Drying kinetics on mass reduction with natural operation of potatoes as simulation model

B Haryanto*, M B Tarigan, T R F Sinuhaji, E A Tarigan and N A Br Sitepu
Faculty of Engineering, Universitas Sumatera Utara, Medan, North Sumatra 20155, Indonesia

*Email: bode.haryanto@usu.ac.id

Abstract. The increase in cases of coronavirus infection causes research to be carried out at home. This is due to the rapid mutation of the coronavirus. So far, WHO has confirmed 4 variants of the coronavirus. The research carried out this time is to make a kinetic model and the percent reduction in mass in potato samples by drying using sunlight as a form of research effort carried out at home. This drying has been done before and this time it is compared with previous research data. The results obtained are that there is a difference, namely the percent reduction in sample mass before and after drying. In the sample carried out this time, the percent mass reduction on the first day was very large, but when tested on the last day it was superior to the previous research, which means that the surface area of the sample accelerates the drying process.

1. Introduction
Lately, the rise of cases of coronavirus transmission has made many countries return to lockdown. Large-scale social restrictions were again carried out and outdoor activities were again eliminated. This massive transmission is caused by the coronavirus experiencing mutations. Based on the clinical and epidemiological impact, namely an increase in transmission, virulence, and the ability to evade immunity formed from vaccination, several variants are classified as variants of concern (VOC). There are 4 VOCs until June 2021, namely variants B.1.1.7, B.1.351, P.1, and B.1.617.2, which have been labeled by WHO as alpha, beta, gamma, and delta variants, respectively [1].

Drying is the oldest and most frequently used preservation method for agricultural products around the world. Agricultural goods are frequently dried so that they can be used as raw materials for further processing [2]. Home research is an alternative to scientific activity, such as research done at this time. Studies on the impact of environmental conditions have been documented, including available environmental performance, firm profitability, and asset utilization [3,4].

Figure 1. Potato’s sample
Potatoes are a sort of vegetable and a source of carbs that are rather easy to come by in this tropical country. The drying technique on potatoes has also been carried out using sun drying [3]. In addition, other samples were also dried using sunlight and others methods, such as Ginger [2,5-7], Carrot [8-10], Cucumber, and Radish [11].

This time, drying research will be carried out again, to verify the results obtained in drying using sunlight. Based on previous research involving the effect of thickness, it is found that drying will be completed quickly when the thickness is reduced [3]. The aim of this research is to re-verify and provide knowledge of the same thing with minor changes in drying research.

2. Experiment and Method
The material chosen in this study was radish purchased at the traditional market in Selayang Medan. The tools used in this research are cutter and meter. The sample was prepared in an unformed shape as in Figure 2A. The material is then weighed as shown in Figure 2B with a scale. Also measured the volume with a measuring cup as Figure 2C. Drying is done openly with an online environmental temperature analysis such as an example of a 2D image.

![Figure 2. A. Potato as a sample, B. The digital balance instrument, C. The measurement of volume, D. The following is a sample of natural temperature data in the vicinity of the operation area.](image)

To ascertain the sample's initial weight, it is first weighed ($W_0$). Weight fluctuations are measured every 60 minutes to 6 hours, and then weight measurements ($W_i$) are terminated once the sample weight has stayed constant. On each sample, measuring procedures were utilized until the seventh day/constant mass.

For drying kinetics, weight loss was measured with a digital balance until the weight changes were stable at sufficient time intervals. Weight loss is calculated as follows based on the results:

$$Weight_{(t)} = Weight_{(0)} - Weight_{loss_{(t)}} \tag{1}$$

$Weight_{(t)}$ shows the weight of a dry potato at a certain time interval, while $Weight_{(0)}$ represents the weight of a wet potato before drying. The weight loss$_{(t)}$ represents the change in the weight of a dry potato over time. Calculate percent mass reduction is

$$%W = \frac{(W_0 - W_t)}{W_0} \times 100\%$$
3. Results and Discussion

The data consists of 3 samples with the physical properties of the samples based on changes in thickness. The sample size shown in Table 1 is the same as the previous research [3]. However, the area was narrowed down to 56%.

