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Effectiveness of Temperature and Drying Time on the Quality of Red Chili Powder (*Capsicum annum* L.)

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ABSTRACT

The purpose of this study was to examine how temperature and drying time affect the quality of red chili powder. This study took place from December 6 to 21, 2023, at Almuslim Peusangan-Bireuen University's Mathematics and Natural Sciences Laboratory. This study used factorial RAL. There were two factors studied: temperature (S1 = 50°C, S2 = 60°C, and S3 = 70°C) and drying time (P1 = 5 h, P2 = 6 h, and P3 = 7 h). This study's findings include organoleptic tests, moisture content, and yield. The results showed that the temperature treatment at 70°C had a very significant effect on the moisture content of red chili powder, with a moisture of 7.91% and meeting the SNI requirements for dried chili moisture of 11%, but the treatment had no significant effect on the moisture of red chili, yield, or organoleptic test. The drying time treatment had no significant effect on the moisture content of red chili, the moisture content, the yield, and the organoleptic test; however, the 7-h drying time treatment had the highest percentage of the moisture content of red chili and red chili powder, as well as the lowest yield. The organoleptic test on red chili powder treated at 500°C with a drying time of 7 h had the highest color score, namely 3.68 an average score, and the highest aroma score, namely 3.58 with the category of quite like.

Keywords: chili powder, drying time, red chili, temperature

INTRODUCTION

Horticultural crops include a wide variety of crops such as vegetables, fruits, and ornamental plants. Red chilies are one of the most frequently farmed horticulture commodities in Indonesia, owing to the continually rising demand for them. According to Central Statistics Agency (BPS) data, per capita red chili consumption in Bireuen Regency reached 0.059 kg per week in 2022, with the demand increasing year after year. Red chili peppers are a shrub-like plant from the eggplant family that produces spicy fruit, have a significant nutritional value, with calories, protein, fat, carbohydrates, calcium, and vitamin C. Red chili peppers are needed for households and industry (Rindani 2015). Red chili peppers have gained popularity due to their strong economic worth. Demand for red chili peppers rises year after year, reflecting the expanding population and the development of companies that rely on red chili peppers as raw materials. However, red chili peppers are difficult to keep fresh (they easily deteriorate), especially in humid situations. Preserving red chili peppers by drying is an appropriate post-harvest technology solution for storing them for an extended period.

Drying red chilies is an alternative to excessive red chili output. There are two methods for drying red chilies: traditionally and using mechanical instruments. Drying conventionally using direct solar heat has the disadvantage of being highly dependent on weather conditions. Furthermore, the quality of dried chilies cannot be guaranteed. Oven drying can accelerate the rate of water evaporation in the material due to the consistent temperature. External contamination is also reduced because drying occurs in an enclosed location. The higher the drying temperature, the faster the water evaporates from the surface. However, if it hardens, this does not imply that the dried product is of high quality (Irfan *et al*. 2021). Before being used as a condiment in food, red chilies are often dried and ground into chili powder. Dried red chilies are ground into chili powder to make them more handy and ready to eat. Red chili powder consumption is on the rise as customers tastes for ready-to-eat dishes shift (Maflahah 2010).

Red chili powder is a more processed version of dried red chilies. Dried red chiles are pounded into a powder during this processing method, a substance that is easier to keep than raw red chili. This powdered substance has very fine particles (Sudaryati *et al*. 2011). Increasing the drying time and temperature reduces the moisture content of red chilies, resulting in an increase in the solid weight of the powder. Increasing the weight of the chili powder results in a larger capsaicin concentration, giving the chili powder

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a spicier taste than raw red chilies. According to Hasrayanti (2013), capsaicin is particularly sensitive to heat conditions; the temperature and drying time employed to reduce moisture content have a significant impact on the loss of capsaicin concentration in red chilies. Capsaicin in red chilies is soluble in fat but insoluble in water, and it is rapidly destroyed by high temperatures due to oxidation.

To achieve high-quality chili powder, correct drying temperature and duration are essential. Drying at high temperatures speeds up the drying process, however it often degrades the nutritional value of dried red chilies. Low temperatures cause longer drying times. Based on these difficulties, the purpose of this study was to determine and assess the influence of proper drying temperature and duration on the quality of red chili powder.

