

# Increasing the Longevity of Coconut Water

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## Abstract—

In recent years, coconut water (*Cocos nucifera* L.) has become a trendy beverage. It is tasty, refreshing and has multiple health benefits. However, the longevity of fresh coconut water is a problem for those who have restricted physical access to fresh coconuts, especially patients. This research project focuses on increasing the longevity of coconut water using the flash pasteurization technique without destroying its nutritional value. A sample of coconut water was treated using flash pasteurization technique, and stored for 30 days after that. Sensory properties (color, aroma, taste and consistency) and nutritional data of coconut water before undergoing flash pasteurization was recorded, including pH, concentration of sodium and potassium solids. The data after undergoing flash pasteurization was also be recorded in order to ensure that there is no loss in nutritional benefits. Tests were conducted after ten days and one month to test the nutritional value of stored coconut water. The study was conducted by storing coconut water in both normal environment and in refrigerated environment, and it was observed that the resulting solution of coconut water lasted for 30 days in normal environment and 10 weeks in refrigerated environment.

**Keywords** – coconut water, *Cocusnucifera*, flash pasteurization, longevity, preservation, tender  
*coconut*

## 1. Introduction

Coconut Water (*CocusNucifera*), called as '*srifal*' in Sanskrit is considered as an important fruit in Hindu mythology. Almost every new venture is started by breaking a coconut. The coconut tree is called as *kalpavriksha* (*Tree of Life*) as almost all of its parts have several uses. The preservation of green coconut water is a worldwide demanding food processing technology [1]. For increasing the longevity of coconut water, different techniques of preservation like filtration, adjustment of pH, increasing the sugar contents, ultrasonic treatment, concentrating by reverse osmosis [2] and spray drying, addition of preservatives, carbonation [3], etc., have been investigated either separately or in various combinations.

Coconut water is extracted from young tender coconuts, and is generally an opaque, almost clear juice or water. Coconut water is the liquid endosperm that is found inside the cavity of the nut. It begins forming approximately after two months after the natural opening. The volume of water in the nuts varies widely, but a coconut on an average contains approximately 300 ml of water.

It is naturally low in fat, and has a balance of sodium, magnesium, potassium and calcium, without any cholesterol. Thus, it makes an excellent electrolyte drink, that has been used for rehydration around the world for ages. Recent studies have confirmed its health benefits. Coconut water can be used for oral rehydration as it helps to recover fluid loss in patients suffering from severe dehydration <sup>[4][5]</sup>. Coconut water has also been successfully used intravenously<sup>[6]</sup>.It is reported to have antioxidant properties <sup>[7]</sup>, and thus helps in neutralizing reactive oxygen species produced due to long duration exercise <sup>[8]</sup>.Interestingly, a study has shown that regular consumption of coconut water is effective in controlling hypertension<sup>[9]</sup>.It is also an excellent remedy in cholera cases <sup>[10]</sup>. Nutrients in coconut water are as shown in Table 1.

**Table 1 : Nutrients in mature coconut water<sup>[4]</sup>**

<b>Nutrient</b>	<b>Units</b>	<b>Value per 100 grams of edible portion</b>
Water	g	94.99
Energy	kcal	19
Protein	g	0.72
Total fat	g	0.20
Ash	g	0.39
Carbohydrate	g	3.71
Fiber	g	1.1
Sugars	G	2.61
<b>Minerals</b>		
Calcium, Ca	mg	24
Iron, Fe	mg	0.29
Magnesium, Mg	mg	25
Phosphorous, K	mg	20
Potassium, K	mg	250
Sodium, Na	mg	105
Zinc, Zn	mg	0.10
Copper, Cu	mg	0.040
Manganese	mg	0.142
Selenium, Se	mg	1.0
<b>Vitamins</b>		
Vitamin C	mg	2.4
Thiamin	mg	0.030
Riboflavin	mg	0.057
Niacin	mg	0.080
Vitamin B-6	mg	0.032

The major drawback of coconut water is that it is highly sensitive to atmospheric chemical conditions, and nutritionally deteriorates very rapidly once exposed to air. This presents a serious inconvenience as coconuts are very difficult to transport and their nutritional value could be destroyed if the water is transported after extracting it from coconut. The taste of coconut water can also change, along with its nutritional value.