| Sample | Thickness (cm) | Length (cm) | Wide (cm) | Volume (ml) | Rho (mg/ml) |
|--------|----------------|-------------|-----------|-------------|-------------|
| 1      | 0.5            |             |           |             | 3.18        |
| 2      | 1.0            | 2.0         | 1.7       | 5.20        | 1.1930      |
| 3      | 1.5            |             |           | 7.62        |             |

Figure 3. The drying kinetics of potato on the 1st day

Figure 3 depicts the rate of drying on the first day. The drying procedure reduces the weight of the sample, as seen in Figure 3. As a result of mass transfer during the drying process, the sample's moisture content has evaporated into the air [10,11]. After 6 hours of drying, sample 1 has the lightest dry weight of 0.56 mg, while samples 2 and 3 have dry weights of 1.48 mg and 2.68 mg, respectively, as shown in Figure 3. Based on the reduction in the initial mass, sample 1 got a mass reduction of 82.39%, samples 2 and 3 were 71.54% and 64.83%, respectively. The shrinkage profile of potatoes over time clearly shows that sample shrinkage occurs virtually linearly over time. When moisture is withdrawn from water-filled pores on the surface of the sample, the mechanical balance of the cell walls is disrupted, and the tissue structure deforms [12].
Figure 4 is a graph showing the drying mass data carried out on potato samples every day until the seventh day. On the seventh day, sample 1 was 0.42 mg, samples 2 and 3 were 0.86 mg and 0.92 mg. The total mass loss in each sample, for sample 1 was 86.79%, samples 2 and 3 were 83.46% and 87.93%, respectively. Comparison with previous research data [3]. The total mass loss in sample 1 was 88.18%, samples 2 and 3 were 90.39% and 86.68%, respectively. It can be seen that during the hourly reduction of mass on the first day to 6 hours of drying, at 56% reduction in area, it was initially superior. The difference with previous research data [3], in sample 1 the difference is 2.39%, in sample 2 and 3 the difference is 14.33% and 14.04%. But when the total mass reduction reaches the end of the day, a larger area provides a larger mass reduction as well. As seen in sample 1 the difference is 1.39%, samples 2 and 3 are 6.93% and 1.25%. According to the statement [13], it may be concluded that variables such as sample surface area influence drying rate. Increasing the surface area reduces the drying time, which in other words increases the surface area increases the drying rate [14].

Figure 5 involves a comparison mass reduction between samples in other conditions where it is explained that condition A is a condition when it rains, condition B and C is a condition when it is sunny. It is the same with previous research which explains that environmental conditions affect the mass loss.
in the sample [3]. Based on the investigations of Tariku, et al [15], the temperature when there is no rain is higher and higher when there is no wind-driven rain. As a result, the transfer of steam will be faster and the mass will be reduced more quickly.

Figure 6. Drying Progress Samples

Figure 6 is a sample image before and after drying. The difference between the samples is very clear. This effect has been very well explained why it can occur [2,3,9,10,11]. The Maillard reaction happens during drying, creating dark pigments that affect the color of the product [16]. Temperature drives this process, with greater temperatures producing more dark pigments. However, the length of time the product is exposed to this condition is also essential, because the shorter the exposure time, the less dark pigments are produced, resulting in a compensatory effect [16].

4. Conclusion

In this study, it was concluded that drying was carried out with the power of sunlight on potato samples. In the first drying period for the next 6 hours, the largest percentage of reduced mass was obtained on sample 1 with a value of 82.39%, compared to samples 2 and 3 of 71.54% and 64.83%, respectively. However, when viewed daily, between sample 1, sample 2, and sample 3, the percent reduction in mass did not experience a significant difference. The mass percent reduction range is between 83-87%. The difference in mass reduction is very clear when carried out under various conditions. Outdoor conditions provide the greatest mass reduction. In the drying process, there is a change in the color of the sample to dark or black and changes in the surface characteristics of the sample. This is caused by the Maillard reaction that occurs during the drying process.

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