

Nutrition Studies on Mature and Immature Coconut Meat and Coconut Water

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Abstract

Coconuts are one of the most nutritious fruits. The nutrients and physical characteristics change as a coconut mature. In this research, coconuts (mature and immature stages) were subjected to analyze for physicochemical properties of coconut meat and coconut water. Coconut samples were collected from Tharkayta Township, Yangon Region. Nutritional values such as protein, fat, fiber and carbohydrate of coconut meat and water (mature and immature stages) were determined. Determination of protein contents was made by Micro-Kjeldahl method. Examination of fat contents was carried out by Soxhlet extraction method. Investigation of fiber contents were performed by Acid-base treatment method. In addition, carbohydrate contents were determined by AOAC official method. Moreover, pH values were measured by pH meter, water contents by Dean and Stark distillation method and ash contents by Ashing method. Mineral contents (K, Na, Ca, Mg, Fe, As and Cd) were also determined by atomic absorption spectrophotometric method. The results of compositions of coconut samples showed a significant increase in protein, fiber, fat and carbohydrate and calorie contents but decrease in water content as coconut mature. All the analyzed samples were acidic pH range and are termed as low acid foods except immature coconut water. The chemical analysis of coconut meat and coconut water (mature and immature stages) showed highest percentage of potassium among the minerals.

Keywords: coconut meat, coconut water, protein, fat, fiber, carbohydrate, mineral

Introduction

The coconut palm (*Cocos nucifera* Linn.) is found throughout the tropics (Website 1). All full maturity, coconut consists of an average of 33 % husk, 16 % shell, 33 % kernel and 18 % coconut water. Coconut water

Pacific islands such as Hawaii, Africa and the Caribbean. Coconut meat is a large part of the diet for many people who live in tropical region. Coconuts are not only sources of nutrients but also have been reported as therapeutic foods useful in preventing diseases.

The coconut meat is good sources of protein, fat and carbohydrate (Balleza and Zenaida, 1976). It contains minerals, vitamins, dietary fibers, sugars, organic acids, fatty acids composition and amino acid. It is relatively high in minerals such as irons, phosphorous, magnesium, sodium and zinc. Coconut meat nutrition is very high and great source of dietary fiber, which can help regulate digestion. The fiber in coconut has been found to lower blood sugar levels because it slows down the conversion of carbohydrates into sugar, thus lowering one's blood sugar level (Website 2). The nutrients and physical characteristics change as a coconut mature about the same amount of nutritional benefit from mature coconuts can get young coconuts if both the liquid and its meat consume. Moreover, more energy can get consuming young coconut liquid and meat than consuming mature coconut liquid and not only that but young coconut taste much better.

Coconut water is the most nutritious wholesome beverage that the nature has provided for the people of the tropics to fight the sultry heat (Website 3). Coconut water contains small amounts of protein and most of the minerals such as potassium, sodium, calcium, phosphorus, iron, copper, sulphur and chloride. It also supports both the immune and nervous systems and promotes stable blood sugar levels. It contains a variety of nutrients including vitamins, minerals, antioxidants, amino acids, enzymes, growth factors and other nutrients. Coconut water is considered an excellent remedy for rehydration or to prevent dehydration as well as

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being a means of boosting your immune system (Website 4). Coconut water is used extensively as a treatment for cholera, dysentery and other infectious diseases that promote dehydration. It has a therapeutic effect on the urinary and reproductive systems. It is reported to remove kidney stones and (Campbell-Falack, 2000). Coconut water consumption reduces the risk of heart failure in heart disease. It improves blood circulation and benefit to diabetes.

Aim and Objectives

The aim of this research is to compare the nutritional values of coconut meat and coconut water (mature and immature stages) from analytical point of view. To fulfill this aim following objectives were carried out.

- To analyze the nutritional value (contents of protein, fat, fiber, carbohydrate) including pH, water, ash in coconut meat and coconut water samples
- To determine the mineral contents in coconut meat and coconut water samples
- To compare the results obtained from analysis of coconut meat and coconut water samples

Botanical Description



Fig. 1 Coconut

Kingdom	: Plantae
Family	: Arecaceae
Subfamily	: Cocoideae
Genus	: <i>Cocos</i>
Common name	: Coconut
Botanical name	: <i>Cocos nucifera</i> Linn.

