The Observations of Hot Water Blanching Effect on Trimmed Young Coconut (*Cocos nucifera* (*L.*))

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Abstract. Trimmed Young Coconut or TYC is one of Indonesia's favorite tropical fruit. The high demand for TYC brings to the development of TYC preservation in Indonesia. However, due to its damage, postharvest handling that has not been optimally operated impedes the development of the TYC agroindustry. In addition, it can cause problems in the form of quality degradation such as the appearance of mold, decay, shell cracking, and browning of TYC. The solution to prevent damage and extend the shelf life of trimmed young coconut (TYC) is hot water blanching. In this study, the temperature that is used is 80 °C and 95 °C. While the immersion time applied was 1.5 and 5 min was carried out to keep the TYC quality for long-term storage. This study used 12 TYCs produced by local coconut farmers. Then, the TYC was kept at cold storage which is set at a temperature of 17 ± 0.5 °C and RH 90%. Physiological changes parameters such as carbon dioxide (CO2) production and colour changes were analyzed every day for 6 days of storage. Statistical analysis was implemented to test the hot water blanching effect on TYC for each parameter. This study has a conclusion that TYC with 95 °C with 5 min of hot water blanching gives the best result in extending the shelf life of TYC.

Keywords: Postharvest · Browning · Blanching · Respiration · Observation

1 Introduction

Trimmed young coconut or TYC (*Cocos nucifera* (L.) is one of the tropical fruits that is great in demand on both domestic and world market. Badan Pusat Statistik Indonesia or BPS shows that the total area of Indonesian coconut plantations in 2021 is more than 3.3 million hectares [1]. According to information from the Ministry of Industry of the Republic of Indonesia, the production of coconut from coconut plantations in Indonesia is 18 million tons per year. One of the characteristics of coconuts is that they have a fresh taste of water and meat [2]. In general, coconuts sold in supermarkets have their standards, such as how to cut and pack the product. Some of the coconut husks are cutted neatly to produce a coconut shape with a conical top, a cylindrical body or middle, and

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a flat at the bottom [3]. The goal is to increase selling value based on physical or visual appearance and make it easier for consumers. This piece of coir causes a colour change in the form of browning in the remaining part of the coir so that it can reduce the visual quality. In addition, cutting also triggers the growth of fungi in the coconut mesocarp and results in the shorter shelf life of the product [4].

The colour change of browning process was caused by the enzymatic oxidation process of phenolic compounds. The enzymatic oxidation allows the polyphenol oxidase (PPO) to turn into o-quinones. This enzymatic oxidation is highly reactive to produce brown polymers [5]. The formation reaction requires oxygen as a co-substrate. This reaction was activated by PPO [6]. It indicates that environmental factors such as temperature and humidity affect the browning reaction. The browning process is cramped by applying the appropriate postharvest methods such as immersion using an anti-browning solution so that the product remains of high physical and chemical quality and has a long shelf life [7].

Physical methods for regulating enzymatic browning include thermal treatment, prevention of oxygen exposure, low temperatures, and irradiation. Heat treatment, such as blanching, can efficiently inhibit the activity of enzymes that can affect the oxidation process resulting in browning. Hot steam blanching is a physical method of preventing the discolouration of materials. This process usually requires a temperature setting of 80–90 °C. This temperature treatment was controlled under conditions set in the water bath [8].

Activities of the enzymes peroxidase and polyphenol oxidase (PPO) served as markers for the browning response. The results depicted that PPO activity noticeably decreases as blanching temperature and duration are increased. It was discovered that the inactivation of PPO was finished between 5 and 25 min into the experiment at 90 and 90 °C. Peroxidase was still quite active. Therefore, compared to the control, the whiteness index of the blanched samples marginally decreased. Therefore, for additional research on changes in colour and texture of frozen young coconut meat, blanching temperatures of 90 and 95 °C within 5 min were chosen [9].

2 Materials and methods

2.1 Experiment Design and Treatments

This research was conducted at the Postharvest Engineering Laboratory, Department of Agricultural and Biosystem Engineering, Faculty of Agricultural Technology, Gadjah Mada University. This study requires 12 coconuts. The study was conducted on October 2022.

This study used a completely randomized block design by each treatment having three replications. The study used two variations of treatments, such as the variations of water blanching temperature and the immersion time. The temperature that is used are 80 °C and 95 °C. While the immersion time applied was 1.5 and 5 min. The research stage begins with cutting some of the coconut fibre. Then, the coconuts that have been trimmed are given an application according to the treatment. A total of 4 treatments were applied, including hot water blanching temperature at 80 °C immersion for 1.5 min, 80 °C immersion for 5 min, 95 °C immersion for 1.5 min, and 95 °C immersion for 5 min.

After applying hot water blanching, samples were stored in cold storage at a temperature of 17 ± 0.5°C and RH 90%. °C and RH 90%.

