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Physical-Chemical Quality of Onion Analyzed Under Drying Temperature

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Abstract. Drying is one of conventional processes to enhance shelf life of onion. However, the active compounds such as vitamin and anthocyanin (represented in red color), degraded due to the introduction of heat during the process. The objective of this research was to evaluate thiamine content as well as color in onion drying under different temperature. As an indicator, the thiamine and color was observed every 30 minutes for 2 hours. Results showed that thiamine content and color were sensitvely influenced by the temperature change. For example, at 50^{o}C for 2 hours drying process, the thiamine degradation was 55.37 %, whereas, at 60^{o}C with same drying time, the degradation was 74.01%. The quality degradation also increased by prolonging drying time.

INTRODUCTION

Onion (*Allium Cepa*) is a strong-flavored potential vegetable widely used as food seasoning or medicine. It is the largest vegetable cultivated, produced and consumed in the world [1]. The color and nutrient content of the onion are the most important quality attributes affecting the degree of acceptability of the product by the consumer [2]. Most of fresh agricultural products contain high moisture ranging 70% - 90% (wet basis) [3]. In example, after harvesting, onion has high initial moisture content rounding 88%. So, onion is perishable vegetable due to spoilage easily by organisms, enzymes, and vinegar flies [4].

The drying is useful to keep the outer layer of onion being dry for protecting the inside part from spoilage. Thus, the shelf life of onion can be longer. Drying is generally defined as the removal of moisture by introduction of heat. The process yields the product (supposed agriculture crops) with preferable moisture content for inhibitting micro bacteria activiy [3, 5, 6]. The sunlight drying is one of the most common methods for drying vegetable products. The drying is simple and low energy cost [7, 6]. Meanwhile, the convective drying using combustion of fuel or electricity was more reliable in term of moisture content in product. However, with the incease of operational temperature, most of the important ingredients deteriorated [4, 8]. Thus, the major challenge during drying of food materials is to reduce the moisture content of the material to the desired level without substantial loss of product quality such as flavor, taste, color and nutrients [9].

Onion has an organic volatile compound and other chemical and biological compounds such as vitamins and antioxidant. One of vitamins in onion that important role in carbohydrate and energy metabolism is thiamine [10]. Thiamine is very heat-sensitive vitamins. So, it can be lost in drying process [11]. In addition, drying also changes the color of onion. Product color is the other quality parameter that needs to be maintained during onion drying.

Color is one of the most important qualities affecting its visual appearance. The deterioration of color during drying has a negative impact on its acceptability [12, 13]. Chemical changes that occur during the drying process, resulted the variations in color [7]. During drying, the browning reactions occured corresponding to the fluctuating temperature and moisture levels [14]. The higher the temperature, the higher it affects the rate of non-enzymatic browning reaction [15]. So, the drying conditions are to be optimized to retain maximum product quality, besides considering the process economics [16].

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The objective of this research was to the quality deterioration in terms of thiamine content and color of onion undergoing convective drying at various temperatures. The information obtained could be meaningfull to finding proper drying condition in order to minimize the quality deterioration.

MATERIALS AND METHODS

Materials

Fresh onions called *Bima* variety provided from a local farmer Central Java Indonesia were selected and cleaned from dust and soil. The initial moisture content in onion analyzed by gravimetry was 89.97% (wet basis, close to moisture ratio of 9 (dry basis). To support the study, thiamine hydrochloride standard (purity 99.0% p.a), hydrochloric acid (purity 37.0% p.a), sodium acetate (purity 99.5%), sulfuric acid (purity 98.0% p.a) and methanol (Nano grade purity 95.0%) were obtained from Merck Germany.

Convective Drying in Onion

The onion drying were conducted in a laboratory tray dryer under various temperatures. Drying temperatures of 40°C, 50°C, 60°C and 70 °C were operated for 2 hours under at air velocity of 7 ms^{-1}. The moisture content in onion, were measured by gravimetry every 30 minutes for 2 hours. Meanwhile, the color change and thiamine content were observed every 30 minute using High Performance Liquid Chromatography and Chroma Meter, respectively. The data were used to evaluate physical-chemical quality of onion under various temperatures.

