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The Effect of Coconut Water (*Cocos nucifera* L.) and An Isotonic Drink on The Change of Heart Rate Frequency in The Rats Induced Hypertension

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Abstract

The objective of the present study was to evaluate the effect of coconut water (*Cocos nucifera* L) and an isotonic drink on the changes of heart rate frequency in the rats induced hypertension. Wistar male rats were divided into five groups: a negative group, a mineral-watered group, a coconut-watered group, a group with isotonic drink, and a group with medicine. The rats were induced hypertension by administering NaCl solution high concentration for 14 days, and then they were treated with the test materials given to each group for another 14 days without stopping the induction. Their heart rate was measured using a tail cuff before the induction (d0), at the beginning of the treatment (d14), and at the end of the treatment (d28). When being induced hypertension, higher heart rate frequency was significantly showed by the groups with coconut water and isotonic drink ($p \leq 0.05$) compared with the control group. When the rats of coconut water group were treated with coconut water, their heart rate became significantly lower ($p \leq 0.05$) compared to the control groups. When the rats of isotonic drink group were treated with isotonic drink, their heart rate was lower, although not significant, than the control groups. The results showed that coconut water (*C. nucifera* L) lowered the heart rate frequency better than the isotonic drink.

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1. Introduction

Chobanian¹ defines hypertension as a serious condition in which a person experiences an increase of blood

pressure with systolic pressure more than 140 mmHg and diastolic pressure greater than 90 mmHg. Blood pressure is influenced by cardiac output and peripheral resistance. The higher cardiac output, the higher the blood pressure will be. Martini² states that the higher peripheral resistance and the smaller the blood flow cause the greater of the blood pressure. Porth³ also suggests that sometimes hypertension arises unconsciously. Its symptoms appear when the effects of hypertension involve long-term effects on the organs such as kidneys, heart, eyes, and blood vessels. According to the JNC 7¹, to treat hypertension someone could take a non-pharmacological therapy by changing his/her lifestyle and a pharmacological therapy by taking medicines. In pharmacological therapy, most of hypertensive patients need to take two or more medicines to lower their blood pressure, and the hypertension treatment usually requires a longer period of time.

The results of the study of Alleyne et al.² on the hypertension treatment using coconut water showed significant reductions in the systolic and the diastolic of blood pressure. Other studies conducted by Bhagya et al.⁵ found that tender coconut water could prevent and restore high blood pressure caused by a diet rich in the fructose which was likely to affect its hypolipidemic. Along the lines of previous studies, Indo Asian New Service⁶ mentioned the study in rats at the University of Kerala India which explained that the resistance of rats against heart disease increased after drinking coconut water. Of the 24 tested rats, 12 rats drinking coconut water did not get heart problems. The research team believed that coconut water could help patients with the heart problems because it contained potassium, calcium, and magnesium. According to Karyadi and Muhilal⁷ consuming high potassium could reduce hypertension.

Naturally, cardiac function is dependent on the electrolyte balance of calcium, potassium, and sodium. Either the increase or decrease of electrolyte will affect the heart rate frequency. In accordance with Ethel⁸ the normal heart rate ranges from 60 to 100 beats per minute, with an average pulse of 75 times per minute. With such speed, the cardiac cycle lasts for 0.8 seconds including 0.5 seconds of systole and 0.3 seconds of diastole.

The study investigated the effectiveness of genjah salak coconut water (*C. nucifera* L) in lowering the heart rate frequency of animal models induced hypertension as preclinical trials. The coconuts water was taken from 7 to 9 months-old coconuts because according to Jackson and Gordon⁹ the total content of sugars, proteins, electrolytes as well as the volume of coconut water varies based on the age of the coconuts, and the ideal parameters of coconut water content could be found in the 7 to 9 months coconut with the range of glucose levels started from 0.38 to 0.61 %. To compare with coconut water, the study also examined the effectiveness of an isotonic drink on the market.

2. Experiments

2.1. Material

In this study, the coconut water was taken from 7 to 9 months old *genjah salak* vaerietiy coconuts. The coconut trees were originally from Pematang Siantar, South Kalimantan and grown at the Research Institute for Plant of Pakuwon in Parungkuda Sukabumi. It also used an isotonic drink (mizone brand), mineral water as the control, and captopril. 40 wistar male rats weighing about 200-210 grams were used in the study

2.2. Methods

Autoclaf, This study applied an experimental method. Forty male rats were randomly divided into five groups of treatment including one group as a negative control and a group of positive control. In the subsequent treatment the rats were induced hypertension for 14 days by orally administering NaCl solution as much as 3.75 g / kg. The period of fourteen days treatment were tailored to each group. The first group was the negative group; the second group was the positive group given 1 ml/100g of mineral water; each rat in the third group was given 5 ml coconut water; each rat in the fourth group was given 5 ml isotonic drink, and the fifth group was given 4.5 mg / kg weight captopril. During the treatment, all of the rats kept being induced NaCl.

The parameters observed and measured in the study were the heart rate frequency which was performed on d0, d14 and d28 in the laboratory animal of School of Pharmacy of Bandung Institute of Technology. The instrument used to measure the heart rate was a *tail cuff*, and the heart rate measurement procedures were performed by manual instructions attached to the kit.

Data were analyzed statistically using the program of Statistical Package for Social Science (SPSS) with ANOVA method. Significant differences between the coconut water and the isotonic drink were determined by the Least Significant Difference (LSD) test. The differences were considered significant at $P \leq 0.05$.

