

# Drying Rate of Skim Milk From Virgin Coconut Oil Remaining Water

Abu Hasan<sup>1</sup> Indah Purnamasari<sup>1,\*</sup> Muhammad Yerizam<sup>1</sup> Robert Junaidi<sup>1</sup>

<sup>1</sup> Chemical Engineering Department, Politeknik Negeri Sriwijaya

\*Corresponding author. Email : [indah.purnamasari@polsri.ac.id](mailto:indah.purnamasari@polsri.ac.id)

## ABSTRACT

Coconut tree's benefits were not only in flesh that can be processed into coconut milk, copra, and coconut oil but also in all part of coconut plants. Coconut oils were produced from dried coconut by extraction. The oil from this process is known as virgin coconut oil (VCO). During the VCO production, coconut residue (left after removing the coconut milk), coconut skim milk (CSM) and insoluble protein are the main by-products. By product such as skim milk and insoluble protein in coconut have been used to increase products value, which is used as a low protein healthy drink. This study aims to determine the drying rate in producing of CSM using a dryer. VCO remaining water is fed into the vacuum freeze dryer, the drying temperature is maintained (-10 °C) – (-25 °C) with drying time of 12 hours and 13 hours. The results show that the lower temperature and the longer time drying, the slower drying rate. The highest levels protein were at the drying time for 13 hours with a drying temperature of -25 °C, namely 36.28% with water content contained in the CSM of 5.49%. The drying rate obtain 2.53 – 2.54 gram per hour in every drying times and temperatures.

**Keywords:** Coconut, Drying, Skim Milk, Rate

## 1. INTRODUCTION

Coconut plant is a type of food plant in Indonesia that can be used to help overcome malnutrition [1]. Coconut responds as a source of protein to affect the work of enzymes, hormones, and immunity. Protein is one of the nutrients needed in large quantities every day, and it contributes to the supply of energy (calories) to the body [2]. Fresh coconut meat only contains 4.5% by weight of protein, this protein is important because the highest level of coconut production in the world [3]. Coconut is usually used and processed optimally through the manufacture of Virgin Coconut Oil (VCO) with by-products in the form of skim coconut milk waste water and insoluble protein[1].

The VCO byproducts or skim processing sometimes are left alone and disposed in the environment. Even though it can be useful if its turn into a high value potential food and healthy for the body, namely coconut skim milk (CSM). Processing of Coconut Skim Milk (CSM) into selected powder to increase shelf life and simplify product application [4].

The alternative processing techniques for CSM into powder can be done by drying [5]. Solid Drying means separating a small amount of water or other liquid from the solid, thereby reducing the residual liquid content in the solid to an acceptable value. Drying is usually the last process in operation series, and drying products are

usually ready to pack [6]. Drying is the process of reducing the moisture content of a material until it reaches a certain water content.

The basic of the drying process is water evaporation into the air because vapor content difference between the air and the dried material. In order for a dried material, the air must have a moisture or moisture content lower than the material to be dried [7].

Freeze vacuum dryer is a good dryer because drying with this method can maintain the quality of the results from drying so that the resulting product is a powder with a stable form and does not change color [8]. The production of CSM powder which is expected to be an alternative business that might be one of the solutions for people who lack nutritional intake.

## 2. EXPERIMENTAL PROCEDURE

### 2.1. Materials

The raw material is coconut with weight of 5 grams which is procced with water and separated into heavy and light product. The heavy product is procced into VCO and light product is procced into CSM.

## 2.2. Equipments

A prototype freeze vacuum dryer equipment consisting of compressor, vacuum pump, heating room, cooling room, fan, condensor, water trap, and electricity panel as shown in Figure 1.

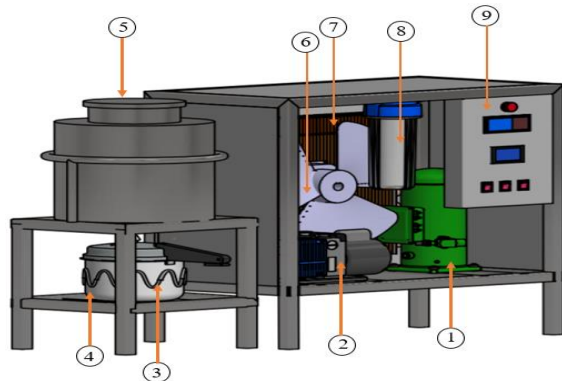


Figure 1. Freeze vacuum dryer prototype

## 2.3. Methods

VCO remaining water is turned to vacuum freeze dryer with specific weight. Drying is occurred in the batch process with temperature is maintained ( $-10^{\circ}\text{C}$ ) – ( $-25^{\circ}\text{C}$ ) in drying time of 12 - 13 hours.

