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COMPARISON OF NATURAL AND BRANDED COCONUT WATER

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ABSTRACT

Due to its hydrating qualities and nutritional advantages, coconut water is extensively drank. The purpose of this study is to assess the nutritional value, flavour, pH levels, and general quality of natural and branded coconut water. To evaluate the variations and identify the version with the best health advantages, laboratory testing was done. The results will provide light on consumer preferences and possible health consequences. Comparing the physicochemical characteristics of packaged and natural coconut water (NCW) was the goal of this study. A heating technique can make the solution more soluble in coconut water, a nutritious beverage that can be employed as a solvent. In the open, coconut water's characteristics can alter quickly. As a result, pure coconut water is transformed into packaging. However, the packaging of coconut water frequently includes a lot of other substances that might alter the water's flavour and nutritional value. PCW, or coconut water. Unheating-NCW (uh-NCW), heating-NCW (h-NCW), unheating-PCW (uh-PCW), and heating-PCW (h-PCW) were the four sets of samples. The UV-Vis spectrum (190–790 nm), pH, turbidity, and conductivity were used to investigate the physicochemical characteristics. The wavelengths of the NCW and PCW were 229, 262 nm and 286, 296 nm, respectively. The absorbancy of PCW was higher than that of NCW. The physicochemical characteristics of an NCW and PCW were unaffected by heating. Compared to NCW, PCW exhibited more turbidity. The extra components in PCW were the reason for its high absorbancy and turbidity. Every sample had a pH between 5.42 and 5.49, turbidity between 19.48 and 69.63 NTU, and conductivity between 15.48 and 19,88 mS.

KEYWORDS: UV-Vis spectrum, physicochemical characteristics, and coconut water.

1. INTRODUCTION

It has been said that the coconut (Cocos nucifera L.) is the most significant and widely planted palm tree in the world. Because of its organic process and therapeutic qualities, coconut water the clear liquid that is found within young coconuts—is widely prized. One of the tropical nations is Indonesia. In tropical climates, coconuts may thrive.[1]

Therefore, Indonesia has a great chance to cultivate the coconut, a very beneficial plant. In many parts of Indonesia, coconuts may grow freely in fertile soil, making it easy for people to consume the fruit. People all throughout the world frequently consume goods made from coconut fruit. Coconut water is a component of the coconut fruit. The liquid from young coconut fruit is called endosperm, or coconut water. The nutrients included in coconut water, such as ascorbic acid, vitamin B, calcium, sodium, potassium, copper, iron, phosphor, sulphur chloride, or some types of sugar and amino acids, make it a nutritious beverage.[2]

In addition, coconut water is widely drank due to its affordability and ease of access. Dehydration, constipation, digestive issues, exhaustion, heatstroke, diarrhoea , kidney stones, and urinary tract infections can all be avoided or treated with coconut water.[3]

One polyherbal product, Eritin (Erythropoiesis Modulatory and Stimulatory Agent), has coconut water as a component. Red rice and soybeans make up the polyherbal product EMSA Eritin, which is dissolved in coconut water.[4]
Many components may be made more soluble by heating them to the ideal temperature of 50–60 °C.[5]
Despite being sterile when in the coconut shell, the physicochemical shift makes it challenging to serve coconut water fresh for an extended period of time. Thus, a lot of businesses turn natural coconut water into a variety of goods, and bottled coconut water is one of them.[6]

Natural coconut water (NCW) and packaging coconut water (PCW) are the two varieties of coconut water. The investigation of physicochemical characteristics is necessary to comprehend the basic differences among the different kinds of coconut water. The nature of various types of coconut water may be determined by their physicochemical characteristics, which will help researchers identify the ingredient in the water and use it to certain applications. In comparison to natural coconut water (NCW), packaged coconut water (PCW) differs in a number of physicochemical properties. The extended storage duration is the goal of the coconut water processing.[7]

Additional chemicals included in a PCW include citric acid, which regulates acidity, and sodium carbonate, which serves as a preservative. However, those other additives have the potential to alter the nutritional value and flavour of coconut water.[8]

Because we can learn more about the capacity of active chemicals to be stimulated at specific wavelengths, whether in heating samples, this research is crucial. It is believed that there are component differences in coconut water based on the varied absorbance wavelengths. The purity of an NCW may be determined by the component difference. Comparing the physicochemical characteristics of packaging coconut water (PCW) and natural coconut water (NCW) was the goal of this study.

