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# Formulated coconut drink can reduce dehydration and subjective fatigue in Chefs working at a restaurant kitchen

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**Abstract**

Working in hot environment such as kitchen restaurant can lead to dehydration and subjective fatigue which in the long term can impair the health of the workers. The following research was carried out to study the ability of formulated coconut drink to reduce dehydration and subjective fatigue of chefs at "X" restaurant in Semarang city-Central Java Indonesia. Formulated coconut drink was made of coconut water and formulated to contain 0,66 g/L sodium, 0,23 g/L potassium, and 7,6% reducing sugar. The coconut drink was given to the chefs at "X" restaurant in Semarang City, Central Java, Indonesia which was exposed to heat radiated from cooking in the kitchen. This study was a pre and post test control group design. Nineteen subjects were studied and their body weight, pulse rate, blood pressure, and temperature were measured before and after working each day for 6 consecutive days. The first 3 consecutive days served as control group and the second 3 consecutive days served as treatment group. Subjects in the treatment group consumed 2 x 200 mL of coconut drink everyday for 3 consecutive days. The first 200 ml were consumed in the morning before starting work and the second one were consumed in the afternoon at the break time. Subjective fatigue was measured at the first day and the last day of the study. Data were analyzed by Paired t-test, Wilcoxon, and Multivariate Analysis of Covariance (MANCOVA). The results showed that formulated coconut drink could reduce weight loss (p=0,003), pulse rate increase (p=0,008), diastolic pressure decrease (p=0,006), body temperature increase (p=0,004), and subjective fatigue (p=0,0001) of chefs working in the kitchen restaurant. When intake of energy and water for one day was added with the intake of the coconut drink, the drink still could reduce weight loss (p=0,0001), diastolic pressure decrease (p=0,032), body temperature increase (p=0,023), and subjective fatigue (p=0,006). Consuming 400 ml/day of formulated coconut drink for 3 consecutive days can give rehydration and reduce subjective fatigue of chefs exposed to radiated heat in a restaurant kitchen.



## Introduction

Long term heat exposure (ISBB > 30°C) can lead to dehydration and fatigue. Some of dehydration symptoms are weight loss, pulse rate increase, blood pressure decrease, body temperature increase, and subjective fatigue. The main indicator of dehydration is body weight loss, especially in women, as 50% of their weight is contributed by fluid. Rehydration drink can be given to prevent dehydration by replacing body fluid lost throught sweat. Rehydration drink is made to imitate the electrolyte composition of sweat. A research showed that to replace electrolyte loss through sweat, it requires 0.514 g sodium and 0.201 g potassium per L sweat (Bates and Matthew, 1997; Stellman, 1998). Indonesian government specifies that rehydration drink must contain at least 5% reducing sugar (SNI 01-4452-1998).

The aim of this study was to formulate rehydration drink based on coconut water and to study its ability to rehydrate and reduce subjective fatigue in Chefs at local restaurant. The main ingredient of the drink is coconut water as its electrolyte composition was known to be similar to body fluid and easily absorbed (Martin and Chomist, 2003). From economical point it is inexpensive and abundantly available.

## Materials and Methods

### *Formulated coconut drink*

Coconut water used in this study had 0.04-0.08 g sodium/L and 0.00019 g potassium/L. It was lower

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than the intended level of rehydration drink i.e. 0,5 g sodium/L and 0,2 g potassium/L. Therefore it is formulated to give the intended level of sodium and potassium. In addition sugar was added to assist sodium and potassium absorption as well as sensory acceptance. Determination of sodium, potassium, and reducing sugar content of the rehydration drink was done according to AOAC 2005.

*Subject of study*

Subject of this study were Chefs at "X" restaurant in Semarang city Central Java Indonesia. This study was a quasi experiment with a pre and post test control group design. Nineteen subjects were purposely chosen according to inclusion criteria i.e 1) woman 17-30 years old, 2) woman who were not pregnant nor breast feeding, 3) healthy, 4) had normal blood pressure and haemoglobin level, 5) normal body mass index (BMI), 6) minimally graduated from senior high school, 7) had been working for at least 6 month and 8) agreed to participate in the study. Subjects who were included in the study had given informed consent. Subjects were excluded if they were ill or not working during the study.

