Effects of temperature and duration of drying on the quality of powdered *Asam sunti*

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Abstract. Generally, Acehnese use *asam sunti* as a spice in cooking. *Asam sunti* is made from dried *belimbing wuluh* (*Averrhoa bilimbi* Linn), it has a flat shape with brownish colour. To increase the aesthetic value, ease of storage, and maintain its quality, *asam sunti* is produced in powder form. The quality of *asam sunti* is determined from several parameters such as water content, ash content and oxalic acid content. The powdered *asam sunti* was prepared by using Tray and Spray Dryer. The effects of temperature and duration of drying on the quality of *asam sunti* have been studied. Aesthetically, it is seen that the powdered *asam sunti* has better appearance than that of the original form. The water, ash and oxalic acid contents in the powdered *asam sunti* dried using a spray dryer was lower than that of dried by tray dryer. The optimum temperature was obtained at 80 ºC. The optimum drying time were 45 minutes and 3 hours for spray and tray dryer, respectively. Water, ash and oxalic acid contents in optimum condition with tray dryer were 49.7%, 26.3% and 10.4%, consecutively. Meanwhile, by using spray dryer, the product has higher quality in terms of water content (4.7%), ash content (14.25%) and oxalic acid level (9.48%).

1. Introduction

Drying is a process of removing moisture from the material to improve the quality and shelf life of the product. Drying process has been applied to food preservation since centuries ago. The aim of drying a food product is to reduce the water content in the food to a safe limit to the increase shelf life of the product and to provide microbiological stability and reduce food damage caused by chemical reactions [1]. Moreover, by the drying process, the products are expected to have similar level of moisture [2].

In the food and vegetable industries, powdered product provides advantages such as reducing packaging expenditure, facilitating storage and transporting, and more stable than liquid products [3]. Some researchers have applied drying process to obtain powdered end-products, for example, *sinteractive thoria* powder which obtained by using freeze drying method and microwave drying [4], powdered milk by using drum dryer [5], and kimchi powder by spray dryer [6].

*Belimbing wuluh* (*Averrhoa bilimbi Linn*) is well known in Indonesia because it has sour taste and a distinctive aroma, it is often used in cooking [7-8]. In Aceh, people use or cultivate bilimbi into semi-
dried salty bilimbi or commonly known as asam sunti. Asam sunti is widely used by the people of Aceh as one of cooking spices as it provides distinct sour flavor, color and increase thickness to cuisine. Prior to usage as a spice, asam sunti has to be milled because it is still in a semi-dried form. The resulting asam sunti is brown with elastic texture and flat-shaped form as shown in Figure 1.

As seen in Fig.1, the shape and appearence of asam sunti seems less attractive. Increasing the aesthetics of asam sunti can be done by changing its texture into powder by drying. Besides increasing the aesthetic value, drying can also prolong the shelf life of asam sunti, enhance portability, as well as achieve uniform structure and quality of the product. In addition, the economical value of powder asam sunti can be increased and can be recognized by all Indonesian people outside Aceh. In this study, the powdering process of asam sunti was done by drying technique using Tray Dryer and Spray Dryer. The influence of operation conditions such as drying time and drying temperature to the quality of asam sunti i.e. water content, ash content and oxalic acid content are studie. Besides, this research also aims to find the optimal condition of the research variables performed on both methods of drying.

2. Methods

2.1. Materials
The materials used were fresh belimbing wuluh which obtained in the vicinity of Banda Aceh city. Kitchen salt was used as asam sunti preservative. NaOH 0.1 N was used as a standard solution for the analysis of oxalic acid level, Phenolph talein indicator was used as an indicator solution in titration process. Maltodextrin was used as a filler on drying with Spray Dryer. All of those three compounds were purchased from Merck. Whatman filter paper was used as a solution filter. The tool used were blender, analytical scales, oven, Tray Dryer (DSR-115, ISUZU SOYOKAZE), Spray Dryer (Leybold Didactic, Germany), desiccator, blast furnace, electric bath, titration equipment, petri dish, porcelain cup, clipping cup, volume pipette, glassware, filter paper, plastic and bucket.

2.2. Preparation of asam sunti
A total of 10 kg fresh belimbing wuluh was washed and weighed. Belimbing wuluh was blanched for 5 minutes in boiling water, then it was dried on the floor with plastic on its surface for ± 8 hours, allowed overnight then re-dried for another ±8 hours. Following that, the dried belimbing wuluh was put in a plastic container and sprinkled with salt. It was then settled for 1 night, and dried again for ± 8 hours. Asam sunti was obtained when the dried belimbing wuluh turned into brown color.
2.3. Fabrication of powdered asam sunti

Asam sunti which was produced from 10 kg of belimbing wuluh was cut into small pieces, and blended to form an asam sunti paste. 100 gram of generated asam sunti paste was weighed then dried with two different drying methods i.e. using Tray Dryer and Spray Dryer. The quality of powdered asam sunti was analyzed in terms of water, ash, and acid content.

