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The Effect of Immersion Time and Drying Method on The Colour of Canarium Nuts (*Canarium vulgare* Leenh)

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A B S T R A C T

This study aimed to evaluate the resulting discoloration through a combination of immersion times and different drying methods. The design used in this study was a completely randomized design arranged in a factorial experiment with four replications. The first factor was immersion time, i.e., no immersion; immersed for 24 hours; immersed for 48 hours; while the second factor was drying methods, including without drying; drying in direct sunlight; drying by smoking, and drying by roasting in the sand. The research data were processed using the SPSS program using one-way ANOVA analysis by design. The Tukey test on treatments that were significantly different at a 95% confidence level. The results showed that: 1). Canarium nut without drying (fresh) produces a color (L) with a higher brightness level compared to the color of canarium nut from drying, smoking, and roasting; 2). Immersion for up to 48 hours did not result in significant changes to the color component; and 3) the change in color components was relatively small among the three different drying methods, namely drying in direct sunlight, smoking, and roasting.

Introduction

Canarium is a native Indonesian plant widely grown in Eastern Indonesia, such as Maluku and North Maluku. According to Mailoa (2015), fresh canarium nut from Maluku contains about 20 substances, including many nutritious compounds, bioactive chemicals, and aroma compounds. Omega 6 fatty acids (2.56%), omega 7 fatty acids (12.77%), omega 9 fatty acids (9.13%), squalene (2.46 %), δ tocopherol (1.02%), and β tocopherol are only a few examples (1,07%). Due to the high water content (32.70%) of fresh canarium nuts are easily damaged and have a short shelf life of 3–4 days at room temperature (Mailoa, 2018). To increase the shelf life, a drying step is required. Along with the drying process, retaining the Canarium nut's quality is critical. The objective of drying Canarium nuts is to reduce their moisture content to hinder the growth of microorganisms and enzyme activity that contribute to deterioration, hence extending their shelf life. According to Mailoa (2018), farmers in Maluku dry canaries in two ways: drying and fumigation, which occurs during the rainy season. Canarium is typically immersed for up to 48 hours (2 days) before drying to facilitate the stripping process. Pangastuti *et al*. (2013) demonstrated that could immersion can increase the lipase enzyme activity, allowing short-chain free fatty acids quickly dissolve into the immersion media's water, resulting in a decrease in fat unsaturated fatty acids. Suhaidi (2003) also suggested that prolonged immersion can deplete the protein content by allowing the protein structure bonds to break and the protein components to dissolve in the water. According to Martunis (2012), drying generally damages the color and causes it to turn brown (Mallard reaction). Several of the research findings indicate that canarium drying, which begins with immersion, can result in various canarium qualities, including nutritional content, bioactive compounds, and color. The purpose of this study was to determine the color change in the canarium caused by a combination of immersion and drying processes, immersion and smoking processes, and immersion and roasting processes.

Materials and Methods

This research was carried out for two months in Ambon City, and the color was analyzed at the Food Technology Laboratory of IPB University, Bogor.

Tools and materials

Drying trays, frying pans, mixing spoons, basins, and stoves were all used. The chromameter CR 310 was used to determine the color. Black canarium (*Canarium vulgare* Leenh) and sand for roasting were used as materials.

Experimental Method

Following harvesting, the canariums were immersed in three different ways: without immersion, immersed for 24 hours, and immersed for 48 hours. Following treatment-specific immersion, the exocarp and mesocarp were separated to obtain the endocarp, which was then separated from the shell and testa to obtain seeds (called "canarium nut") for physical or color testing. Endocarp from each immersion time (0 hours, 24 hours, and 48 hours) was dried using four different methods: no drying; sun drying for up to 14 days smoking for up to 12 days; and roasting using sand media for 2 hours and cooling for 2 hours.