2. MATERIALS AND METHODS

2.1. Sample preparation

Natural coconut water (NCW) and packaged coconut water (PCW) were the samples utilized in this study. A delicate coconut from Wlingi, Blitar, East Java, Indonesia, ranging in age from 6 to 8 months, yielded an NCW. A study by Sanganamoni et al. (2017) was cited as the source of the coconut water removal technique. [9]

A knife was used to open the coconut shell. After filtering, an NCW was transferred into a container. PT Kalbe Farma Tbk provided a PCW (Hydro Coco Original product). The container was filled with a PCW. One unheating-NCW (uh-NCW), one heating-NCW (h-NCW), one unheating-PCW (uh-PCW), and one heating-PCW(h-PCW)sample group were employed in this study. A Pyrex beaker glass, a laboratory electric burner, and a thermometer to measure the samples' temperature at 50 °C were used for the heating process. Three repetitions of each sample demonstrated the various qualities of each coconut fruit or packaging. A PCW that came from a different container and an NCW that came from a different coconut fruit both included repetition.

2.2. Using UV-Visible spectroscopy to measure the absorbance profile

A UV-Vis spectrophotometer (Genesys 10 UV) operating in the wavelength range of 190-790 nm was used to measure the absorbance profile of the samples [10]. The measurement result was averaged after being performed twice . The data from spectrophotometry was interpreted as a line graph with absorbance (y axis) and wavelength (x axis).

2.3. Measurement of pH

A glass beaker was filled with samples. The pH meter (Qis) was used to test the pH by dipping its electrodes into the sample. The "Measure" button was depressed. We took note of the pH displayed on the screen. The measurement result was averaged after being performed twice.

2.4. Measurement of turbidity

A sample bottle was filled with the samples. A turbidimeter (Hach 2100Q) was used to measure the sample bottle. "Read" was selected from the menu. The screen's turbidity was observed. The measurement result was averaged after being performed twice.

2.5. Measurement of conductivity

A glass beaker was filled with samples. A conductivity meter (Extech EC600) was used to test the conductivity by dipping its electrodes into the sample. The "CAL" button was depressed. They took notice of the conductivity displayed on the screen. The measurement result was averaged after being performed twice.

2.6. Analysis of data

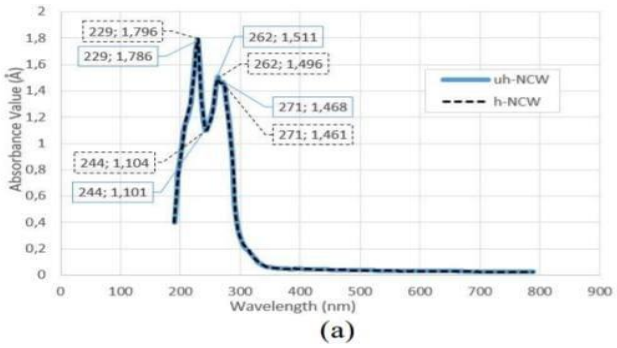
The data from this exploratory experimental study was presented in a descriptive manner. A chart with wavelength (x axis) and absorbance (y axis) displayed the UV-Vis spectrophotometry data. Each sample's wavelengths and absorbance were recorded. The samples' UV-Vis spectra were compared. Each sample's pH, turbidity, and conductivity measurement results were shown in a table and chart.