*Determination of the amount of formulated coconut drink administration*

Before administration of the drink, a preliminary study was carried out by measuring the body weight of the 19 subjects. This measurement was done to measure body weight loss due to heat exposure from working in the restaurant kitchen. The data was used to determine the amount of coconut drink administration i.e. 400 mL. The drink was also tested for acceptance by preference test before administration for the study.

*Admininstration of formulated coconut drink to the Chefs at X restaurant*

Subjects were given 400 ml formulated coconut drink per day for 3 consecutive days. The drink was given twice a day (200 ml each time) at 08.00 and 13.30 o'clock and completely drinken. The body weight, pulse, blood pressure, and body temperature were measured before (before exposure to heat) and after working (after exposure to heat) for 6 consecutive days. The first 3 consecutive days was assigned as control group (no administration of formulated coconut drink) and the second 3 consecutive days was assigned as treatment group (subjects were given and drinking formulated coconut drink). Subjective fatigue was measured at the first and last day of the study. The level of energy and fluid intake were surveyed and documented for 6 consecutive days during the study. The body weight was measured by Seca weight scale, blood pressure and pulse were measured by AD digital tensimeter, body temperature was determined by Omron ear thermometer, and subjective's fatigue was scored based on industrial fatigue research committee's subjective self rating test (Tarwaka *et al*., 2004). The data were expressed as total score of the ratings.

The independent variable of this study was administration of formulated coconut drink for 3 consecutive days. Dependent variable of this study were change of body weight, pulse rate, blood pressure (diastole and cystole), and body temperature before and after working each day for 6 consecutive days. Subjective fatigue was also measured as dependent variable. Subjective fatigue was measured at the first day and the last day of the study.

*Statistical analyses*

All data were analyzed by SPSS. Univariate analysis was used to describe the level of energy and fluid intake, as well as subjective's fatigue. Bivariate analysis and Paired t-test was used to show a change in body weight, pulse rate, cystole, diastole, and body temperature, before and after working, between control group and treatment group. It was also used to show a change in subjective's fatigue between the first days and the last day of study. Wilcoxon test was used to analyze a change in body weight, systolic pressure, and body temperature before and after working between control and treatment group. Multivariate Analysis of Covariance (MANCOVA) was used to analyze the effect of formulated coconut drink to reduce weight loss, pulse rate increase, diastole decrease, body temperature increase before and after working, as well as for subjective fatigue between control and treatment group after intake level of energy and fluid being taken into account.

## Results and Discussion

The formulated coconut drink which was used to reduce dehydration to chef at X restaurant contained 0.66g sodium/L, 0.23 g potassium/L, and 7.6% reducing sugars. Rehydration drink should have a minimum of 0.5 g sodium/L, 0.2 g potassium/L, 5% reducing sugar (SNI, 1998). On the basis of this reference, the formulated coconut drink can serve as rehydration drink.

The characteristic of subjects which were included in this study showed that the average working length of the subjects were 11 months (Table 1). Such working time was important to assure that the radiated heat from the kitchen restaurant had taken its effect (Williams, 2007). After all subjects

Table 1. Subjects included in the study

| Variables | Average±SD | Minimum[a] | Maximum[a] |
|---|---|---|---|
| Body Weight (kg) | 52,8±4,9 | 41,5 | 61 |
| Height (cm) | 157,8±5,2 | 149 | 168 |
| BMI (kg/m$^2$) | 21,1±1,5 | 18,7 | 22,8 |
| Hb (g/dl) | 12,8±0,5 | 12 | 13,9 |
| Age (year) | 21±3,3 | 17 | 30 |
| Length of work (months) | 11±4,3 | 7 | 22 |