For sun drying, canariums that were still in their shells were arranged in trays and dried at 30–35°C. If the weather was cloudy or rainy, or if it was late afternoon, the trays were stored in a dry and cool room with a temperature of 25–28°C without adjusting the relative humidity of the air, then dried again for up to 14 days. For the smoking treatment, the canarium was dried by smoking and was prepared in a smoking room. Wood was burnt, canariums still in the shell were arranged on a smoking rack, and smoking continued throughout the day (temperature 30-40˚C), removed after completely dry, approximately 12 days. For roasting, canariums that were still in the shell were roasted in a frying pan (the sand had been washed clean, the canarium to sand ratio is 1:2) at a temperature of 80°± 2°C for 2 hours, then allowed to stand for approximately 2 hours to evenly distribute the moisture content on the shell containing the canarium. Physical tests were carried out on dried canarium, which included color fractions (L, a, b).

Experimental Design

The design used in this study was a Complete Randomized Design (CRD), which was prepared as a factorial design with four replications. The first factor was immersion time (R), which consists of three levels of treatment, namely

R_0 : No Immersion

R_1 : 24-hour immersion

R_2 : 48-hour immersion

While the second factor is the drying process (P) which consists of four levels of treatment, namely:

P_0 : No Drying

P_1 : Drying in the direct sunlight

P_2 : Drying by Smoking

P_3 : Drying by roasting

Thus, the combination of treatment was as follows: R_0P_0, R_1P_0, R_2P_0. R_0P_1, R_1P_1, R_2P_1, R_0P_2, R_1P_2, R_2P_2, R_0P_3, R_1P_3, R_2P_3 The number of experimental units was 3 x 4 x 4 = 48 experimental units. By the experimental plan used, the mathematical model is as follows:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where:

Y_{ijk} = Response of each parameter observed

μ = General average score

α_i = Effect of immersion time treatment

β_j = Effect of drying treatment

$(\alpha\beta)_{ij}$ = Effect of interaction immersion time and drying method

ε_{ijk} = Experimental Error

Statistical Analysis

The research data were then analyzed using analysis of variance (ANOVA) according to the design used, then continued with the Tukey test on treatments that were significantly different at a 95% confidence level, using the SPSS program (Sheridan & Steed, 2009).

Results and Discussion

Color: Visual Observation and L, a dan b values

The final result of this research was the measurement of physical properties (color). Color is one of the important parameters in determining the quality of food. The color of a food material is closely related to other physical characteristics and chemical properties and is a sensory indicator of food material (Mendoza *et al*., 2006). Physical characteristics (color) can affect the first impression and consumer acceptance of foodstuffs. Figure 1. shows the color of the canarium nut of each treatment visually.