3. Findings and conversations

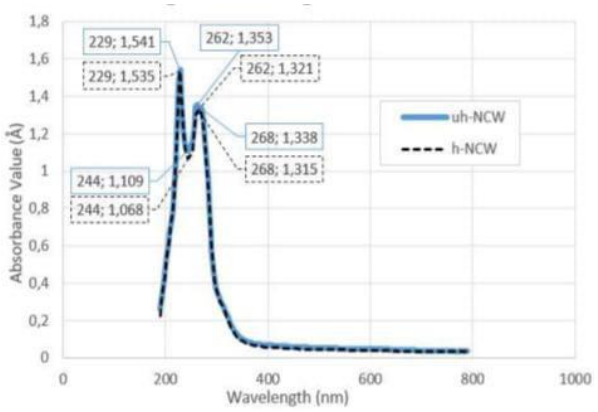
3.1. Analysis of UV-Vis spectrophotometry results

The general characteristic of each sample was that the absorbance spectrum pattern varied with each repeat. The

chromophore component difference was displayed by the peak pattern difference from every sample. In the first repeat of the NCW, Figure 1a demonstrated that heating had no significant effect on absorbance on UV-Visible spectrophotometry. However, there was a little variation in absorbance between the heating samples at the same wavelengths. With absorbances of 1,786 Å (uh-NCW) and 1,796 Å (h-NCW), the greatest peak was found at 229 nm.



(a)



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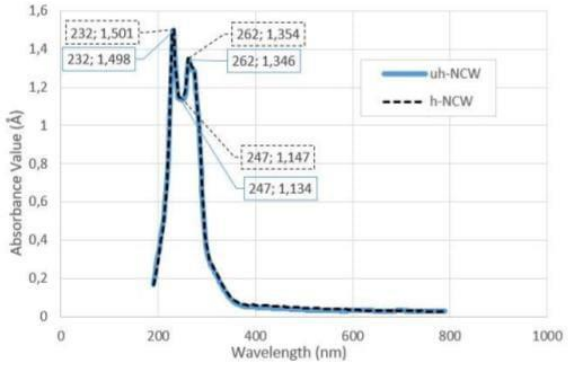

(c)

Figure 1: The results of UV-Visible spectrophotometry show that an NCW (heating) is repeated (a) once, (b) twice, and (c) three times.

In addition, two peaks were situated next to each other at 262 and 271 nm. The UV-Vis spectrophotometry chart from the second NCW repeat also contained two nearby peaks in addition to the greatest peak (Figure 1b). However, in the second iteration, there were more variances between the NCW's unheated and heated samples. The chart's "valley" at 244 nm and the nearby peaks at 262 and 268 nm showed the discrepancies. It is known from those wavelengths that heating led to a decrease in absorbance in the NCW's second reception because the third iteration of the NCW only had

two peaks at 232 and 262 nm, it differed slightly from the first and second repetitions. After heating, the sample's absorbance slightly increased. The UV-Vis spectrophotometry chart of the heating samples (Figure 1c) did not change significantly.

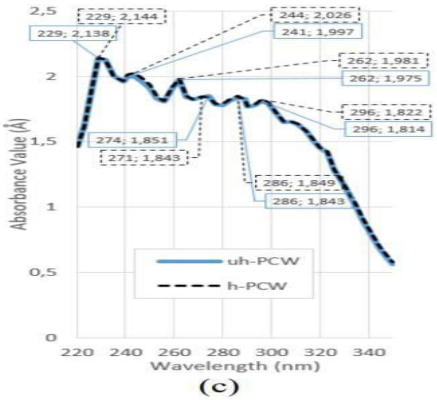

Figure 2: The results of UV-Visible spectrophotometry show that a PCW (heating) is repeated (a) once, (b)twice, and (c) three times.

The peaks of h-PCW were found at 229, 247, 262, 274, 283, and 296 nm, whereas the six peaks in the first repeat of uh-PCW were found at 229, 244, 262, 271, 286, and 296 nm. Only at the last peak did the unheating and heating sample charts clearly vary from one another.