[a] Descriptive values

had fullfilled the inclusion criteria, the kitchen temperature was recorded during the 6 days studies to estimate the amount of heat exposure to subjects. The temperature measurement during 6 days observation showed that the subjects were exposed to inapproriate temperature (Figure 1). Based on the Decre of Minister of Workforce (Keputusan Menteri Tenaga Kerja) No : Kep-51/MEN/1999, the ISBB for working environment with continous and medium working load is 26.7°C. Therefore the kitchen temperature was quite far from ideal working temperature. Such high temperature could speed the occurance of dehydration due to increase sweating (Handayani *et al.*, 2005). Furthermore it could lead to physiological disturbance such as decrease body weight and blood pressure, increase body temperature, pulse rate, and subjective fatigue. A change in physiological disturbance before and after exposure to heat radiated in the kitchen in control and treatment groups were shown that in control and treatment groups there were significant physiological changes (Figure 2). Such changes were due to dehydration of subjects which manifested in a decrease in body weight and blood pressure, increase in pulse rate and body temperature. The results of this study was similar to Muflichatun (2006) who found that welder, exposed to heat radiated from the fire also experience a decrease in blood pressure and an increase in pulse rate.

To show more clearly the difference between control and treatment groups the data were presented in Figure 3 as the difference of all variables measured. It showed that formulated coconut drink could reduce physiological changes due to radiated heat in the kitchen. To see further if the physiological changes in control groups were different significantly to treatment groups, further test was performed on each dependent variables. The test showed that there was significant difference in the average of body weight decrease, (p= 0,003), diastolic blood pressure (p=0,006), body temperature (p=0,004), and pulse rate (p= 0,008) before and after working in control or treatment groups. There was also a

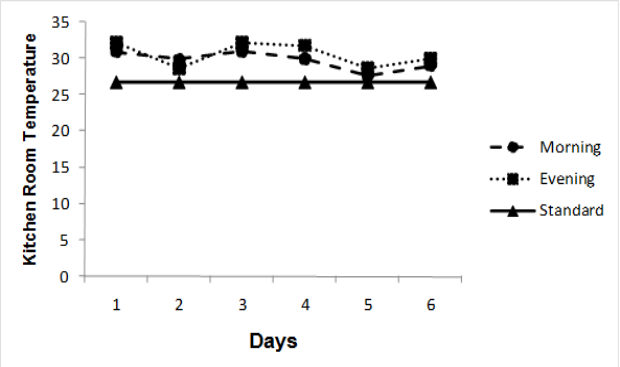


Figure 1. Kitchen room temperature during 6 days experiment

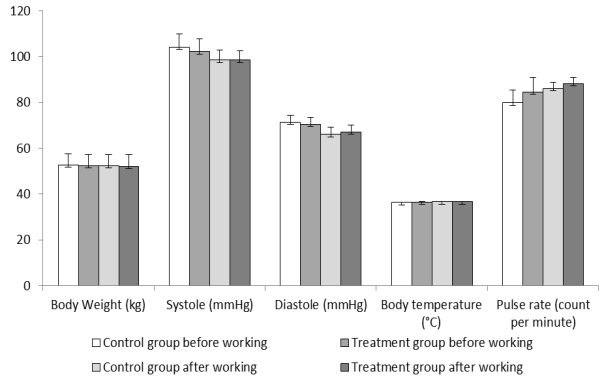


Figure 2. A change in body weight, systolic pressure, diastolic pressure, body temperature and pulse rate before and after working - in control and treatment group (all variables were significantly different at p=0.0001). The unit of each parameter on Y axis was writen in the bracket of each parameters, for example body weight was in kg.