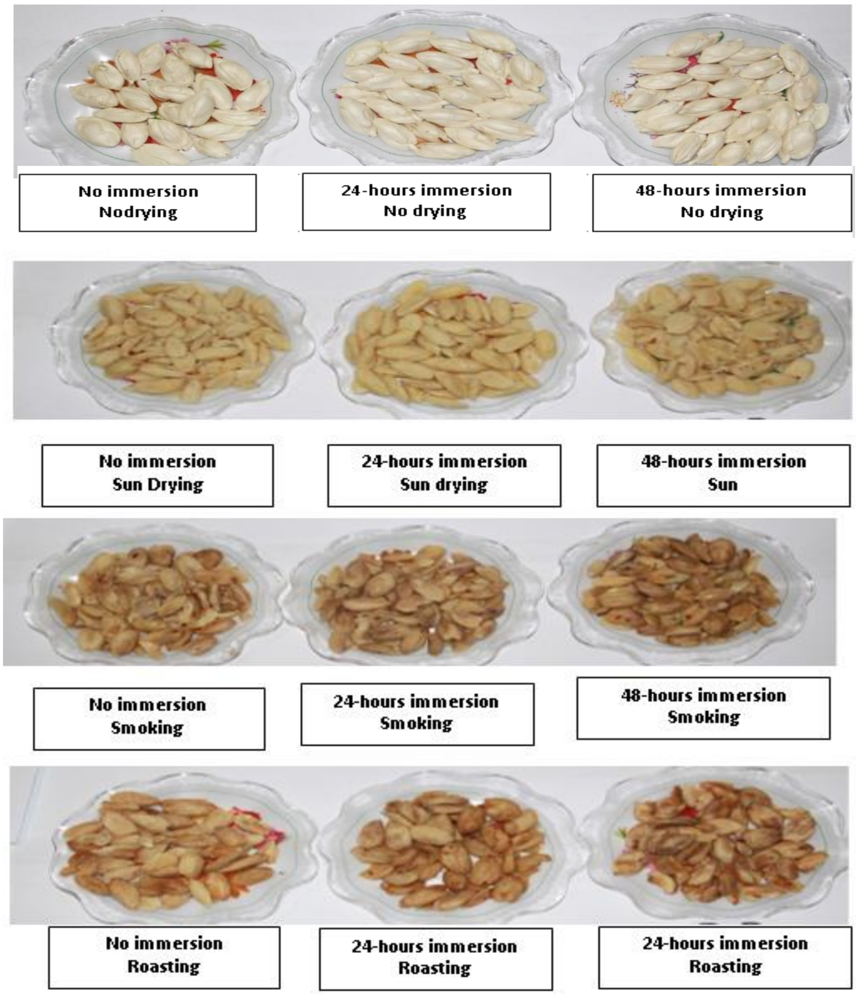

Figure 1. Differences in Color of Fresh and Dried Canarium Nut Visually

Table 1. Brightness (L) of the Canarium nut with four replications

Treatment		Replications				Average
Immersion Time (hours)	**Drying Method**	**1**	**2**	**3**	**4**	
0	No drying	75,56	75,56	76,33	77,15	76,15 ± 0,76
24	No drying	75,74	75,81	67,64	68,26	71,86 ± 4,52
48	No drying	79,07	79,10	74,82	75,56	77,14 ± 2,27
0	Sun Drying	62,58	62,58	62,79	62,90	62,71 ± 0,16
24	Sun Drying	66,51	66,46	66,06	65,70	66,18 ± 0,38
48	Sun Drying	61,81	61,90	67,27	67,07	64,51 ± 3,07
0	Smoking	50,44	50,37	64,52	64,67	57,50 ± 8,19
24	Smoking	47,33	47,52	64,54	64,61	56,00 ± 9,90
48	Smoking	50,38	50,43	70,51	70,80	60,53 ± 11,69
0	Roasting	52,82	52,78	66,57	66,68	59,71 ± 7,98
24	Roasting	52,90	53,28	65,65	65,72	59,39 ± 7,27
48	Roasting	52,14	52,14	66,98	66,58	59,46 ± 8,45

Table 2. ANOVA for immersion time, drying method, and their interaction on brightness (L) of the Canarium nut.

SK	F Count	F table	Significance	Description
R	$0{,}401^{ns}$	3,259	0,673	ns
P	16,251*	2,866	0,000	*
R * P	$0{,}360^{ns}$	2,364	0,899	ns

Describtion: ns = Not significantly different; * = significantly different (α 5%)
SK = Source of variation; R =Immersion time; P = drying method
R*P = Interaction between immersion time and drying method

Table 3. Average Brigtness (L) of Canarium Nut

Treatment		Average		
Immersion Time (Hours)	**Drying Method**	**Interaction between immersion time and drying method**	**Immersion Time**	**Drying Method**
0	No drying	76,150		
24	No drying	71,863	R0 = 64,019	$P0 = 75{,}050^{a}$
48	No drying	77,138		
0	Sun Drying	62,713		
24	Sun Drying	66,183		$P1 = 64{,}469^{b}$
48	Sun Drying	64,513	R1 = 63,358	
0	Smoking	57,500		
24	Smoking	56,000		$P2 = 58{,}010^{b}$
48	Smoking	60,530		
0	Roasting	59,713	R2 = 65,410	
24	Roasting	59,388		$P3 = 59{,}520^{b}$
48	Roasting	59,460		