METHODS

Place and Time

This work was carried out From December 6 to 21, 2023, at Almuslim Peusangan-Bireuen University's Mathematics and Natural Sciences Laboratory.

Tools and Materials

This study's tools include knives, blenders, basins, spoons, ovens, desiccators, porcelain dishes, Petri dishes, sieves, digital scales, gloves, and cameras. The materials utilized in this study are curly red chilies, aluminum foil, cassava paper, label paper, and plastic clips.

Procedure

This experiment used a Completely Randomized Design with a Factorial pattern of two factors.

Temperature and drying time were investigated at three different treatment levels. Factor 1: temperature (S): 50°C, 60°C, and 70°C. Factor 2: drying time (P) P_1 = 5 h, P_2 = 6 h, and P_3 = 7 h. Each treatment combination was tested in triplicates using, with a total of 27 experimental units. The collected data were statistically evaluated using analysis of variance (ANOVA). If the F result influenced the treatment, another BNT test was performed (Steel & Torrie 1995) using a significance level of 0.05.

RESULTS AND DISCUSSION

Moisture Content

The analysis of variance table reveals a significant ($P<0.01$) effect of drying temperature on the moisture content of red chili powder. The drying time treatment showed no significant effect on the moisture content of dried red chili powder or dried red chili. Table 1 shows the average moisture content of dried chilies, the moisture content of red chili powder, and the yield of red chili powder as a function of drying temperature and drying time. The drying temperature treatment has a substantial effect on the moisture content of red chili powder but not on the moisture content of dried chili. The percentage of moisture content in dried red chili powder is lowest at 70°C (S3) with a drying time of 7 h (P3) and greatest at 50°C (S1) with a drying time of 5 h (P1). This demonstrates that as the temperature and drying time increases, the moisture content decreases with the use of heat energy. Drying temperature has an impact on moisture content and yield because water evaporates and diffuses through the surface into the air. The amount of water in food impacts its freshness and shelf life. High moisture content promotes the growth of bacteria, mold, and yeast, resulting in dietary modifications (Winarno & Wirakartakusumah (2018).

The longer a substance is dried, the more water evaporates Lubis (2018). The moisture content of the product reduces during the manufacturing process, resulting in a lower yield (Susinggih *et al*. 2015). The moisture of red chili powder in the drying time treatment fulfills the SNI standard quality standards because it reaches the prescribed value, which is a maximum moisture content of 11%, although the moisture content

Table 1 Moisture content of dried chilies, red chili powder, and effect of drying temperature and drying time

Treatment	Test			Average
	I	II	III	
S1P1	14.80	13.18	10.31	12.76
S1P2	14.80	9.94	12.71	12.48
S1P3	13.89	10.43	11.25	11.85
S2P1	10.45	11.55	9.40	10.46
S2P2	15.67	10.23	9.83	11.91
S2P3	13.50	9.47	12.09	11.68
S3P1	14.17	10.88	12.87	12.64
S3P2	13.70	8.11	9.04	10.28
S3P3	11.15	8.04	6.84	7.91

Remaks: S1P1 = drying temperature 50°C and drying time 5 hours, S1P2 = drying temperature 50°C and drying time 6 hours, S1P3 = drying temperature 50°C and drying time 7 hours, S2P1 = drying temperature 60°C and drying time 5 hours, S2P2 = drying temperature 60°C and drying time 6 hours, S2P3 = drying temperature 60°C and drying time 7 hours, S3P1 = drying temperature 70°C and drying time 5 hours, S3P2 = drying temperature 70°C and drying time 6 hours, and S3P3 = drying temperature 70 °C and drying time 7 hours.

produced in red chili powder in this study is on average less than 11%. Rosidin *et al*. (2012) found that moisture content reduces as drying time increases. This is because longer drying times result in more water evaporation, making the product drier.

Drying is a technique for removing some of the water from a material by evaporating it with heat energy (Riansyah 2013). In this investigation, temperature treatments at 50°C and 60°C are still not ideal. Each treatment still contains enough water to be turned into dried chilies. Red chilies and red chili powder with a high moisture content cannot be stored for too long because the risk of rotting and mold growth remains high. This is because the water activity of food ingredients increases with temperature, which is caused by water activity during drying, where the moisture content decreases in line with the temperature and drying time (Endrasari *et al*. 2018). The moisture content of dried chilies and chili powder that meets the SNI standard quality requirements is limited to 11%. Suyanti (2017) discovered that a drying temperature of 700°C considerably reduced the moisture content in chiles.

