Capacity. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 9*(1), 101-107. doi:https://doi.org/10.33394/j-ps.v9i1.3947

https://doi.org/10.33394/j-ps.v9i1.3947

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. Research says coconut oil contains lauric fatty acid, which is the main fatty acid that can increase the amount of good cholesterol (HDL). But these fatty acids can also increase the amount of bad cholesterol (LDL). Research says coconut oil contains lauric fatty acid, which is the main fatty acid that can increase the amount of good cholesterol (HDL). However, these fatty acids can also increase the amount of bad cholesterol (LDL).

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

.

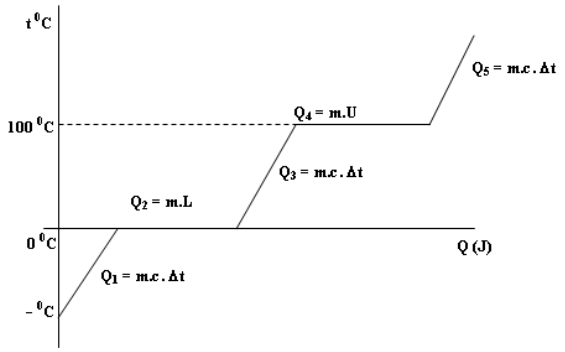

Figure 1. Graph of Temperature against time by Novitasari (2014)

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

$$Q = m.c.\Delta T \qquad (1)$$

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

$$Q = C.\Delta T \qquad (2)$$

dimana
Q = Heat absorbed (calories)
C = heat capacity (kal/°C)
ΔT = Temperature change (°C)

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

$$Q = V.i.t \qquad (3)$$

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

.

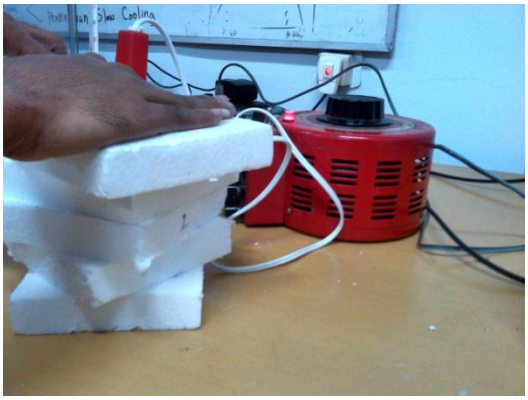

Figure 2. Experimental Series of Coconut Oil Heat Capacity

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.

.

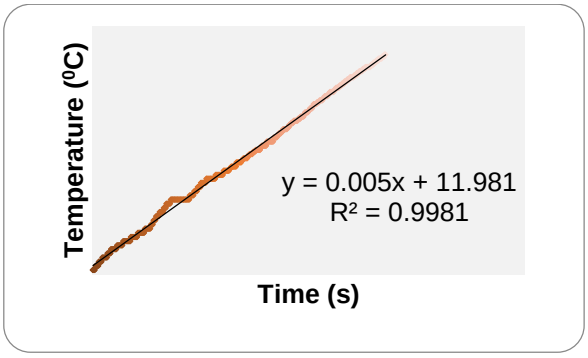

Figure 3. Graph of the Relationship between Temperature and Time in Coconut Oil for Solid, Transitional (latent) and Liquid Phases.

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.

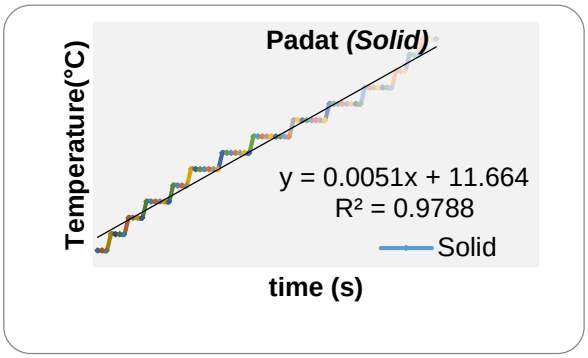

Figure 4. Graph of the Relationship between Temperature and Time in Coconut Oil for the Solid Phase

In Figure 4, it can be seen that in the initial condition phase at a temperature of 10^0C, 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.