2.2 Coconut Shell Colour

Shell colour was measured on each fruit everyday for 6 days of storage with three replications of each treatment using a TES 135A type colour meter. The colour measurement data are CIE L*, a*, and b* values. The colour data is then used as calculation to determine the level of browning or browning index on coconut coir. Browning index was calculated according to Eq. 1, respectively:

$$\mathrm{BI} = \frac{\mathrm{x} - 0,31}{0,172} \times 100 \tag{1}$$

$$\text{When x} = \frac{(\mathrm{a} + 1,75\mathrm{L})}{(5,645\mathrm{L} + \mathrm{a} - 3,012\mathrm{b})} \tag{2}$$

2.3 Respiration Rate (CO2 Productions)

The measurement of respiration rate both CO_2 production and O_2 consumptions was carried out on the same fruit with 3 replications for each treatment. Measurements were made using a 15.2 L capacity glass jar and CO_2 meter (model: GC-2028; made in Taiwan). Measurements were made by inserting a coconut and a CO_2 sensor probe into a jar and closing it tightly. Changes in CO_2 concentration are calculated for an hour and the rate of CO_2 production is calculated using the following equation:

$$R = \frac{\mathrm{dx}}{\mathrm{dt}} \times \frac{\mathrm{V}}{\mathrm{W}} \tag{3}$$

where:

R = CO_2 production rate.
x = CO_2 gas concentration t = Storage time (hours).
W = Mass of product (g).
V = Free volume of the jar (ml).

2.4 Shelf Life

Observation of the shelf life of TYC after blanching treatment was carried out from day 0 to day 6 of cold storage with a setting of 17 ± 0.5 °C and RH 90%. The method of shelf life observation is by taking photo data from day 0 to day 6 and comparing between treatments based on BI values (browning index). Also, analysis of significant differences was carried out using the one-way ANOVA statistical method to determine the effect of different variations temperature and dipping time treatment to TYC. Other observation indicators are the appearance of damage to TYC in the form of growing fungi, bad aromas that arise during storage, and the formation of cracking in TYC.

2.5 Statistical Analysis

Statistical analysis was performed using SPSS software version 26.0 (SPSS Inc.; Chicago, IL, USA). All data were analyzed by repeated measure one-way (ANOVA). The analysis used a significant difference at $P < 0.05$ determined by Duncan's Multiple Range Tests.

3 Results and Discussion

Based on the results of data collection, the average value of Browning Index and photos during storage are shown. The value obtained from observation during storage at cold temperatures. Mean value is accompanied by standard deviation during data collection. The mean value in each column followed by the same lowercase letter was not statistically different by Tukey's multiple-distance test ($P < 0.05$).

3.1 Coconut Shell Colour

Figure 1 Shows that the colour changes between 6 days after blanching treatment is quite different at each treatment. Blanching at 95 °C and 5 min immersions shows best result on inhibiting the brown colour of TYC after trimmed until 4 days of storage. Meanwhile, on the day 5–6, all treatments shows quite severe degree of brown colour that will be shown at the TYC's shelf life photos on Sect. 3.3 shelf life.

Effects of the temperature employed on the physical quality of TYC during the experiment, with the average value in each observation time. In accordance with statistical

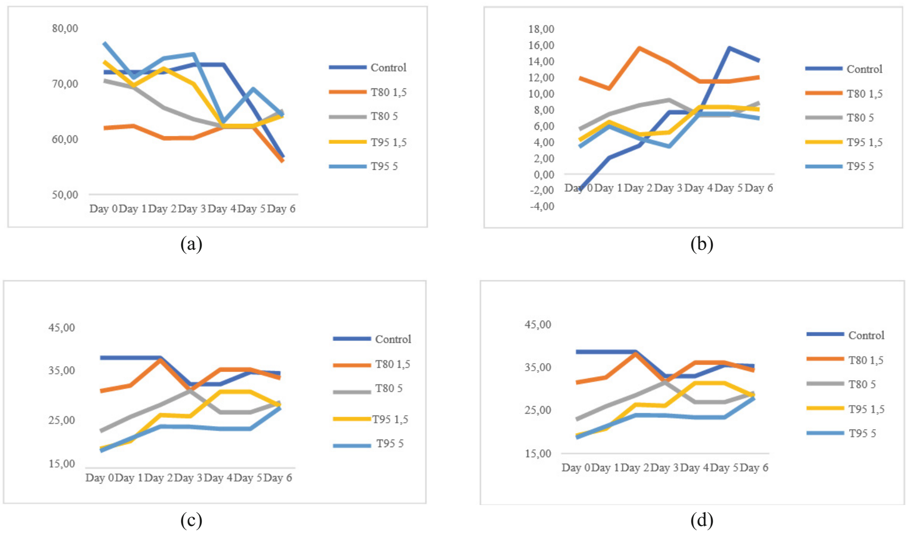

Fig. 1. Effects of the hot water blanching treatments employed on the browning index during the experiment, with the average value in each day observation based on a) lightness, b) redness, c) yellowness, and d) browning index.