After heating, the absorbance of a PCW's first repeat rose overall (Figure 2a). At 229, 247, 262, 271, 286, and 296 nm, the six peaks in the second iteration of a PCW (heating) were found. Only at the second peak (247 nm) did the unheated and heated samples clearly vary from one another. Overall, heating reduced the absorbance of a PCW's second repeat (Figure 2b). It is challenging to discern between the UV-Vis spectrophotometry chart from the third repeat of a PCW's heating samples. The peaks of h-PCW were found at 229, 244, 262, 271, 286, and 296 nm, whereas the six peaks of uh-PCW in the third repetition were found at 229, 241, 262, 274, 286, and 296 nm.

With the exception of the fourth peak (Figure 2c), the absorbance of the third repeat of a PCW increased overall after heating. In Aljamali's (2015) investigation, both hyperchromic (absorbance rising at peak) and hypochromic (absorbance falling at peak) conditions were observed [11]. The ratio of incoming light intensity to absorbed light intensity is known as absorbance. The concentration of a material in a solution determines absorbance. The absorbance in a solution increases with the amount of material present. [12]. Auxochromes and chromophores are the two groups that have an impact on the molecules' absorbance spectrum. Functional groups called chromophores enable molecules to absorb energy from visible or ultraviolet light. Another category known as auxochromes has an impact on chromophores. Attached to chromophores, auxochromes modify the molecules colour intensity.[13]

The UV-Vis spectrum characteristics of a PCW and an NCW were different. In UV-visible spectrophotometry, a PCW exhibited six peaks, whereas an NCW had two to four. An NCW's absorbance spectrum pattern was normal, with one or two greater absorbance peaks and another or two lower absorbance peaks separated by a "valley" of the spectrum.

The six peaks in a PCW's UV-Vis spectrum were next to one another and had a similar form. More ingredients might result in more peaks, which would increase the number of chromophore components that could create a peak. Citric acid is used as an acidity regulator and sodium carbonate is used as a preservative in PCW.[7]

Table 1: Peak data tabulation of UV-Visible spectrophotometry.

Sample	Repetition	229	232	241	244	247	262	268	271	274	283	286	296
uh-NCW	1st	+					+						
	2nd	+					+						
	3rd	+		+			+						
h-NCW	1st	+				+	+						
	2nd	+				+	+						
	3rd	+		+			+						
uh-PCW	1st	+					+					+	+
	2nd	+				+	+		+			+	+
	3rd	+		+			+			+		+	+
h-PCW	1st	+					+			+		+	+
	2nd	+				+	+		+		+	+	+
	3rd	+		+			+			+		+	+

Table 1 displays the UV-Vis spectrophotometry peak appearance data tabulation for each sample. A PCW had particular wavelengths of 286 and 296 nm, whereas an NCW had specific wavelengths of 229 and 262 nm. An NCW's peak appearance and characteristic UV-Visible spectrum pattern can be utilized to determine a PCW's purity. The presence of peaks at 229 and 262 nm in a PCW suggested that it had NCW components. A PCW had additional components in addition to an NCW, as shown by the peaks at 286 and 296 nm.

The extra elements, such the preservative and acidity regulator, may be the other components. Peak area difference creates a variation in the ability to absorb UV light because it shows the chromophore group difference in each sample.[14] A molecule or ion can absorb radiation in ultraviolet or visible light area if the radiation can cause the electron transition in compound. When an electron shifts from one orbital to another with a different energy level, this is known as an electron transition. Electrons can be moved from lower energy orbitals (ground state orbitals) to higher energy orbitals (excited state orbitals or antibonding orbitals) by the energy carried by light.[15] At wavelengths between 230 and 300 nm, peak generation is brought on by the electron transition from the $\pi \rightarrow \pi*$ and $n \rightarrow \pi*$ orbital, respectively. The electron transition in the $\pi \rightarrow {}^{0}*$ orbital is what causes the peak development at a wavelength of 268 nm.[15]