Yield

The analysis of variance table indicates that the drying temperature and time treatments had no significant influence (P<0.01) on the production of red chili powder. Table 2 shows the average yield of red chili powder due to different drying temperatures and times. The temperature and drying time treatments had no significant effect on red chili powder yield, however there was a variation between treatments. The lowest percentage of red chili powder yield was obtained in the temperature treatment of 70°C (S3) with a drying time of 7 h (P3), while the greatest was found in the temperature treatment of 50°C (S1) with a drying time of 5 h (P1). This demonstrates that when the temperature rises, the yield decreases due to the need

Table 2 Yield of red chili powder due to drying temperature

Treatment	Test			Average
	I	II	III	
S1P1	18.73	19.25	15.41	17.79
S1P2	17.00	14.60	9.27	13.62
S1P3	13.30	14.01	10.60	12.63
S2P1	19.73	10.07	11.15	13.65
S2P2	15.07	13.67	15.25	14.66
S2P3	14.00	12.13	14.13	13.42
S3P1	12.73	8.27	11.87	10.95
S3P2	15.13	15.70	12.53	14.45
S3P3	12.07	13.50	11.50	12.35

Remaks: S1P1 = drying temperature 50°C and drying time 5 hours, S1P2 = drying temperature 50°C and drying time 6 hours, S1P3 = drying temperature 50°C and drying time 7 hours, S2P1 = drying temperature 60°C and drying time 5 hours, S2P2 = drying temperature 60°C and drying time 6 hours, S2P3 = drying temperature 60°C and drying time 7 hours, S3P1 = drying temperature 70°C and drying time 5 hours, S3P2 = drying temperature 70°C and drying time 6 hours, and S3P3 = drying temperature 70 °C and drying time 7 hours.

Table 3 Organoleptic of red chili powder based on color due to drying temperature and drying time treatment

Treatment	Test			Average
	I	II	III	
S1P1	4.14	3.05	3.37	3.52
S1P2	3.71	2.94	3.65	3.43
S1P3	4.06	4.65	3.57	2.68
S2P1	3.17	3.34	3.14	3.21
S2P2	3.09	2.77	3.77	3.21
S2P3	3.22	3.71	3.03	3.32
S3P1	3.20	3.08	3.17	3.15
S3P2	2.51	3.37	2.94	2.94
S3P3	3.11	3.31	3.34	3.25

Remaks: S1P1 = drying temperature 50°C and drying time 5 hours, S1P2 = drying temperature 50°C and drying time 6 hours, S1P3 = drying temperature 50°C and drying time 7 hours, S2P1 = drying temperature 60°C and drying time 5 hours, S2P2 = drying temperature 60°C and drying time 6 hours, S2P3 = drying temperature 60°C and drying time 7 hours, S3P1 = drying temperature 70°C and drying time 5 hours, S3P2 = drying temperature 70°C and drying time 6 hours, and S3P3 = drying temperature 70 °C and drying time 7 hours.

Table 4 Organoleptic of red chili powder aroma due to combination of temperature treatment and drying time

Treatment	Test			Average
	I	II	III	
S1P1	3.77	3.22	3.82	3.60
S1P2	3.17	3.42	3.45	3.34
S1P3	3.22	3.25	3.06	3.17
S2P1	3.14	3.34	3.09	3.19
S2P2	3.68	3.82	4.82	3.58
S2P3	3.31	3.80	2.94	3.35
S3P1	3.00	3.20	3.25	3.15
S3P2	3.00	3.28	3.62	3.30
S3P3	3.94	3.05	3.17	3.38

Remaks: S1P1 = drying temperature 50°C and drying time 5 hours, S1P2 = drying temperature 50°C and drying time 6 hours, S1P3 = drying temperature 50°C and drying time 7 hours, S2P1 = drying temperature 60°C and drying time 5 hours, S2P2 = drying temperature 60°C and drying time 6 hours, S2P3 = drying temperature 60°C and drying time 7 hours, S3P1 = drying temperature 70°C and drying time 5 hours, S3P2 = drying temperature 70°C and drying time 6 hours, and S3P3 = drying temperature 70 °C and drying time 7 hours.

for heat energy to evaporate the water, as well as the longer drying time.

