



A review: an overview on study of physico-chemical parameters chemical composition and biological properties of coconut water

S A Najan

Assistant Professor, Department of Chemistry, Arts, Commerce and Science College, Sonai, Tal Newasa, Ahmednagar, Maharashtra, India

Abstract

The Coconut water with its many applications is one of the world's most versatile natural products. The coconut water is a natural, nutritious and healthy beverage. There is increasing scientific evidence that supports the role of coconut water in health and medicinal applications. The wide applications of coconut water can be justified by its unique chemical composition of sugars, vitamins, minerals, amino acids etc.

This review attempts to summarize and evaluate the chemical composition and biological properties of coconut water.

Keywords: coconut water, composition, physicochemical properties

Literature Review

Optimum Physico-Chemical and Processing Parameters for the Preservation of King Coconut Water was studied by the K.D.P.P. Gunathilake and R.M.C.N. Rathnayake. The composition of the King coconut water was analyzed in triplicate for all parameters. Total solids and ash content were determined by using the method described in Ranganna (2000) [1]. Total sugars were determined by using a colorimetric method described by Dubois *et al.*, 1956 [2]. Absorbance was measured at 645 nm using UV/VIS spectrophotometer (Shimadzu UV 160-A, Japan). Sodium and Potassium content were measured at 589 nm for Na⁺ and 766.5nm for K⁺ using Atomic Absorption Spectrophotometer (GBC 904 AA, Japan) according the method described in Association of Analytical Chemists (AOAC, 1995). [3]. Calcium and magnesium content was measured at 422.7nm (for Ca²⁺) and 285.2nm (for Mg²⁺) using the AOAC, (1995) [3]. Total soluble solid or Brix of coconut water was measured using a hand held refractometer (ATAGO NI-E). Total acidity was measured by titrating with 0.1N NaOH and phenolphthalein as indicator and calculated as percentage of citric acid (Ranganna, 2000) [1]. The pH was determined using TOA IM-450 pH meter at 25 °C. Ascorbic acid content of King Coconut water was determined by using Ranganna, 2000.

Optimization of physical chemical and processing parameters

Preliminary studies were conducted to identify the optimum physico-chemical and processing conditions based on sensory evaluation by using a semi trained panelists. Four levels of pH were evaluated within the range of 4.0 to 4.7 and it was found that mean sensory scores for the King coconut water within the selected pH range insignificant ($p < 0.05$). The limiting pH for most food poisoning bacteria is 4.5 [4]. Therefore pH level 4.4 was selected for the processing of King Coconut water to extend the shelf life. Composition and Physicochemical Properties of Fresh and Freeze-Concentrated Coconut (*Cocos nucifera*) Water was

studied by Seow Eng Kenga, Azhar Mat Easaa, Ahmad Munir Che Muhamedb, Cheong-Hwa Ooib, and Tan Thuan Chewa. Changes in pH were apparent due to maturity as well as after the freeze-concentration process. The pH (5.67 to 5.81) of coconut water was found to increase with maturity. This trend compared favourably with those reported by Santoso *et al.* (1996) [5], Jackson *et al.* (2004) [6], Terdwongworakul *et al.* (2009) [7] and Tan *et al.* (2014) [8]. During the ripening process of the coconut fruit, organic acid content (predominantly malic acid) of the coconut water was degraded and this accompanied by a steady increase in pH value from young to mature coconut water. After the freeze-concentration, freeze-concentrated coconut water was significantly lower ($P < 0.05$) in pH. Thus, the decrease in pH shows that the acidity of the coconut water is increasing as the organic acids content increases in concentration. The decrease in pH (5.17 to 5.00) after freeze-concentration process is supported by the finding from Lo *et al.* (2007) [9] where pH of sugar-cane juice decreased after the freeze-concentration. This might be due to the concentrating process, where part of the organic acids stays trapped in the concentrate (Galić *et al.*, 2009) [10]. Minerals are the second most constituents in coconut water, with K as the predominant mineral (Yong *et al.*, 2009 [11] Solangi and Iqbal, 2011 [12] Tan *et al.*, 2014) [8]. The K content in GC water is significantly higher ($P < 0.05$) than MC water, wherein the reverse trend is observed for Mg, Na, Ca, and Fe contents. In general, MC water has a significantly higher ($P < 0.05$) mineral content in comparison with GC water. There is a significant difference ($P < 0.05$) for all the samples of coconut water after freeze-concentration process. The result is in line with the findings with increase in P, Mg, K, and Ca contents of the concentrated pineapple juice (Couto *et al.*, 2011) [13], and Mg and Na contents in freeze-concentrated tofu whey (Belén *et al.*, 2013) [14]. Interaction between the same molecules formed clusters during the freeze-concentration process, whereby big molecules were separated from the ice crystals and possibly remained in high concentration in the coconut

water concentrate, resulting in the increase of minerals concentration. It has been reported that the level of minerals content in the coconut water depends on their presences in the soil, water irrigation, and the species of coconut cultivars (Solangi and Iqbal, 2011) [12].