Table 4. Degree of redness (a)of the Canarium nut with four replications

Treatment		Replications				Average
Immersion time (Hours)	Drying Method	1	2	3	4	
0	No drying	0,04	0,06	1,87	1,92	0,97 ± 1,07
24	No drying	0,95	0,94	2,79	2,81	1,87 ± 1,07
48	No drying	1,08	1,06	2,09	2,14	1,59 ± 0,60
0	Sun Drying	2,34	2,29	2,57	2,63	2,46 ± 0,17
24	Sun Drying	1,92	1,96	2,23	2,25	2,09 ± 0,17
48	Sun Drying	2,72	2,74	2,58	2,53	2,64 ± 0,10
0	Smoking	5,81	5,81	3,43	3,51	4,64 ± 1,35
24	Smoking	6,99	6,93	4,08	4,11	5,53 ± 1,65
48	Smoking	6,12	6,09	2,12	2,16	4,12 ± 2,29
0	Roasting	6,61	6,61	5,69	5,72	6,16 ± 0,52
24	Roasting	7,18	7,15	5,05	5,16	6,14 ± 1,19
48	Roasting	8,55	8,47	4,14	4,19	6,33 ± 2,51

Table 5. *ANOVA for immersion time, drying method, and their interactions on the degree of redness (a) of the canarium nut*

SK	F Count	F table	Significantly	Description
R	0,296^{ns}	3,259	0,745	ns
P	32,917*	2,866	0,000	*
R * P	0,532^{ns}	2,364	0,780	ns

Describtion: ns = Not significantly different; * = significantly different (α 5%)
SK = Source of variation; R =Immersion time; P = drying method
R*P = Interaction between immersion time and drying method

Table 6. *The average degree of redness (a) of the canarium nut*

Treatment		Average		
Immersion (Hours)	**Drying method**	**Interaction between immersion time and drying method**	**immersion Time**	**Drying Method**
0	No drying	0,973		
24	No drying	1,873		
48	No drying	1,593	R0 = 3,557	P0 = 1,479^{c}
0	Sun Drying	2,458		
24	Sun Drying	2,090		
48	Sun Drying	2,643		P1 = 2,397^{c}
0	Smoking	4,640	R1 = 3,906	
24	Smoking	5,528		
48	Smoking	4,123		P2 = 4,763^{b}
0	Roasting	6,158		
24	Roasting	6,135	R2 = 3,674	
48	Roasting	6,338		P3 = 6,210^{a}

Table 7. *Degree of yellowness (b) of the Canarium nut with four replications*

Treatment		Replications				Average
Immersion Time (hours)	**Drying Method**	**1**	**2**	**3**	**4**	
0	No drying	21,30	21,31	15,26	15,36	18,31 ± 3,46
24	No drying	19,69	19,71	12,09	12,26	15,94 ± 4,35
48	No drying	18,41	18.37	14,53	14,84	16,54 ± 2,14
0	Sun Drying	23,10	23,02	12,80	12,81	17,93 ± 5,92
24	Sun Drying	26,26	26,25	11,90	12,00	19,10 ± 8,26
48	Sun Drying	25,75	25,75	13,04	12,99	19,38 ± 7,35
0	Smoking	21,37	21,58	10,75	10,83	16,13 ± 6,17
24	Smoking	20,27	20,27	9,68	9,70	14,98 ± 5,44
48	Smoking	21,43	21,36	11,83	11,92	16,64 ± 5,49
0	Roasting	23,91	23,90	17,87	17,92	20,90 ± 3,47
24	Roasting	21,85	21,97	14,71	11,00	17,38 ± 5,44
48	Roasting	22,65	22,64	11,00	11,12	16,85 ± 6,69

Table 8. Annova immersion time, drying method, and their interactions on the degree of yellowness (b) of the canarium nut

SK	F Count	F table	Significance	Description
R	0,278^{ns}	3,259	0,759	ns
P	0,663^{ns}	2,866	0,580	*
R * P	0,226^{ns}	2,364	0,966	ns

Description: ns = Not significantly different; * = significantly different (α 5%)
SK = Source of variation; R =Immersion time; P = drying method
R*P = Interaction between Immersion time and drying method