Material and Methods

Collection of Samples

The samples studied such as coconut meat and coconut water were collected from the Tharkayta Township of Yangon Region.

Preparation of Samples

On arrival at the laboratory, outer husk was removed and water was transferred into a new and clean polythene bottle through an eye of middle hard shell. Filtered through glass wool, placed into other polythene bottle and then hard shell was removed to obtain coconut meat. Coconut meat and coconut water samples were kept cool in a refrigerator at 4 °C for investigation (Website 5).

Physicochemical Analysis

The chemical procedures were for protein contents which were determined by micro-Kjeldahl method, fat contents by Soxhlet extraction method, fiber contents by Acid-base treatment method, carbohydrate contents by AOAC official method. Moreover, pH values were

measured by pH meter, water contents by Dean and Stark distillation method and ash contents by ashing method. Mineral contents (K, Na, Ca, Mg, Fe, As and Cd) were also determined by Atomic Absorption Spectrophotometric method. Some apparatus used in this research were Schott Gerate CG 712 pH meter, a graduated “Dean and Stark” moisture trap, an electric carbolite furnace (max. tem. 1600 °C, England), a digestion unit (max. temp. 300 °C, Gallenkamp England), and a Soxhlet extractor, a Perkin Elmer Analyst 800 Atomic Absorption Spectrophotometer at the Universities’ Research Centre (URC), University of Yangon, Yangon Region.

Results and Discussion

Determination of Protein Content

The Kjeldahl method estimate the total nitrogen which is converted to total crude protein by means of an empirical factor usually which is dependent on the proportion of the various nitrogenous compounds present in a particular sample (Kuberski *et al.*, 1979). The total nitrogen includes both protein nitrogen and non protein nitrogen such as TVB-N and amino acids. In this research, after deducting free ammonia from total nitrogen, the protein nitrogen was obtained. Coconut water contain small amount of protein. The nitrogen and total protein content of coconut meat increased gradually with maturation. The mean protein content of coconut meat and coconut water samples was shown in Table 1. It was found that coconut meat (mature and immature stages) contains higher protein content whereas coconut water (mature and immature stages) contains small amount of proteins. Moreover mature coconut meat has higher protein content (1.11 %) than immature coconut meat (0.66 %) as well as mature coconut water has higher protein content (0.81 %) than immature coconut water (0.66 %). It can be concluded that protein content of coconut meat increased after maturation.

Determination of Fat Content

Lipid compounds such as free fatty acids, tri-, di- and monoglycerides, phospholipids, sterols and derivative can be extracted from coconut meat and coconut water as crude fat (Cook *et al.*, 2004). The fat content of coconut meat and coconut water sample was determined by using Soxhlet extraction with petroleum ether (60-80 °C). The data was listed in Table 1. In comparison between fat content of both mature and immature coconut meat and water samples, coconut meat samples had higher fat content than coconut water samples. The highest fat content, 6.83 % was found in mature coconut meat. It can be suggested that the fat content of coconut increased when it is mature. The low fat contents are also important from a nutritional perspective. Therefore it is most suitable to eat immature coconut from the view point of fat content only. Coconut meat samples have higher fat content than coconut water samples. Mature coconut meat sample has the highest fat content among the samples. It indicated that fat content of coconut also increases in mature.

Determination of Fiber Content

Fiber is the structural part of the plant and is part of a healthy diet (Dolendo, 1969). Coconut fiber has all the benefits of other dietary fibers, it lowers risk of heart disease, help to prevent cancer, improve digestive function, helps regulate blood sugar, *etc.* Eating more fiber (soluble and insoluble) is a great tip for weight loss. Coconuts are a great source of dietary fiber, which can help to regulate digestion. Unlike most forms of coconuts actually taste good (Website 3). Fiber contents of coconut samples were shown in Table 1. It was found that the highest fiber content, 7.19 % was found to be present in mature coconut meat sample whereas coconut water samples were absence in fiber. Coconut fiber unlike most forms of fiber and is actually taste good.