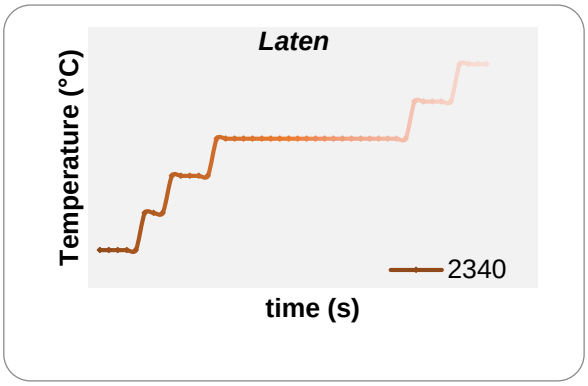

Figure 5. Graph of the Relationship between Temperature and Time in Coconut Oil for the Transition Phase

Figure 5 shows where the latent phase occurs at a temperature of 28^0C. 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.

.

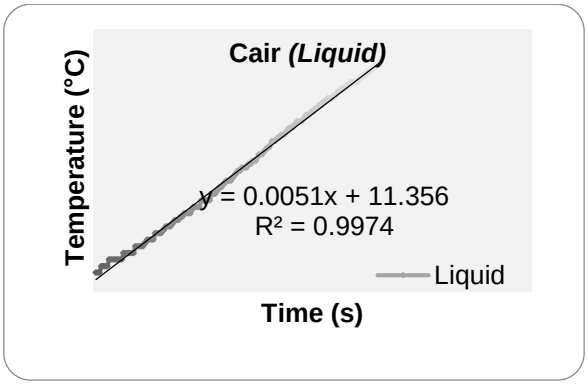

Figure 6. Graph of the Relationship between Temperature and Time in Coconut Oil for Liquid Phase

.

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. Both oil palm and ordinary coconut have benefits, either directly or indirectly for humans. Based on a number of scientific records, coconut oil which is predominantly natural saturated fat provides a number of profound health benefits, such as, improves heart health, increases thyroid, increases metabolism, can lose weight, supports your immune system.

And in 50% of the fat in coconut oil is found an acid called lauric acid. This lauric acid in the body will be converted into monolarium which has anti-virus, anti-bacterial and anti-protozoal properties. And this substance is not found in palm oil. Coconut oil is also the richest source of medium-chain fatty acids (MCFAs), also called medium-chain triglycerides or MCTs. These MCTs are easily digested and directly burned by the liver for energy - just like carbohydrates, but without the insulin spike. MCTs actually increase metabolism and help the body use fat for energy, as opposed to storing it, so it can actually help us become leaner.

Meanwhile, for palm oil, its prestige has decreased slightly due to the negative campaigns of a number of European countries which aggressively call palm oil not good for health. Allegations of palm oil containing trans fatty acids cholesterol and causing degenerative diseases have long been used to block palm oil in the international market, and all are nothing more than black campaigns.

Because scientifically the accusations are unfounded, both in terms of nutritional value and scientific evidence about the effect of palm oil consumption on health. In fact, the nutritional content of palm oil actually contributes to the prevention of various degenerative diseases such as heart disease, cancer and others. Palm oil also does not contain trans fatty acids (trans fat free) and contains saturated and unsaturated fatty acids in balanced proportions. Palm oil contains active compounds such as carotenoids (precursors of vitamin A), tocopherols and tocotrienols (vitamin E) and essential fatty acids (oleic, linoleic, linolenic) which play important roles as antioxidants and prevent various degenerative diseases in humans.

Not only that, palm oil contains the highest vitamin E compared to other vegetable oils. The vitamin E content in palm oil reaches 1172 ppm, higher than the vitamin E content of soybean oil (958 ppm), sunflower seed oil (546 ppm), and corn oil (782 ppm) and so on. In addition to containing high vitamin E, palm oil also contains vitamin A which is also relatively high compared to other food ingredients.

The vitamin A content of red palm oil is higher than the vitamin A content of food ingredients that are considered a source of vitamin A such as oranges, carrots, bananas and

others. The benefits of vitamin E, vitamin A and essential fatty acids of palm oil for human health have been widely proven through health/medical research.

Among them are preventing vitamin A deficiency, preventing and controlling blindness, preventing cancer/tumor, anti-free radicals, preventing premature aging, inhibiting liver swelling, increasing body immunity, reducing cholesterol, preventing atherosclerosis such as coronary heart disease and blood vessels and others. It is also important to know that palm oil does not contain cholesterol. Because cholesterol is only produced from animal oils.

Then if the question keeps coming up, if you are asked to choose between consuming palm oil or coconut oil, what is the answer? Penny Kris-Etherton is a professor of nutrition at Pennsylvania State University, One tablespoon of coconut oil contains 117 calories, 14 g total fat and 12 g saturated fat. While unsalted butter contains only 102 calories, 12g total fat and 7g saturated fat. 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 it self.

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 28^0C. 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 it self.

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