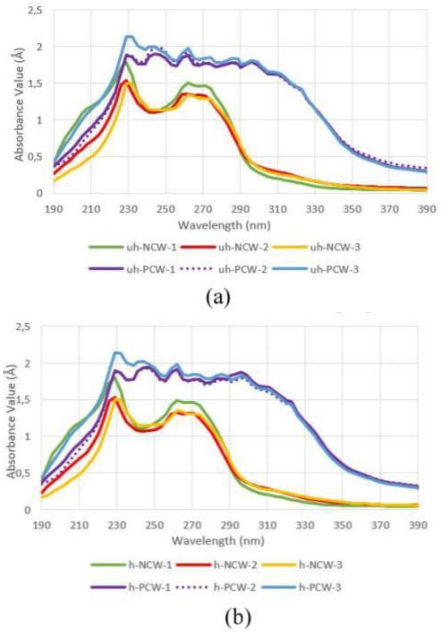

Figure 3: Shows the results of all (a) unheated and (b) heated samples using UV-Vis spectrophotometry.

Every sample showed a constant low absorbance (below 0.5 Å) in the visible light area and a high absorbance in the UV region. Coconut water may not have been able to absorb energy in regions with visible light since it was a colourless sample. A PCW's absorbance dropped significantly (below 0,5 Å, although lower than a PCW) near 400 nm, while an NCW's absorbance dropped significantly (below 0,5 Å, although lower than a PCW) at 300 nm, as shown in Figure 3.

It could have happened because an NCW contained more water than a PCW. The absorbance of a PCW was higher than that of an NCW since it had more extra components. Turbidity measurement results, which indicated that a PCW had more turbidity than an NCW, supported this conclusion. The total calories in a PCW "Hydro Coco" are 60 kcal. There is no fat or protein in this product (0 g). A PCW "Hydro Coco" has 16 g of carbohydrates, 100 mg of salt, and 360 mg of potassium.[16] The total calories in an NCW are 17.4 kcal. An NCW contains 95.5% water. An NCW has less than 0.1 percent fat and 0.1 percent protein. An NCW has 4% carbohydrates. Vitamins, minerals, and amino acids are also included in an NCW.[17]

3.2. Analysis of conductivity, turbidity, and pH

The results of the pH measurement indicated that the pH of each sample was very similar. All samples had pH values between 5,42 and 5,49 (Table 2). The findings are similar to those of.[18] which claimed that the pH of coconut water is acidic and ranges from 5 to 5. More free hydrogen ions (H+) will make water acidic, whereas more free hydroxyl ions (OH-) will make water alkaline.[19] The pH test result was unaffected by temperature. The pH of the samples, which remained unchanged after heating, serves as evidence for this. Weak acids and bases do not dissociate when exposed to temperature.[20] Turbidity is a metric used to quantify how much light is dispersed by suspended particles. Water-borne light is blocked by the suspended particles.[19]

The results of the turbidity measurement differed greatly. All samples had turbidity levels between 19,48 and 69,63 NTU. Compared to an NCW (heating), a PCW showed more turbidity (Figure 4). Citric acid, a regulator of acidity, and sodium carbonate, a preservative, may be the reason of the high turbidity.

It is known that heating marginally reduced the turbidity of coconut water because all samples showed a decrease in turbidity after heating, with the exception of the third NCW and PCW repeat. The insoluble materials (suspended particles) in coconut water may become somewhat soluble when heated. The results of the conductivity measurement differed greatly across all samples (Table 2). The range of conductivity was 15,48 to 19,88 mS. There was a slight variation in conductivity between the heated and unheated samples since the increase or decrease in conductivity was not statistically significant. Coconut water's conductivity was unaffected by heating. The concentration of ions in a solution is determined by conductivity [21]. The quantity of soluble salt in coconut water is shown by conductivity. The quantity of soluble salt is linked to a plant's ability to take up nutrients from the soil.[22].The electrolyte solution is used to test conductivity. An electrolyte is a material that includes ions, such as an ionized substance in solution or an ionic salt solution. The ion that forms in a solution contributes to electrical conductivity. Certain electrolytes, like salt, acid, or base, can be either strong or weak.[23]

An electrolyte that is weak is coconut water. A material that is not completely ionized in solution is referred to as a weak electrolyte. Because weak electrolyte solutions include fewer ions that transfer the charge from one electrode to another, they are less able to conduct electricity than strong electrolyte solutions.[24]

Table 2: The pH, Turbidity (NTU), and conductivity (mS) of each simple.