Color Analysis

Color change of onion was analyzed by Minolta Chroma meter CR 400 Color meter (KONICA MINOLTA SENSING INC, Japan). The color meter was calibrated using a standard calibration plate of a white surface and set to CIE Standard Illuminant C. The response parameters on the scale were L*,a* and b*. The color brightness coordinate L* measures the whiteness value of a color and ranges from black at 0 to white at 100. The chromaticity coordinate a* measures red when positive and green when negative, and chromaticity coordinate b* measures yellow when positive and blue when negative [7]. Color change from each material (fresh or dried at 40, 50, 60, or 70°C) was analyzed by Chroma Meter. The fresh and dried onion was placed above the light source and covered with a white plate and L, *a*, *b* values were recorded. The L*, a*, b* values are average of 5 reading.

Thiamine Analysis

The thiamine content in onion was analyzed by high performance liquid chromatography (HPLC) (LC 10AT, Shimadzu, Japan) [17]. The measurement were analyzed at ambient temperature in triplicate using a C18 (ODS) column (5µm x 30cm, Shimadzu) with an UV detector set at 254nm. Concentrations of thiamine in analyzed samples were determined by calibration curve method. Based on the peak areas corresponding to the retention time of 8.5 min, the concentration was calculated from the standard curve as mg/ml on moisture free basis. For the analysis of thiamine, 5 gram onion were transferred a 100 ml beaker containing 50 ml H_2SO_4 0.1 N to be sample. Sample was heated using autoclave for 30 minutes with 15 psig pressure. After that, it was cooled and put under pH = 4.5 with by adding 2 M Na-acetate. Sample was made up to 100 ml using aquadest and filtered using Minisart RC 15 Membrane. 10 µl of the filtrate were injected in the U6K Loop Injection in HPLC. Thiamine was read from a standard curve prepared using standard thiamine in the range 0 ppm – 800 ppm. Concentration of thiamine was analyzed as described above [18].

RESULT AND DISCUSSION

Convective Drying of Onion

This research studied the effect of convective drying of onion using tray dryer under various drying time and temperatures. The onion dried at 40°C, 50°C, 60°C and 70°C were observed at 2 hours respectively. The decreasing moisture content of onion at the current drying time, was observed under various drying temperatures as presented in Fig 1. Based on this research, the moisture removal was strongly effected by temperature. For example, at the same time during the drying, the moisture content of onion at 70°C was lower than that of 60°C or below. It implied that higher temperature reduced drying time.

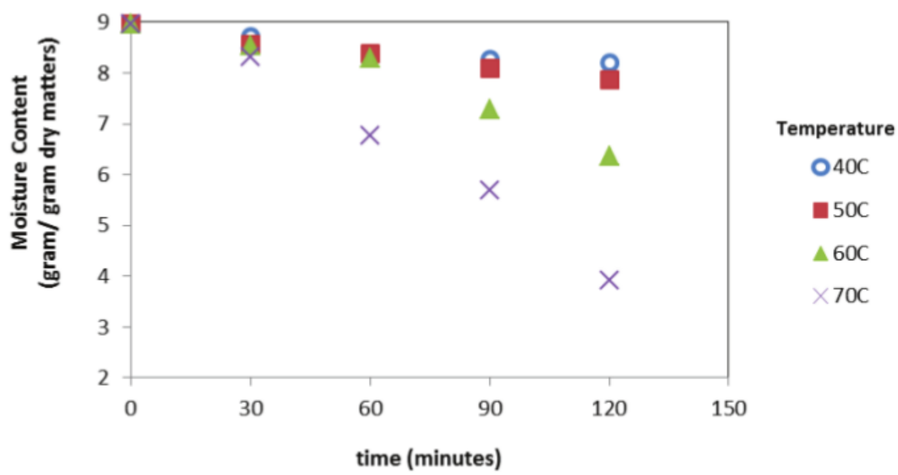

FIGURE 1. Moisture content removal under various drying time and temperatures.

Color Quality during Onion Drying

Color is one of the most important qualities that first observed by costumer. The change of color during drying has a negative impact on its acceptability [12, 13]. Therefore, the study about color change of food has high interest. Most of studies were observed color degradation of onion slice during drying. Beside on drying of onion slice, the outer layer of post-harvest onion as raw material was also dried before stored in market to prevent the inside part of onion from spoilage by microorganism. Thus, color change of onion as raw material during drying was the important aspect.

This research observed the color change on the outer layer of onion during the drying. The color change on the outer layer of onion was measured by Chroma Meter with three parameters valued recorded in terms of L (lightness), a (redness and greenness) and b (yellowness and blueness). Based on this research, red color on the outer layer of onion changed to be brown during drying showed in both *a* and L values. In contrast, the *b* value reduced as indicated that the colour change to be browness. The browning was significantly affected by temperature and drying time. Similar research have been observed by Ahmed and Shivhare [19] in onion paste, they have reported that optimal combinations of three parameters L, *a*, *b* as the total color change was L*a/b*. The value of La/b change corresponding to the drying time and temperature, was illustrated in Fig. 2.