We therefore decided to carry out the current study with an aim to increase the longevity of coconut water without any addition of chemical preservatives whatsoever, and to maintain the taste and chemical constituents of original coconut water, using the method of flash pasteurization.

## **2. Materials and Method**

The present research study was conducted at Vishwakarma Institute of Technology, Pune

### **2.1. Raw Material**

Tender coconut water was used in the present study for the final procedure. The canning procedure for the tender coconut water is much easier than that of matured coconut water. Tender coconut water is fat free, low in calories and with high potassium<sup>[1]</sup>. Hence, it is great for replenishing lost fluids in the body. It has been used as medicine in many cultures. Its carbohydrates are easily digestible. The tender coconuts were first rinsed and cleaned with chlorinated water, then they were perforated under all aseptic conditions to avoid contamination of coconut water and fresh coconut water was obtained for the procedure. The suspended debris was removed using a nylon mesh.

### **2.2. Study Samples**

Three groups of samples, ten of each were prepared:

Group I – Pasteurized coconut water with added fresh lemon juice as preservative.

Group II – Pasteurized coconut water without any added preservative.

Group III – Unprocessed (unpasteurized) coconut water.

### **2.3. Pasteurization**

All the required instruments and apparatus were sterilized beforehand to avoid contamination. The glass bottles which can be wax sealed, were used for final collection of coconut water and were also sterilized. Lemon fruit was cut using a sterilized knife and juice was obtained using a domestic squeezer. It was strained using a muslin cloth to obtain a clear lemon juice.

The process of flash pasteurization involves a high temperature short time treatment in which the liquids are heated for three to 15 seconds to a temperature that destroys harmful microorganisms. It is generally used for pasteurization of perishable beverages like fruit and vegetable juices, milk, etc.

After sterilizing the apparatus, coconut juice was injected in holding tube, which is heated to 80°C by circulating hot water around it. This heated product was collected in a container which was soaked in ice bath, so as to decrease the temperature from 80°C to 30°C instantaneously.

Group I and II samples were packed in glass bottles after pasteurization. Group III samples were packed as it is in glass bottles. All the pure samples obtained from the experiment were stored in refrigerator at 4°C for 10 days and 1 month.



#### 2.4. Analysis of external properties

After 10 days and one month, the experimented coconut water samples were analyzed by ten different independent individuals for the qualities such as appearance, color, texture, consistency, aroma, taste, and overall quality. It was done by individuals who regularly drink coconut water and have knowledge regarding consumer preferences. It was performed on a nine point hedonic scale having a score of 9 for extreme liking and 1 for extreme disliking.