Parameter	1st Repetition	2nd Repetition	3rd Repetition	Average
uh-NCW				
pH	5.64	5.55	5.07	5.42 ± 0.30
Turbidity	17.35	22.25	18.85	19.48 ±2.51
Conductivity	10.28	23.95	23.30	19.18 ±7.71
h-NCW				
pH	5.63	5.55	5.11	5.43 ±0.28
Turbidity	17.05	20.60	30.50	22.72 ±6.97
Conductivity	10.09	23.80	25.75	19.88 ±8.53
uh-PCW				
pH	5.55	5.55	5.37	5.49 ±0.10
Turbidity	68.50	72.95	67.45	69.63 ±2.92
Conductivity	11.84	9.51	25.10	15.48 ±8.41
h-NCW				
pH	5.54	5.49	5.43	5.49 ±0.06
Turbidity	67.50	69.75	69.50	68.92 ±1.23
Conductivity	11.44	10.05	25.15	15.55 ±8.35

As a liquid's temperature rises, its viscosity decreases because rising molecular thermal energy increases molecule mobility and termolecular distance, both of which can reduce flow resistance. Total Soluble Solids (TSS) will decrease in tandem with a reduction in viscosity. Sugar and other soluble solids make up the majority of the solids in coconut water. In coconut water, the number of solids decreases as the activation energy decreases as well. In soluble substances, lowering the potential energy barrier requires less energy [25]. According to some, a greater temperature can make coconut water more soluble. Between 50 and 60 degrees is the ideal heating temperature to improve the solubility of several substances.

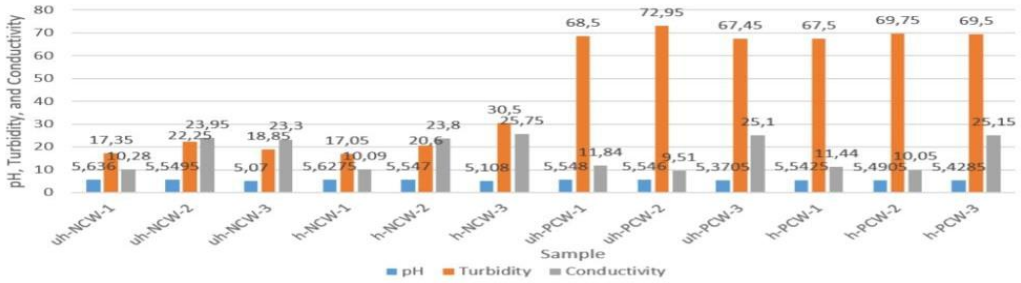

Figure 4: Shows each sample's pH, turbidity and conductivity.

CONCLUSION

Based on rigorous testing, the project will finish with conclusions about whether natural coconut water is better than branded alternatives. There will also be suggestions for customers and possible directions for future study.

It is a possible rehydration and sports drink due to its moderate acidity, balanced sugar level, and isotonic mineral composition. The suitability of coconut cultivars for the production of coconut water as a beverage can be estimated using quality criteria like the water per nut ratio, total soluble solids content (TSS), total sugar per nut, [reducing sugars/total sugars] ratio, and, to a lesser extent, potassium content. It is evident from the synthesis of biochemical data that dwarf coco-nut variations are the best cultivars to produce a sweet and delicious product because of their tiny nuts, high water volume, high sugar content, and good organoleptic scores.

The immature sample had greater quantities of Ca, Mg, P, K, and Na, according to the mineral analysis.

The UV-Vis spectrum characteristics of an NCW and a PCW were different. In UV-Vis spectra, a PCW exhibited six peaks, whereas an NCW had two to four peaks. An NCW had marker wavelengths of 229 and 262 nm, whereas a PCW had marker wavelengths of 286 and 296 nm. PCW had greater absorbance and turbidity than NCW. The physicochemical characteristics of an NCW and a PCW were unaffected by heating.

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