Table 9. *The average degree of yellowness (b) of the canarium nut*

Treatment		Average		
Immersion time (Hours)	**Drying method**	**Interaction between immersion time and drying method**	**Immersion Time**	**Drying Method**
0	No drying	18,308		
24	No drying	15,938		
48	No drying	16,538		P0 = 16,928
0	Sun Drying	17,933	R0 = 18,318	
24	Sun Drying	19,103		
48	Sun Drying	19,382		P1 = 18,806
0	Smoking	16,133		
24	Smoking	14,980	R1 = 16,851	
48	Smoking	16,635		P2 = 15,916
0	Roasting	20,900		
24	Roasting	17,383	R2 = 17,352	P0 = 16,928
48	Roasting	16,852		

The results in Table 2, Table 5, and Table 8 indicate that the difference in immersion time and interaction treatment between the immersion time and the drying method was insignificant. The drying treatment resulted in a significant difference between measured colors L and a, but not between measured colors b. Table 10 shows the average L, a, and b values of the canarium nut as a function of the drying method.

Table 10. *L, a, b values of the canarium nut as affected by drying method*

Drying method	L values	a values	b values
No drying	75,050[a]	1,479[c]	16,928
Sun Drying	64,469[b]	2,397[c]	18,806
Smoking	58,010[b]	4,763[b]	15,916
Roasting	59,520[b]	6,210[a]	16,928

Description: Numbers followed by the same letter in one column is not significantly different at the 0.05 level (Tukey's test)

Fresh canarium nuts that had not been dried had a higher average brightness level (75,050) than canarium nuts that had been dried using other methods, such as sun drying, smoking, or roasting (58.010–64,469). A higher level of brightness (L) in fresh canarium nuts was achieved because the nuts were not heated. According to Saraswati & Yuwono (2015), the brightness value (L) obtained through the heating process was lower than the value obtained without heating.

The immersion time had no significant effect on the brightness (L) of the canarium nuts. This shows that the endocarp (shell) and testa, which shield the canarium nuts during immersion, act as a barrier to water penetration. As a protector, the endocarp maintains brightness at similar levels.

Dried and smoked canarium nuts had lower brightness (L) values than fresh canarium nuts. This is believed to occur as a result of an enzymatic browning reaction. Enzymes can continue to function at drying temperatures of 30–35 °C and smoking temperatures of 30–40 °C. According to Afrianti (2013), certain conditions favor the occurrence of enzymatic browning reactions, including the Aw of food and an appropriate temperature for enzyme activity (20 -

40 °C). Because roasting can reach temperatures of up to 80 °C, the browning reaction is believed to be caused by a non-enzymatic browning reaction (the Maillard reaction) induced by high temperatures.

The interaction between immersion time and drying method varied. Based on statistical analysis, there was no significant difference between the treatments. This is influenced by the immersion factor, which also does not show a significant difference between treatments in the value of L and the value of a. The reddish-brown color (a value) was higher in the smoked and roasted canarium nuts, presumably because the heat distributed to the canararium through these two drying processes was higher than in the sun drying process.

The browning reaction is thought to be faster in smoked and roasted canariums. According to Doke & Guha (2015), the color of dried food generally turns brown. These changes are caused by non-enzymatic browning reactions or Maillard reactions. This Maillard reaction occurs between reducing sugars and amino acids, and this reaction occurs due to heat. A significant increase in temperature promotes the Maillard reaction. The higher the temperature, the faster the Maillard reaction occurs.

The ANOVA in Table 8 showed that the interaction between immersion time and drying method had an insignificant difference in the average value of b (degree of yellowness). The immersion time and drying method by themselves also had no significant effect on the b value. The color of fresh canarium nuts was white or slightly yellow, and although it was suspected that a browning reaction had occurred, the yellowish component still dominated the canarium. Statistically, color b (yellowish component) did not show a significant difference. This can also be seen in Figure 1. There is no apparent brownish-red color on the surface of all canarium nuts (visually). Not only was the brown color of the nuts due to enzymatic and non-enzymatic browning reactions, but it was also possible that it was due to the reaction of aromatic phenols such as lignin, a substance found in canarium shells. The elevated temperature degrades the shell cell wall, allowing phenol to be released from the shell. Phenol compounds are organic chemicals that contain a single aromatic ring (Firdausni *et al*., 2011). As colored compounds, these phenolic compounds are related to anthocyanins. Yang *et al*. (2008 in Widyawati *et al*., 2014) stated that the majority of the phenolic compounds in brown rice are anthocyanins, and the number of anthocyanins in rice determines the dark color intensity. When heated, it is believed that aromatic phenols will produce a brown color change and brown pigment will penetrate the canarium nut tissue.