## 3. RESULT AND DISCUSSION

The principle of freeze drying technology begins with the process of freezing food, and is followed by drying, namely removing / separating most of the water in the material that occurs through the sublimation mechanism. Vacuum freeze drying comprises of three stages, those are freezing, primary drying and secondary drying [9]. The freezing process in freeze drying occurs in a vacuum, where the pressure drop process is followed by the evaporation of water vapor through product surface.

### 3.1. Temperature Effect in drying process

#### 3.1.1. The Drying Temperature Effect on Water Content of Powdered Skim Milk

The determination of water content in food ingredients are needed, because the high water content contained, the more that food material will spoil quickly [10]. The water content analysis aims to measure the water content in coconut skim milk produced. The coconut milk skim solution in the liquid phase has a moisture content of 85.80% [11] and has a maximum water content of 5% for dry samples or powdered coconut skim milk products (SNI 2970: 2015). From the results of tests carried out based on the oven method with SNI No. 01-2891-1992, Water content in the sample of liquid coconut milk skim solution was 85.67%

and a range of 4.6% -6.5% for the water content in the resulting powdered coconut skim milk product. The difference in the water content of the powdered coconut skim milk product is still classified as normal, which is close to the standard range of water content of skim milk. The results of water content of coconut skim milk against powdered coconut skim milk are presented in Figure 2.

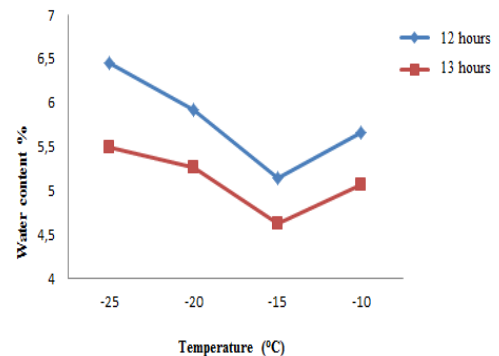


Figure 2. Drying Temperature Effect on Water Content of Powdered Skim Milk

Figure 2 shows that the water content in coconut skim milk is quite high in temperature  $-25^{\circ}\text{C}$ . This is because the vacuum pressure when the study was not maintained stable made the water content in the sample not evaporated optimally. However, this water content is still close to the water content standard for skim milk.

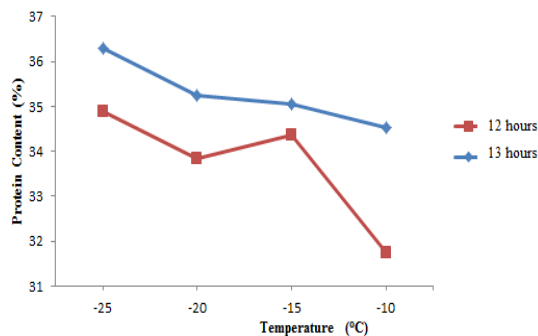
The figure also shows that the sample with the drying time of 12 hours has more water content than the sample with the drying time of 13 hours. So, from these data it can be seen that the longer the drying time, the lower the moisture content in the coconut skim sample. This is due to the water that initially is in the matrix of the coconut skim sample material sublimates with the length of drying time. The drying process condition is maintained below the triple point. If this condition is maintained, then water (ice) in food will continuously decrease through the sublimation process [12].

#### 3.1.2. The Drying Temperature Effect on Protein Content of Powder Skim Milk

Protein is an important nutrient that is useful for the formation of new cells in the body, influencing the work of enzymes, hormones, and immunity. Protein is a source of amino acids that contain elements of C, H, O, and N which are not owned by fat [2]. Analysis of protein content in coconut skim milk products aims to determine the suitability of protein content in the resulting powdered coconut skim milk products.