#### 2.5. The pH analysis

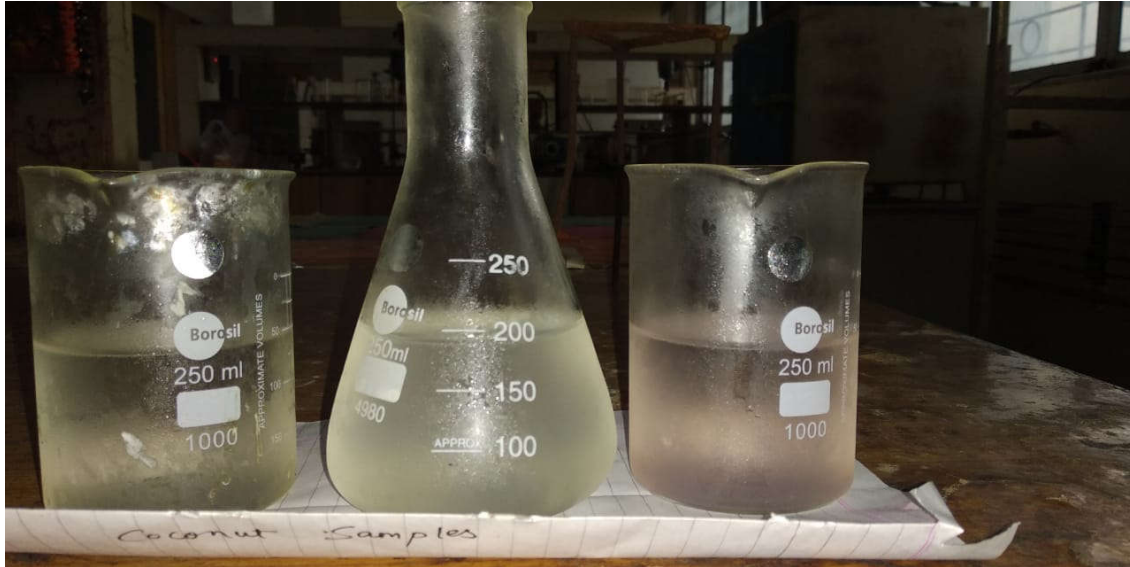
The pH scale gives information whether the given liquid is acidic or basic in nature. The range of pH scale is 0 to 14 from very acidic to very basic. The value 7 is neutral. pH less than 7 is acidic and pH greater than 7 is alkaline. Pure water has a neutral pH of 7. pH of coconut water ranges from 6.10 to 7.0. After consumption of coconut water, body's acidic level turns to alkaline. It increases mucous production in stomach which provides protection from harmful effects of excessive acid production. Coconut water also prevents recurrence of acidity.

#### 2.6. Microbial analysis

Samples were brought to microbiological laboratory. Each sample was mixed thoroughly using vortex and 5 microliter of each sample was inoculated using sterile loop on to selective media by streaking method. Then they were incubated for 48 to 72 hours at 35°C to 37°C. The plates were then examined for bacterial growth. The count was multiplied by 200 (dilution factor) to express colony forming units (CFU) per ml.<sup>[12]</sup> For evaluation of growth of yeast, the samples were diluted in peptone water and were inoculated on YMA (Yeast Malt Agar). The plates were then incubated at 25°C for five days<sup>[13]</sup>. After incubation period, the yeast growth was counted.

## 2.7. Statistical Analysis

All the collected data was analyzed using statistical software SPSS (version 20) positive chi square test and multiple regression analysis were used for the same.

**REPORT**

## Culture Report

Company: Raj Rajhans  
"Chhand", Pipeline Rd  
Savadi, Ahmednagar

Received: 26/08/2018

Sample description: Coconut water without pasteurization  
Sample ID: 20180827-041  
Run date: 27/08/2018 2:00 PM  
Report date: 28/08/2018

ID Number: 2041

## Analysis

*Mesophilic aerobic bacteria* :  $> 3 \times 10^6$  CFU/ml  
*Staphylococcus bacteria* :  $> 3.6 \times 10^6$  CFU/ml  
*E. coli bacteria* :  $> 1.5 \times 10^7$  CFU/ml  
*K. pneumonia bacteria* :  $> 2.4 \times 10^7$  CFU/ml

Notes: Macroscopically, sample is turbid, foul smelling with growth of yeast and fungus is seen. Sample is unfit for human consumption.

**REPORT**

## Culture Report

Company: Raj Rajhans  
"Chhand", Pipeline Rd  
Savadi, Ahmednagar

Received: 26/08/2018

Sample description: Pasteurized Coconut Water  
Sample ID: 20180827-047  
Run date: 27/08/2018 3:00 PM  
Report date: 28/08/2018