3. Results and Discussion

Examination characterization of *genjah salak* variety coconut water (*C. nucifera* L) covers the determination of the volume of water, glucose, carbohydrate, potassium, sodium, protein, calcium, total fat, and its ash. Isotonic drinks are taken off the market and seen the levels of glucose, carbohydrate, potassium, sodium, protein, calcium, total fat, and its ash. All the coconut water characterization results can be seen in Table 1.

Table 1. The Characterization Results of *Genjah Salak* Coconut Water (*C. nucifera* L) and Isotonic Drinks

Parameter	Result	
	<i>Genjah salak</i> coconut water	Isotonic drinks
Volume of water	633.33 mL	500 mL
Glucose	0.46 %	4 %
Carbohydrate	7.35 %	7 %
Potassium	1445.3 mg/L	95 mg/L
Sodium	127.7 mg/L	110 mg/L
Protein	0.15 %	0 %
Calcium	4.1 %	6 %
Total fat	0.3 %	0 %
Ash	0.25	-

The results obtained, it is the potassium of the highest content found in coconut water. Potassium is the highest in intracellular fluid while the highest sodium in extracellular fluid. Potassium is essential to the process of protein and carbohydrate metabolism, and helps to balance acid base regulation. Sodium serves to maintain water balance, extracellular fluid volume control and affect the intracellular fluid volume, as the conduction of nerve impulses and muscle contractions, as the base electrolyte in sodium-potassium pump. Sodium in the body is regulated by salt intake, aldosterone and urine output.

Based on the time period of treatment in each group it was showed that the rats treated with coconut water experienced a decrease in heart rate significantly from 3.24 ± 0.58 to 2.24 ± 0.39 . Similarly, in the group given the isotonic drink, the rats had a decrease, although not significantly, from 2.85 ± 0.58 to 2.59 ± 0.32 . All the average results of the change in the heart rate of each treatment can be seen in Table 2.

Table 2. The Average Differences of Heart Rate Change On All Groups of Rats Induced Hypertension after the Material Tests were Given

Groups	Frequency (Hz)		
	d0	d14	d28
Negative control	2.96 ± 0.83	3.02 ± 0.70	2.67 ± 0.29
Mineral water	1.96 ± 0.78	2.45 ± 0.63	$2.98 \pm 0.59^*$
<i>Genjah salak</i> coconut water	2.58 ± 0.47	$3.24 \pm 0.58^*$	$2.24 \pm 0.39^*$
Isotonic drink	2.21 ± 0.73	$2.85 \pm 0.58^*$	2.59 ± 0.32
Captopril	1.93 ± 0.72	2.28 ± 0.58	$1.43 \pm 0.73^*$

Description: d0 = before induction, d14 = initial therapy without stopping induction d28=last therapy

To see the differences, Fig 1 displays the heart rate changes more clearly. At the treatment period from d14 to d28 when the rats of each group were treated with different test materials, it can be seen that the groups of coconut water, isotonic drinks, and captopril showed a various decrease in the heart rate. The heart rate frequency of the coconut

water group and medicine group decreased significantly, as well as isotonic drinks group although the decrease of this group was not significant. The group given mineral water (positive control group) showed an increase in heart rate frequency significantly from d0 to d28.

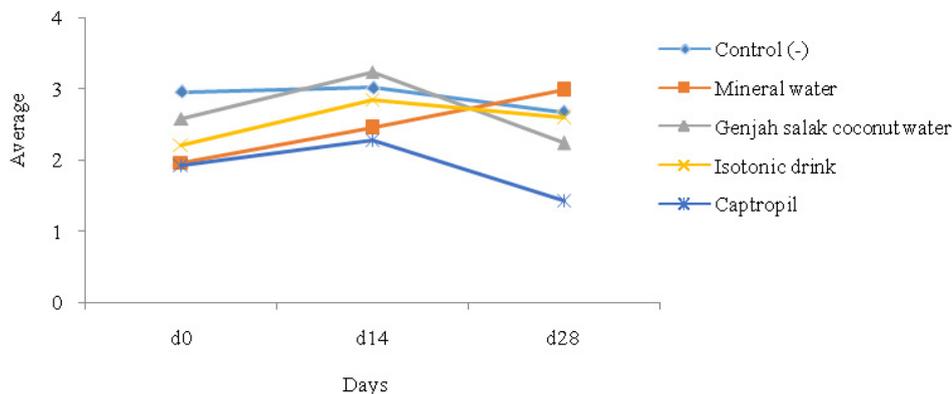


Fig. 1. The Changes of heart rate frequency on all group of rats induced hypertension after the material test were given. Description: h0=before induction, h14=initial therapy without stopping induction, H28=last therapy

The comparison of the average result of heart rate frequency between the group given the coconut water and the group given the isotonic sport drink from h0, h14 to h28 showed no significant differences so that it can be reassured that the coconut water or the isotonic drink could lower the heart rate frequency (Table 3).

Table3. The Change Comparison of Heart Rate Frequency in Rats Induced Hypertension Between the Groups of Genjah Salak Coconut Water (*C. nucifera* L) and Isotonic Drink

Treatment	Group of <i>Genjah Salak</i> Coconut Water (<i>C. nucifera</i> L)	Group of an Isotonic Drink	<i>P</i> value compare to Isotonic Drink Group
d0	2.58 ± 0.47	2.21 ± 0.73	0.23
d14	3.24 ± 0.58	2.85 ± 0.58	0.39
d28	2.24 ± 0.39	2.59 ± 0.32	0.97

4. Conclusion

The coconut water of Genjah Salak (*C. nucifera* L) lowered - the heart rate frequency better than the isotonic drink.

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