2.4. Quality analysis of product

The water, ash and oxalic acid content were analyzed to evaluate the quality of the resulting asam sunti powder. Water content was analyzed by following SNI 01-2891-1992 point 5.1. Meanwhile, the analysis done for ash content was using SNI 923.03 AOAC 1998. As for the oxalic acid, the analysis was done by using acid base titration method.

3. Results and Discussion

The success of a drying process can be confirmed from the reduction of the water content to the nonstick grain level, or in other words, all the feed (liquid or paste) can be converted into powder. Figure 2 shows the asam sunti powder dried with tray and spray dryers. In general, the powdered asam sunti which produced with both drying methods are slightly brownish. The size of the powder produced by Spray Dryer is seemed to be more uniform and finer compared to that of with the tray dryer.

![Figure 2. Powdered Asam sunti dried by (A) : Tray Dryer, (B) : Spray Dryer](image)

3.1. Effect of temperature and drying time on water content in powdered asam sunti

Water content is one of the chemical properties which indicates the amount of water in the food. It has effect on enzyme and microbe activities which cause organoleptic change and nutritional value [9]. Water content is very influential on the quality of food, therefore, during food processing, water is usually issued or reduced by evaporating or thickening and drying. Reduced moisture level can increase resistance to damage and can preserve food [10]. In addition, drying make material become more durable, as well as reducing volume of foodstuffs to facilitate storage and packing space.

The drying process of Asam sunti involves heat and mass transfer. Heat transfer occurs from the heating medium (air) to the asam sunti paste. Simultaneously, mass transfer of the paste into the air also occurred. The consequence of mass transfer event is the decrease of water content of asam sunti paste thus it will become asam sunti in the powder form. The reducement of water content due to drying is shown in Figure 3. The water content of asam sunti paste is originally 70.59%, and reduced to 30.85% after drying using tray dryer, and down to 4.29% by spray dryer. The water content decreases with the increase of drying air temperature (from 50-90 °C). This is due to the increased amount of water evaporated into the air.
3.2 Effect of temperature and drying time on ash content in powdered asam sunti

Ash is a residual inorganic substance resulted from combusting an organic material. The ash content is related to the minerals of a material consisting of two types of salt, namely organic salts (i.e. salt of malic acid, oxalate, acetate, pectate) and inorganic salts (i.e. salts in the form of chloride, phosphate, carbonate, sulfate and nitrate) [12]. Ash content is a property that shows the total amount of minerals in a food product [9]. The ash content of asam sunti paste before dried is 14.91%. Increasing the drying temperature increased ash content in asam sunti powder. As shown in Figure 4., the drying results show that the lowest ash content in asam sunti powder sample is 14.82% for that dried by tray dryer, while the ash content of the spray-dried sunti sample is lower than that of original sample content, namely 6.33%.

3.3 Effect of Temperature and Drying Time on Oxalic Acid Level in Powdered Asam Sunti

Oxalic acid is a natural constituent of plants which usually ingested by animals and human [13]. When plants or foods containing oxalic acid are consumed by human, it will induce bad effects on health because oxalate has the capability to bind calcium and other minerals. Excessive consumption of oxalic acid can lead to stone formation in the urinary tract when acid is excreted in urine. That is why
Asam sunti with high level content can cause kidney stones in the human body [14]. Therefore, the oxalic acid level present in asam sunti is expected to be as low as possible. The relationship between temperature and duration of drying and oxalic acid level in powdered asam sunti can be seen in Figure 5.

Figure 5. Effect of temperature (A) and long drying (B) on oxalic acid levels on powdered asam sunti

Figure 5 shows the increment tendency of oxalic acid level with increasing temperature and duration of drying. This is caused by the hardening of the outside skin of dried fruit hence organic acids are trapped in it [15]. Moreover, the higher the drying temperature and the longer the drying time will decrease water content and will increase the mineral content in a material [11]. Drying with Tray Dryer gives a lower oxalic acid than drying with Spray Dryer. The results show that the lowest oxalic acid level in the asam sunti powder is 10.41% for the sample dried by Tray Dryer, whereas the oxalic acid content in asam sunti dried by Spray Dryer is much lower than the original sample content level, namely 9.48% with drying time of 0.75 hours or 45 minutes.

4. Conclusion
Asam sunti is one of main cooking ingredients for the people of Aceh. To facilitate the storage and enhance the aesthetic of asam sunti, which commonly flat, chewy, and brown, it had been made into powder by using a Tray Dryer and Spray Dryer drying methods. It has been confirmed that, the temperature and duration of drying affect the quality of asam sunti obtained. Drying with Tray Dryer gives the lowest water content at 30.85% while Spray Dryer can decrease water up to 4.29%. For ash content, drying with Spray Dryer produces lower ash content than Tray Dryer. The oxalic acid content of the lowest powdered asam sunti is obtained at 9.48%. This value is obtained with operating conditions of 80 °C and 45 minutes long.

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