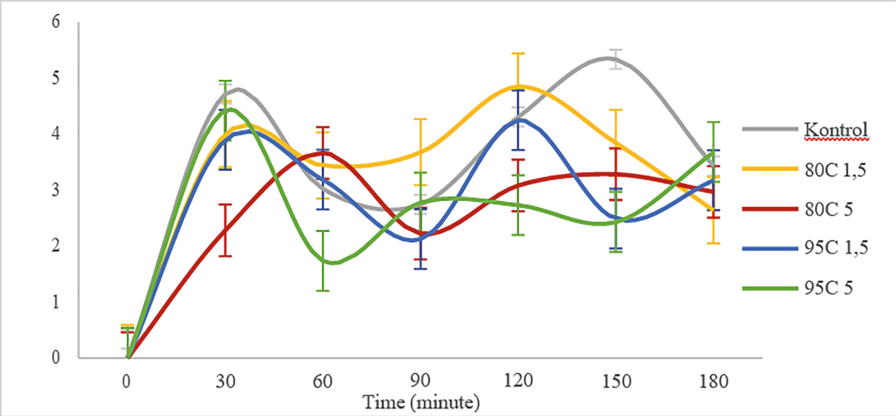

Fig. 2. Observations of respiration rate (CO_2 productions) after 14 days of cold storage of 17 ± 0.5 °C and RH 90%.

tests, Blanching at 95 °C and 80 °C did affect the browning index of TYC, significantly during 5 days of storage. Also, dipping time between 1.5 min and 5 min show significant impact to the value of browning index for 5 days. Browning index of TYC after 5 days of each treatment has no different averaged value on each given temperature and dipping time which is shown at Table 1, except for 80 °C with 1.5 min of dipping time and control. It shows that higher temperature of blanching and longer of dipping time is quite effective to inhibit the browning process. That is because the browning index usually is effected by enzymatic process in the shell which is inhibited by the blanching temperature [10].

3.2 Respiration Rate (CO2 Productions)

Based on statistical tests, hot water blanching treatment did not affect the change in CO_2 production significantly during storage at cold temperatures but significantly affected display storage temperatures. CO_2 production after 14 days of storage at a temperature of 17 ± 0.5 °C and RH 90%. °C and RH 90% was shown in the figure of respiration rate CO_2 production for 3 h of observations.

3.3 Shelf Life

Observations on this study were made on the 0^{th} to the 6^{th} day of the storage process. The indicators seen during the observation were the change in TYC colour to brown and the damage that arose during storage. On the second day until 4^{th} days of storage in cold storage, TYC with a treatment of 80 °C 1.5 min and 95 1.5 min experienced significant discolouration. Meanwhile, on the day 6 TYC with a all treatments experienced browning and the appearance of the fungus or mold. This can be seen at Table 2.

Table 1. Influences of the hot water blanching treatment applied on browning index of TYC

Days	Temperature	Dipping time	Mean
Day 0	80	1.5	82,64 ± 3,04
		5.0	44,33 ± 6,02
	95	1.5	33,46 ± 2,86
		5.0	30,28 ± 4,37
	control	-	70,54 ± 4,81
Day 1	80	1.5	86,76 ± 34,84
		5.0	53,75 ± 4,06
	95	1.5	41.55 ± 1,41
		5.0	41,13 ± 8,80
	control	-	75,13 ± 5,26
Day 2	80	1.5	113,07 ± 10,78
		5.0	65,02 ± 4,44
	95	1.5	49,00 ± 7,12
		5.0	42,45 ± 9,44
	control	-	76,83 ± 4,88
Day 3	80	1.5	89,06 ± 9,04
		5.0	77,49 ± 20,64
	95	1.5	51,01 ± 5,95
		5.0	40,63 ± 7,70
	control	-	65,62 ± 4,12
Day 4	80	1.5	96,24 ± 2,48
		5.0	63,65 ± 3,04
	95	1.5	78,08 ± 12,56
		5.0	54,44 ± 8,10
	control	-	65,62 ± 4,12
Day 5	80	1.5	96,24 ± 2,48
		5.0	63,65 ± 3,04
	95	1.5	78,08 ± 12,56
		5.0	48,50 ± 1,31
	control	-	93,41 ± 33,70
Day 6	80	1.5	105,34 ± 2,94
		5.0	67,52 ± 12,15

(*continued*)

Table 1. (*continued*)

Days	Temperature	Dipping time	Mean
	95	1.5	65,98 ± 11,82
		5.0	64,39 ± 13,53
	control	-	110,24 ± 11,64

Note: Each value represents a mean ± standard error. Mean values in each column followed by the same lower-case letters are not statistically different by Duncan's multiple range test ($P < 0,05$)

Table 2. Result comparison photos between TYC of each treatment at day 0 and day 6

	Day 0	Day 6
Control		
80°C 1.5 minutes		
80°C 5 minutes		
95°C 1.5 minutes		
95°C 5 minutes		

4 Conclusion

Hot water blanching on 95 °C with 5 min dipping treatment significantly on inhibit browning of Trimmed Young Coconut until day 4 compared to the other treatments. However, in all treatments on the and fifth and sixth days of storage, mold appeared on the surface of the coconut coir. Therefore, further research is needed using higher blanching hot water temperature variations and longer soaking times to produce high quality coconuts.

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