ID Number: 2047

## Analysis

*Mesophilic aerobic bacteria* : <0.5 CFU/ml  
*Staphylococcus bacteria* : <0.5 CFU/ml  
*E. coli bacteria* : Nil  
*K. pneumonia bacteria* : Nil

pH analysis : pH of the sample is 6.5

Notes: Sample is fit for human consumption

**REPORT**

## Culture Report

Company: Raj Rajhans  
"Chhand", Pipeline Rd  
Savadi, Ahmednagar

Received: 26/08/2018

Sample description: Pasteurized Coconut Water with added lemon juice  
Sample ID: 20180826-052  
Run date: 27/08/2018 4:00 PM  
Report date: 29/08/2018

ID Number: 2052

## Analysis

*Mesophilic aerobic bacteria* : <0.1 CFU/ml  
*Staphylococcus bacteria* : <0.1 CFU/ml  
*E. coli bacteria* : Nil  
*K. pneumonia bacteria* : Nil

pH analysis : pH of the sample is 6.0

Notes: Sample is fit for human consumption

**REPORT**

## Culture Report

Company: Raj Rajhans  
"Chhand", Pipeline Rd  
Savedi, Ahmednagar

Received: 14/09/2018

Sample description: Pasteurized Coconut Water  
Sample ID: 20180914-025  
Run date: 14/09/2018 3:00 PM  
Report date: 16/09/2018

ID Number: 2025

## Analysis

*Mesophilic aerobic bacteria* : <0.5 CFU/ml  
*Staphylococcus bacteria* : <0.5 CFU/ml  
*E. coli bacteria* : Nil  
*K. pneumonia bacteria* : Nil

pH analysis : pH of the sample is 6.8

Notes: Sample is fit for human consumption

**REPORT**

## Culture Report

Company: Raj Rajhans  
"Chhand", Pipeline Rd  
Savedi, Ahmednagar

Received: 14/09/2018

Sample description: Pasteurized Coconut Water with added lemon juice  
Sample ID: 20180914-026  
Run date: 14/09/2018 4:00 PM  
Report date: 16/09/2018

ID Number: 2026

## Analysis

*Mesophilic aerobic bacteria* : <0.1 CFU/ml  
*Staphylococcus bacteria* : <0.1 CFU/ml  
*E. coli bacteria* : Nil  
*K. pneumonia bacteria* : Nil

pH analysis : pH of the sample is 6.0

Notes: Sample is fit for human consumption



### 3. Results and Discussion

The sample which was kept refrigerated without any pasteurization underwent rapid deterioration. Its taste, consistency changed over the course of few days. After seven days, cloudiness developed in the sample and it became unfit for consumption. Pasteurized coconut water sample showed significantly less bacterial count than the one without pasteurization. In first few weeks, the bacterial count in pasteurized sample was zero. The appearance of the three samples by keeping them at room temperature is as follows -

Sample	Appearance
Group I (Pasteurized with added lemon juice as preservative)	Clear
Group II (Pasteurized)	Clear
Group III (Unpasteurized )	Cloudy

Group I (Pasteurized with added lemon juice as preservative) samples' pH was observed lower than normal due to the added lemon juice.

Both group I and group II samples had no significant effect on sensory properties (color, aroma, taste and consistency) and soluble solid content of coconut water. The sample showed balance of sodium, magnesium, potassium and calcium. However, Group I(sample with added lemon juice) showed better taste, aroma and other sensory properties compared to Group II. Other studies have shown similar results in case of addition of lemon juice<sup>[13]</sup>.

Future studies involving larger sample size and evaluating effects for longer duration are recommended before commercial use.

### 4. Conclusion

The study indicated the feasibility of flash pasteurization as a method to increase the shelf life of coconut water. In both pasteurized sample and pasteurized with added lemon juice samples, few differences in physical and nutritional attributes were indicated. There was no change in sensory properties of coconut water (color, aroma, taste, and consistency), soluble sugars and vitamin content.

Overall, the study demonstrated that flash pasteurization could be used as a technique for increasing longevity of coconut water. Sample stored at room temperature could last upto four weeks whereas refrigerated sample could last more than 8-10 weeks while retaining the original nutritional and chemical properties of coconut water.



## 5. Acknowledgements

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