According to Barlina (2007) and SNI 2970: 2015, the protein content in skim milk is 35% and a minimum of 33%. Protein content analysis is carried out using the Kjeldahl method which is generally carried out by referring to the nitrogen content of the material being

analyzed. The results of the analysis of powdered coconut skim milk protein against drying temperature can be seen in Figure 3.



**Figure 3.** Drying Temperature Effect on Protein Content of Powdered Coconut Skim Milk

From Figure 3 shows that the protein content with a drying time of 12 hours is lower than drying time of 13 hours. This happens because during the drying process, water is released from the matrix of coconut milk skim material form. During the drying process, there is a water content that is bound to polar components, including protein [10].

When the sample is dried for 12 hours, the hydrogen bonds between water and protein are not completely released, so there is still immeasurable protein. Meanwhile, during drying for 13 hours, the more hydrogen bonds were broken between water and protein. So that drying for 13 hours has more measured protein content than drying for 12 hours. This is in accordance with the results of research which reveals that during drying of food, the loss of moisture in the material when drying will cause an increase in nutrient levels in the material [13]. In drying using the vacuum freeze dryer method, the drying temperature in the cold room with a relatively low temperature does not change the texture, taste, nutritional content, and color of these foodstuffs [14].

### 3.2. Drying Rates of Skim Milk Powder

The drying rate of wet solid material depends on the drying conditions, namely the drying air conditions for example temperature, humidity, air mass flow rate and the condition of dried material (surface area, volume, mass, density, initial moisture content and expected final moisture content after the drying process) [15].

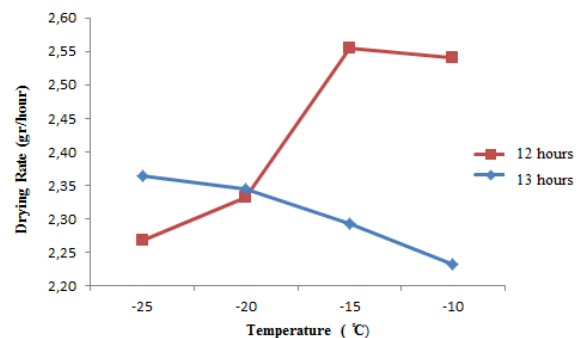
The drying rate in the drying process of a material describes how the drying speed takes place. The drying rate is expressed by the weight of water evaporated per unit dry weight per hour [16]. The mass drying rate formula [17] is stated:

$$R = \frac{W_0 - W_t}{t} = \frac{\Delta W}{t} \quad (1)$$

Information:

R = drying rate (gr / min)  
W0 = weight of the original material (gr)  
Wt = weight of final material (gr)  
t = time (hours)

From the data on the results of the drying process of powdered coconut skim milk that has been carried out, data processing can be carried out to obtain the value of the drying rate that occurs. The result of drying rate can be stated in Figure 4.



**Figure 4.** Drying Temperature Effect on Drying Rate of Powdered Coconut Skim Milk

The drying rate is the change in water content in the evaporated material per unit dry weight and per unit time. The drying rate is influenced by the moisture content of a material where the lower water content, the higher drying rate [18].

Figure 4 shows that a drying time of 13 hours in the -10 °C, the drying rate is lower than others. It is because the smaller drying temperature, the faster sublimation process will occur so that the more water content is lost which will accelerate the drying rate of powdered coconut skim milk.

However, in drying time of 12 hours at a temperature of -25 °C and -20 °C, that products should have shown a high drying rate actually showed a low drying rate. This is because the vacuum pressure at the beginning of the experiment tends to be unstable which makes the pressure drop quickly as previously described. The large vacuum pressure driving force for diffusion increases, making it easier for water vapor molecules from the material to escape [19]. The large vacuum pressure increases the sublimation process of moisture from the coconut skim milk sample and the time required for drying is also shorter. So, the smaller or lower the vacuum pressure, the slower the drying rate of the coconut skim milk will be.

## 4. CONCLUSION

Conclusions from this research are

1. The higher drying temperature, the higher water content, and the lower protein. The highest levels protein was at the drying time for 13 hours with a drying temperature of  $-25^{\circ}\text{C}$ , namely 36.28% with water content contained in the CSM of 5.49%.
2. The lower drying temperature, the higher drying rate. The drying rate obtain 2.53 – 2.54 gram per hour in every drying times and temperatures.

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