Physical quality change of rose tea during freeze drying

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Abstract. Rose tea began to be widely developed since it has advantages in the form of high antioxidant content, and fragrant aroma. Currently, rose tea production uses manual dryers in the form of sunlight energy, which might reduce the physical and chemical quality of rose tea. The low temperature drying is expected to be able to maintain the quality of rose tea. The aim of the study was to determine the drying characteristics of rose tea using a freeze dryer machine. The material used is a local type of rose petals from the Malang region with a water content of 86.76%. The tool used is 1 unit freeze dryer capacity of 1.5 kg with freezing temperature of -18°C, and with a pressure of -76 cm Hg. The drying chamber is made of stainless steel equipped with three heater plates with a total power of 500 watts. The experimental design uses variations in drying time, namely 0, 12, 18, 24, 30, and 36 hours. Parameters measured were water content, color, weight loss, and antioxidant content in the form of flavonoids. The experimental results showed that the final moisture content of roses using drying freeze dryer was 9.54% with a drying rate of freeze dryer of 2.14% per hour. Rose color has decreased from L * value of 27.37 to 8.87 a * value of 52.81 to 14.84 and b * value of 26.19 to -0.77. Based on this, compared to drying with sunlight and cabinet dryers, drying with a freeze dryer is better at drying roses into rose tea.

1. Introduction
Roses are plants being grown second in Indonesia after the chrysanthemum flower. This is based on the publication [1] that roses have harvested area of 3,723,288 m² with a total production of 184 455 598 stalk. Its utilization can be used as cut flowers for gifts. Utilization of ornamental flowers now, not only in its beauty alone but many who utilize ornamental flowers as beauty products, food products even one of them tea.

This time the tea is not only of ornamental *Camellia sinesis* yet been developed from plants such as chrysanthemums, crown of the gods, and the sun. The roses have other potential than as ornamental flowers are a highly nutritious food. The content of the roses in the form of vitamin E and antioxidants can be used as a menstrual pain relief medication, high blood pressure, boost the immune system and improve mood. In
addition to the high antioxidant, high-roses also contain polyphenols which can prevent aging so it is very useful for beauty [2]. The potential of the new product can be used as one form of tea roses. Until now, there are many manufacturers who have not been able to make tea roses with good quality because the rose dried by drying in direct sunlight. The drying in the sun makes the colors of roses to brown and decreased scent very much.

Freeze dryer known as conditioning technology which is able to maintain the taste, color, and aroma of dried product. Preparation of tea roses with freeze drying method may be a solution to the problem of making a traditional rose tea. In reference [3], Already examined the influence of various methods of drying of the active ingredient of loquat flower tea. Until now, information related to tea production rose by using the method of freeze-drying is still very limited. This study was undertaken so that the aim of this study was to determine the kinetics of changes in the quality of tea roses during drying using a freeze-drying.

2. Materials and Methods
2.1. Equipment and materials
The tools used were 1 unit freeze dryer capacity of 1.5 kg with dimensions of 0.7 x 0.5 meters as well as the number of layers in it as much as 2. The device was made of stainless steel, and the three plate heaters were installed with a total power of 500 watts. This machine was design to reach the freezing temperature of -18°C, and the vacuum pressure of -76 cmHg. Additional laboratory tools were used to determine the parameter were the brand Memmert oven for moisture content analysis, brand Ohaus analytical balance with a precision of 0.0001 g, color meter TES-135 brand. The fresh rose were used as materials that were obtained from Malang.

2.2. Experimental design
This study used three types of drying method were freeze dryer, cabinet dryer, and sun dryer. Drying using freeze dryer was conducted with interval time of 0, 12, 18, 24, 30, and 36 hours. Drying using cabinet dryer were performed at 50°C for 12 hours. While the sun drying was done 1 to 2 days in a greenhouse effect dryer.

2.3. Procedures
Stem roses petals were separated between the stem first, then checked for moisture content and color values rose petals before drying. Rose petals with a mass of 100 grams was dried in a freeze dryer. Data retrieval temperature of the material and the ambient temperature was recorded using a data logger with the Extech brand every 1 hour interval. The moisture content was measured using thermo gravimetric methods by way oven at a temperature of 105°C for 24 hours, and the color were measured using the color meter, and the mass was measured using a digital scale.