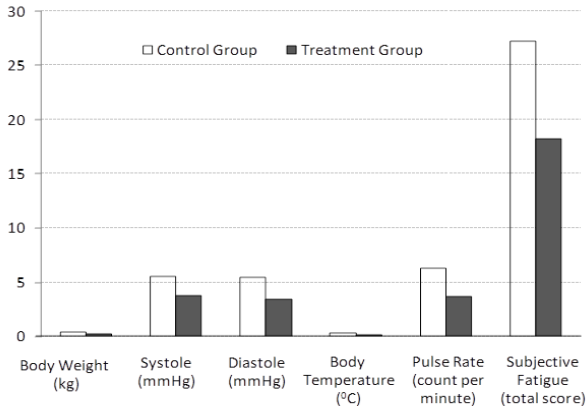


Figure 3. The difference before and after working in body weight (p=0.003), systolic pressure (p=0.083), diastolic pressure (p=0.006), body temperature (p=0.004), pulse rate (p=0.008) and subjective fatigue (p=0.0001) in control and treatment groups. The unit of each parameter on Y axis was writen in the bracket of each parameters, for example body weight was in kg, etc.

significant difference in the score of subjective fatigue (p=0,0001) in control and treatment groups. The score was smaller when subjective fatigue was less. The only variable which was not significantly

Table 2. The level of energy intake and fluid of the subjects in control and treatment group[#]

| Variable | Group | | p |
|---|---|---|---|
| | Control | Treatment | |
| Energy Intake (kcal) | 1164±115.3 | 1501±78.7 | 0.0001* |
| Energy requirement (standard) (kcal) | 1999±225.2 | 1999±225.2 | |
| The percentage of enegy intake (Energy Intake/Energy Requirement, in %) | 58.7±6.4 | 75.8±8.1 | 0.0001* |
| Fluid Intake (ml) | 1465±166.6 | 1667±102 | 0.001* |
| Fluid requirement (standard) (ml) | 2000[##] | 200[##] | |
| The percentage of energy intake (Energy Intake/Energy Requirement, in %) | 73.3±8.3 | 79±3.5 | 0.001* |

[#]Values are means ± SD

[##]As daily fluid requirement for 19-29 years old group is not the same, there is no SD for standard fluid requirement

* Significant difference ($p<0.05$)

different was the difference in sistolic pressure (p=0,083).

The data showed that formulated coconut drink can reconsitute body fluid loss via sweat. Such replenishment could prevent body weight decrease, assist in cooling body tempereature, and therefore reducing pulse rate increase and diastolic pressure decrease by raising blood volume (Mitchell *et al.* 2000; Williams, 2007). The drink could reduce the increase in peripheral blood circulation, easing blood flow to muscle, and hence reducing subjective fatigue in subjects.

To determine if the difference was due to formulated coconut drink intake a further statistical test was carried out (Table 2). Multivariate analyses showed that when energy and fluid intake for each day during the study was also added to coconut drink administration, the drink could not reduce pulse rate increase (p=0,072). Pulse rate increase was not affected either by energy intake (p=0,766) nor fluid intake (p=0,794). This might indicate that pulse rate increase in the subjects which were expose to heat radiated in the kitchen restaurant was affected by other factors such as work load. Each subject was assigned to different work specification and therefore their work load were different for each day.

When energy and fluid intake in a day were taken into account together with formulated coconut drink administration, the drink was still capable of reducing body weight decrease (p=0,0001), diastolic pressure decrease (p=0,032), body temperature increase (p=0,023), and reducing subjective fatigue (p=0,006) in Chefs at the kitchen restaurant. The change in body weight of subjects which were affected by formulated coconut drink, were also affected by fluid intake during the study. (p=0,0001). It showed that body weight change in the subjects were affected by total intake of fluid in one day (Table 2). It should be noted that the duration of the administration of formulated coconut drink in our study was only for 3 consecutive days. A longer intake of the drink (contains electrolytes) is not known yet.

## Conclusions

The formulated coconut drink contained on average 0.66 g sodium/L, 0.23 g potassium/L, and 7.6% reducing sugar. An intake of 400 ml of the drink per day for 3 consecutive days could reduce weight loss (55%), pulse rate increase (41.8%), diastolic pressure decrease (37.5%), body temperature increase (45.5%), and subjective fatigue (33.1%) in chefs exposed to heat radiated from kitchen restaurant.

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