The heat energy that is pushed into the roasted Canary tissue is very high. This allows for a larger brownish discoloration. The data are shown in Table 10. shows that the value of color in roasted Canary is higher (6.210) compared to drying and smoking treatments, which are 2.397 and 4.763, respectively.

The immersion time treatment did not show a significant difference between treatments for both the L value and a value (Table 2 and Table 5). This shows that the endocarp (shell) and testa which protect the Canary during immersion are protective against water penetration into the Canary. Endocarp as a protector makes the resulting color still have the same brightness (L) and redness (a) value.

CONCLUSIONS

Canarium nuts without drying (fresh) produce a higher brightness level (L) compared to sun-dried, smoked, and roasted canarium nuts. Immersion for up to 48 hours generally did not show significant changes to the color component. The change in color components among the three different drying methods, namely drying in direct sunlight, smoking, and roasting, was relatively small.

REFERENCES

Afrianti. L H. (2013). Teknologi Pengawetan Pangan, Penerbit Alfabeta, Bandung

Doke, S. & Guha, M. (2015). Nutritional, physico-chemical and functional properties of ready to use chickpea and soybean flour. *International Journal of Food and Nutritional Sciences*, 2(5), 72-77.

Firdausni, Failisnurdan, & Diza, Y.H. (2011). Potensi pigmen cassiavera pada minuman jahe instan sebagai minuman fungsional, *Jurnal Litbang Industri*, *1*(1), 15-21.

Mailoa, M. (2015). Kajian Senyawa Bioaktif Buah Kenari Segar (*Canarium vulgare* Leenh), Prosiding Seminar Agroindustri dan Lokakarya Nasional FKPT-TPI : A259-A262

Mailoa, M. (2018). Efek Perendaman Buah dan Cara Pengeringan Biji terhadap Karakteristik Daging Biji Kenari (*Canariumvulgare*Leenh) serta Potensinya sebagai Pangan Fungsional, Disertasi, Progarm Pascasarjana Fakultas Pertanian Universitas Brawijaya, Malang.

Martunis. (2012). Pengaruh lama dan suhu pengeringan terhadap kuantitas dan kualitas pati kentang varietas granola, *J. Tekn dan Ind. Pert. Indonesia*, 4(30), 1-5.

Mendoza, F., Dejmek, P., & Aguilera, J.M. (2006). Calibrated color measurements of agricultural foods using image analysis. *Postharvest Biology and Technology*, *41*, 285-495.

Pangastuti, H.A., Affandi, D.R. & Ishartani, D. (2013). Karakterisasi sifat fisik dan kimia tepung kacang merah *(Phaseolus vulgaris* L.*)* dengan beberapa perlakuan pendahuluan, *Jurnal Teknologi Pangan*, 2(1), 1-10.

Saraswati, M., & Yuwono, S.S. (2015). Pengaruh pengovenan dan pemanasan terhadap sifat-sifat bumbu rujak cungir instan selama penyimpanan, *Jurnal Pangandan AgroIndustri*, 3(2), 464-475.

Suhaidi, I. (2003). Pengaruh lama perendaman kedelai dan jenis zat penggumpal terhadap mutu tahu. Jurnal Jurusan Teknologi Pertanian, Fakultas Pertanian, Universitas Sumatera Utara, Medan.

Sheridan, J.C. & Steed, L. (2009). SPSS: Analysis Without Anguish Using SPSS Version 14.0 For Windows, Jhon Wiley & Sons, Inc, New York, USA

Widyawati, P.S., Suteja, A.M., Suseno, T.I.P., Monica, P., Saputraja, W., & Liguon, C. (2014). Pengaruh perbedaan warna pigmen beras organik terhadap aktivitas antioksidan, *Agritech*, 34(4), 399-406.