3. Results and Discussion
3.1. Temperature materials
Temperature of the material during drying is shown in figure 1. The initial temperature was 8.8°C, and decreased to -7.6 °C and stabilized at 750 minutes, then increases again in the last minute to 1410 stabilized to-back minutes 1650. This might be due to the drying using a freeze dryer machine there are three stages in the drying namely freezing, primary drying, and secondary drying. The stages in accordance with the principles of drying and freeze dryer using the operating procedure is the first stage of freezing, the second stage of primary drying, and secondary drying the third stage [4],
In reference [5], stated that the temperature of material in the form of dried banana initially -35.6°C to be -4.1°C using the same drying principle, and the drying time is 696 minutes.

3.2. Moisture content
Initial moisture content of the material of interest was 80.00%. The moisture content of material with the method of freeze drying at 12, 18, 24, 30, and 36 hours were 77.11%, 66.38%, 40.29%, 21.8% and 9.54% respectively. This final moisture show that water could be reduce to safe level of material for storage. Based on that data, it could be calculated that the drying rate of this method dryer was 2.14% per hour. The evolution of moisture content reduction is shown in figure 2. The graph shows that at 12 hours, the material was freezeed and the heater was started at the on position.

The different results are shown in reference [3] that it takes 17 hours to make a moisture content loquat flower from 65% to 10% with drying using a freeze dryer method. This might be due to a different machine or different material characteristics. Based on the reference[6], Roses are dried using forced air circulation at a temperature of 60°C takes 13 hours to make the moisture content of rose to 10% from the initial
moisture content of 90%. Whereas in this study, it takes 36 hours to make the water content rose from 80% to 9.54% by using a freeze dryer drying method. The rose drying using cabinet dryer shows that the final moisture content was 11.03% within 12 hours, or the average drying rate of this method was 6.31% per hour. The rose drying using sun drying shows that the final moisture content was 10.92% and the drying rate was 2.96% per hour.

Different results are also shown in the study belonged to Jose Antonio [7] that the moisture content of strawberry powder after drying using a freeze dryer for 24 hours was 3.9 ± 0.32 and 4.1 ± 0.28. The moisture content is lower than this study different because the materials used in this study are roses and strawberries on the reference powder. Differences in particle size is what influence drying by Einhorn (2015) in the reference [8] that the factors affecting the drying is physical and chemical properties of the product (shape, size, composition and moisture content), the physical properties of the drying environment, and the geometrical arrangement of the products.

3.3. Loss of Weight
Weight loss on a freeze dryer 85.55%, while 85.19% drying cabinet dryer, and drying using the sun 78.72%. Weight loss is due to water removal by sublimation process of water. Cracking or fissuring of the material was not detected in this methods. It is possible losses due some volatile compound evaporated, but it might be not significant.

3.4. Color
The component value of color L*, a*, and b* on fresh roses were 27.37; 52.81; 26.19 respectively. The final color of material using a freeze dryer methods were 8.87 (L*); 14.84 (a*); and -0.77(b*). The color change during drying is shown in figure 3, figure 4 and figure 5. The value of L*, a*, and b* are different from the reference[5] which states that the value of L* a* b* of bananas which have been dried at 59, 16, and 23. This is due to differences in materials used in the drying using a freeze dryer.

The final color of the material using the cabinet dryer were 15.55(L*); 15.22(a*); -0.06(b*), and the material color using sun drying methods were 13.64(L*); 13.91(a*); -1.93(b*). It shows the change in lightness that the product tend to dark color at dry condition. The color change occurs because of the dehydration process that affects the quality of the food color and antioxidant content in foods [9]. The dehydration process is a process in which the water content in food is lowered so as to be low by adding other forms of energy in the food [10].

![Figure 3](image_url)

**Figure 3.** The value of lightness (L*) of tea roses during freeze drying
In Figure 3, the value of lightness (L*) on roses drying results using a freeze dryer to change and tends to be of little value if the longer drying time. This is different from that stated at the reference[11] that the value of L* on a mandarin orange fruit drying freeze dryer using almost the same value worth 66 ± 3 and 72 ± 5.

![Figure 4. The value (a*) of tea roses during freeze drying](image)

![Figure 5. The value (b*) of tea roses during freeze drying.](image)

The color of fresh rose petals before drying is shown in figure 6. The bright red color of roses turns into darker after drying. Rose color after drying sequence of the brightest is the result of freeze dryer drying, cabinet dryer, and sunshine are shown in figure 7.

![Figure 6. The appearance of rose petals before being dried](image)
4. Conclusion
Drying using a freeze dryer could reduce the moisture content from 86.76% to 9.54% and the weight loss was 85.55%. The color of the freeze dryer can be maintained as fresh produce better results than the drying cabinet dryer with final moisture content of 11.03% and a weight loss of 85.19%.

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