Fig. 2 also showed that total color in onion after drying was different from the fresh material. Based on Fig. 2, it can be known that total color change at 60°C lower than at 70°C at the same time. The total color difference in La/b combination between the fresh and dried material at various drying time depended on the drying temperature.

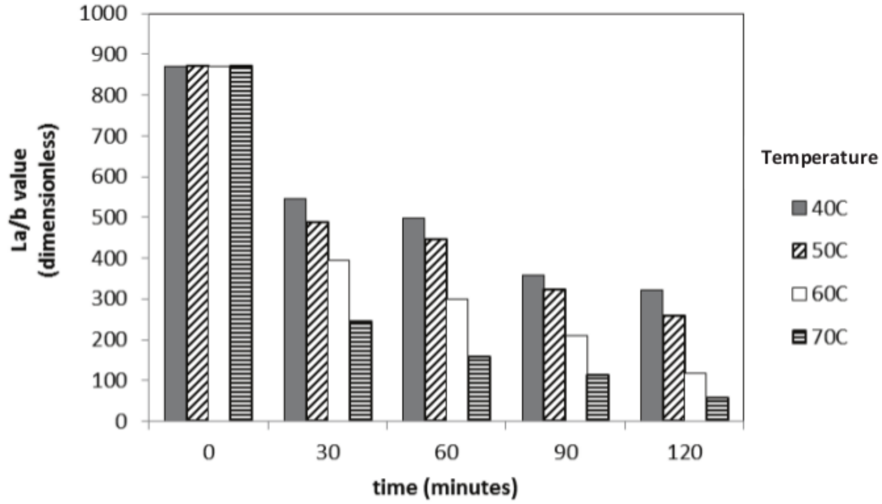

FIGURE 2. Color change of onion during drying under various temperatures and drying time

Thiamine Content in Onion

The percentage of thiamine content during drying under various drying time and temperatures were depicted in Fig. 3. The drying process degraded the compoud because of thermal influence. Based on Fig. 3, it can be known that thiamine content during drying decreased by temperature and drying time. The higher temperature and or/ longer drying time, the reduction of thiamine content was greater. In example after 1 hour drying process under 50^{o}C, the thiamine retention was about 65% (35% degraded). When the drying time extended up to 2 hours, the thiamine retention was around 45% (55% degraded). The retention was lower at higher drying temperature (suppose at 60^{o}C or upper).

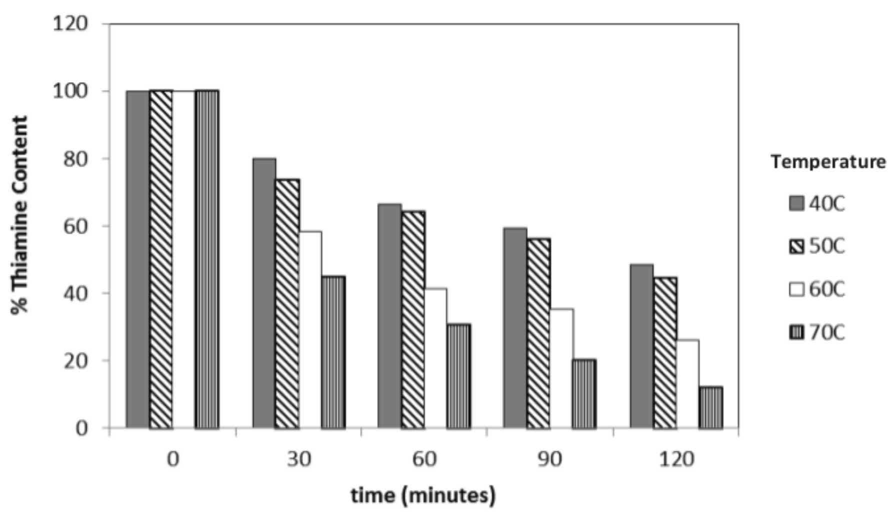

FIGURE 3. The percentage of thiamine content during drying under various drying time and temperatures

CONCLUSION

The onion was dried under different temperatures and drying times. The moisture content removal increased with increasing of air temperature and extending drying time. On the other hand, the quality of onion degraded as shown in colour change and lower thiamine retention. This bottleneck result was meaningful to select the favorable condition for onion drying.

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