The physicochemical properties comparison of the natural coconut water and the packaging coconut water was studied by Christyanita P Ekasari¹ and Sri Widyarti.

pH, turbidity and conductivity analysis

The pH measurement result showed that all samples had pH which was not much different from each other. The pH of all samples ranged from 5.42 to 5.49. That result is not much different with [15] which stated that coconut water has acid pH with range of 5.0 to 5.4. Water with freer hydrogen ion (H^+) will be acidic, while water with freer hydroxyl ion (OH^-) will be alkaline [16]. Temperature did not affect the pH measurement result. It is proved from the pH of the samples which was not changed after heating. Temperature does not cause dissociation in weak acid or base [17]. Turbidity is a parameter to measure the light intensity which is spread by suspended particles. The suspended particles block the light through water [16]. Turbidity measurement result was highly varied. Turbidity of all samples ranged from 19.48 to 69.63 NTU. A PCW had higher turbidity than an NCW (heating or unheating). The high turbidity is possibly caused by sodium carbonate as preservative and citric acid as acidity regulator [18]. Turbidity of all samples decreased after heating, except for 3rd repetition of NCW and PCW, so it is known that heating slightly decreased the turbidity of coconut water. Heating might cause the insoluble substances (suspended particles) of coconut water to be slightly soluble.

Conductivity measurement result was highly varied in all samples. Conductivity ranged from 15.48 to 19.88 mS the increasing or decreasing of conductivity was not significant, so there was a bit difference of conductivity between heating and unheating samples. Heating did not affect the conductivity of coconut water. Conductivity is used to measure the ion concentration in a solution [19]. Conductivity shows the amount of soluble salt in coconut water. The soluble salt concentration associated with plant capacity in absorbing nutrition from soil [20]. Conductivity is measured in electrolyte solution. Electrolyte is a substance that contains ion, i.e. ionic salt solution or ionized substance in solution. The ion formed in a solution plays a role in conducting electricity. Some electrolyte such as acid, base, or salt can be weak or strong [21]. Coconut water is a weak electrolyte. Weak electrolyte is a substance which is not fully ionized in solution. Weak electrolyte solution can conduct electricity, but not as easy as strong electrolyte because weak electrolyte has fewer ions which bring the charge from one electrode to another electrode [21].

Comparative Study of Physico-Chemical Parameters of Tender Coconut Water was studied by Uphade B.K. and Gadhave A.G. The coconut water from irrigated and non-irrigated areas having different pH and different chemical composition. The pH of coconut water from irrigated areas was analyzed and reported 4.7 to 5.1. The pH of coconut water from non-irrigated areas was analyzed and reported 3.4 to 4.2. The chemical composition of tender coconut water in irrigated areas having values in mg% of sodium (45.2 to 50.7), potassium (283.4 to 295.0), calcium(45.3 to 50.9), phosphorous (8.9 to 9.8), iron (114.7 to 117.8), magnesium (11.4 to 17.1), copper (6.1 to 8.8), chloride

(101.9 to 118.7) and sulphate (7.9 to 13.6). The chemical composition of tender coconut water in non-irrigated areas having values in mg% sodium (42.4 to 485), potassium (278.4 to 287.6), calcium(42.7 to 49.3), phosphorous (8.1 to 9.2), iron (112.3 to 116.1), magnesium (10.1 to 12.7), copper (5.4 to 7.7), chloride (99.1 to 105.4) and sulphate (6.6 to 9.5). From this result it is observed the pH and chemical composition of irrigated coconut water is higher than non-irrigated coconut water. The coconut plants were situated near canal and Pravara River which carry municipal waste, industrial waste and domestic waste materials therefore it shows higher values for certain parameters. The higher amount of certain ions is mainly due to the selective absorption by plants. The coconut water from irrigated as well as non-irrigated region shows differences in phosphorous, sulphate and chloride content [21, 23].

Conclusions

On the review of these papers authors conclude that the coconut water is slightly acidic in nature. It contains the metal ions which are useful for human health is medicinally useful. The pH values of all review papers are below the permissible level of drinking water.

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