Drying temperature can affect moisture content and yield because water evaporates and diffuses through the surface into the air. According to Muchtadi *et al*. (2019), the longer a material is dried, the lower its yield and moisture content. Furthermore, Ramadan (2023) found that the loss in yield and moisture content is due to water evaporation during the wilting and drying processes. These figures are based on the original weight of the chili powder, which means that after the drying process, the final weight of the chili powder is reduced by around 70%. The less water in the processed chili, the lower the yield produced. The drying temperature at which the material is dried determines the resulting yield (Taufiq 2014). The higher the drying temperature, the lower the moisture content and weight of the material, resulting in a lesser yield.

Color

Organoleptic testing involves observing a food's color, taste, and scent. Organoleptic testing relies on the human senses to serve as panels. 35 panelists, including color indicators, conducted sensory tests on red chili powder after drying at various temperatures. The analysis of variance revealed that varied drying temperature treatments had a significant influence (P<0.01) on color. The average color findings are shown in Table 3. The temperature and drying time treatments had a substantial impact on the color of red chili powder based on the color and aroma in the criteria of liking the outcomes of chili powder at a temperature of 50°C (S1) and a drying time of 7 h (P3), received the highest color score of 3.68 (very liked). This suggests that most panelists preferred the color in treatment S1 with P3 above the color in the other treatments, and based on the preference criteria, the three red chili powder samples scored quite liked.

The color of chili powder has a considerable impact on the appeal and taste of food. Color in food is an artificial element that is difficult to quantify, resulting in varying opinions of its color quality. Individuals' color assessments differ due to differences in eyesight and taste. In this study, organoleptic examination of the color of red chili powder by panelists revealed that treatments S1 and P3 received the highest marks. According to Mahanom *et al*. (2019), temperature and drying time affect color changes, which influence consumer judgments. Widodo (2016) discovered that if the temperature is too high and the drying period is too long, the color of the chili powder darkens.

High temperatures will degrade the carotenoid pigment concentration, darkening the color of the chili powder. Carotenoids are extremely sensitive to heat, particularly at high temperatures, and are quickly harmed by it. Drying chili powder for an extended period might result in the loss of essential oils, as well as changes in spiciness and color (Yuliana *et al*. 2019).

Aroma

The organoleptic aroma test is an organoleptic test that concentrates on aroma detection. In this study, 35 panelists assessed the sensory properties of red chili powder dried at various temperatures using scent as an indicator. The analysis of variance revealed that varying drying temperatures had a significant influence on aroma. The average scent results are shown in Table 4. The different drying treatment temperatures have no significant effect on the aroma color of red chili powder, as evidenced by the scores of the three treatments in the organoleptic test on the aroma color of red chili powder, based on the aroma criteria of liking the results of chili powder at a temperature treatment of 60°C (S2). A drying duration of 6 h (P2) yielded the highest scent score, 3.58 (very liked). This demonstrates that most panelists preferred the aroma of chili powder in treatments S2 and P2 over the aroma in other treatments, and based on the preference criteria, the three red chili powder samples met the requirements for being quite liked.

The aroma of food is generated by the ingredients used in the production of red chili powder; each ingredient will work together to provide a particular aroma in red chili powder (Khairina *et al.* 2020). In this study, panelists' organoleptic tests of the aroma of red chili powder yielded the best score for treatment S2.

When inhaled, the findings of the organoleptic test on the aroma of red chili powder were like those of all other treatments. This is because all treatments have the same amount of basic chemicals. This red chili powder has a distinct aroma that is similar to that of spices. Aroma is a difficult smell to quantify, therefore differing assessments or perspectives on reaching aroma quality are common. This is because the capsaicin level in red chili degrades after drying (Renate *et al*. 2014). This variation in opinion can be attributed to each person's unique sense of smell; while everyone can differentiate aroma, each person has different preferences (Arifin 2020).

CONCLUSION

The treatment at 70°C and 7 h of drying time had a very significant effect on the moisture content of chili powder, with the lowest analysis result obtained being 7.91%, but had no significant effect on the moisture content of dried red chili, yield, or organoleptic scent test. The organoleptic test on red chili powder treated at 50°C with a drying time of 7 h yielded the highest color score, 3.68 (quite like), and the highest aroma score, 3.54 (quite like), at 60°C.

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