Table 1 Protein, Fat, Fiber Contents in Coconut Meat and Coconut Water Samples

No.	Sample	Protein content (%)	Fat content (%)	Fiber content (%)
1	Mature coconut meat	2.41 ± 0.03	6.83 ± 0.03	7.19 ± 0.02
2	Immature coconut meat	0.90 ± 0.02	1.38 ± 0.05	0.61 ± 0.01
3	Mature coconut water	0.31 ± 0.04	0.18 ± 0.04	-
4	Immature coconut water	0.13 ± 0.03	0.12 ± 0.06	-

Determination of Carbohydrate and Calorie Contents

Plants are the main source of dietary carbohydrates (Cesar *et al.*, 1989). Carbohydrate and calorie contents in coconut meat and coconut water samples were shown in Table 2 and Figure 2. It was found that coconut meat had higher carbohydrate and calorie contents than the coconut water in mature and immature stages.

Table 2 Carbohydrate and Calorie Contents in Coconut Meat and Coconut Water Samples

No.	Sample	Carbohydrate content (%)	Calorie content cal/100g
1	Mature coconut meat	36.57 ± 0.05	217.39 ± 0.01
2	Immature coconut meat	5.38 ± 0.04	37.54 ± 0.03
3	Mature coconut water	8.47 ± 0.06	36.46 ± 0.02
4	Immature coconut water	3.24 ± 0.01	14.56 ± 0.01

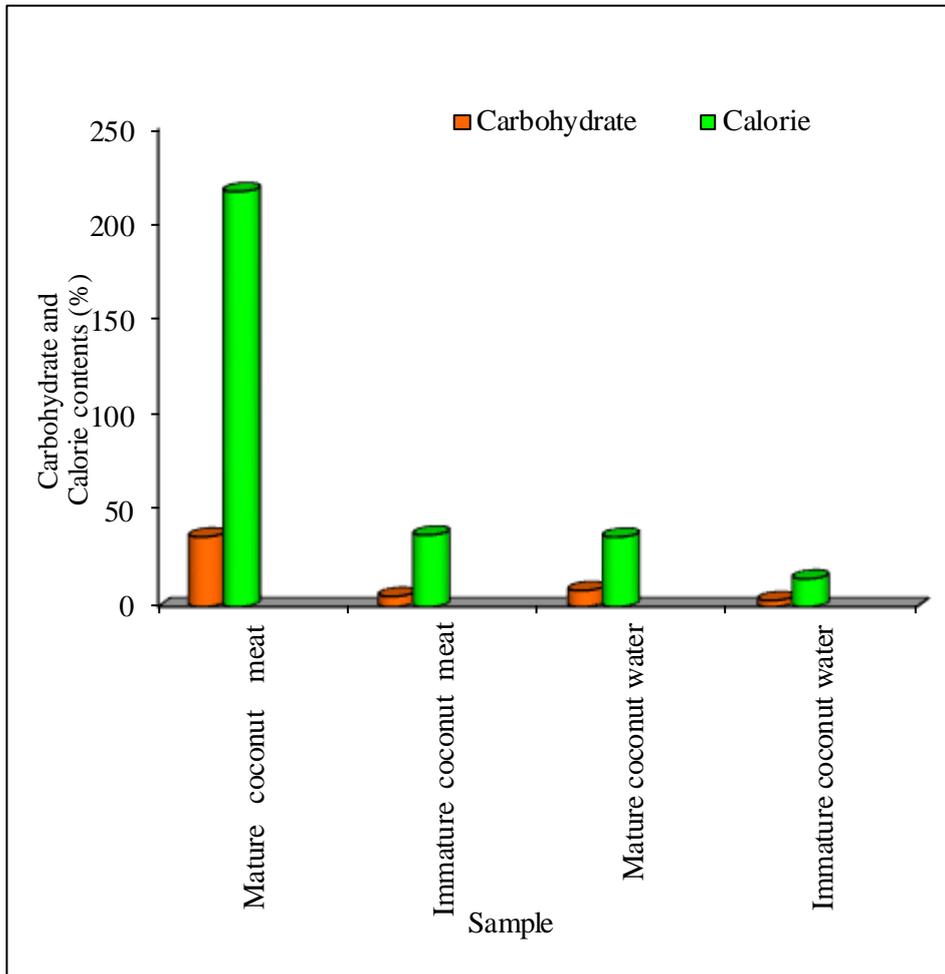


Fig. 2 Histogram of carbohydrate and calorie contents in coconut meat and coconut water samples

Measurement of pH

Food with a pH of 4.6 is termed high acid foods. If the pH is above 4.6, it is a low acid food (Jeganathan, 1992). The pH values of mature and immature coconut meats were found to be 6.2 and 5.3 whereas 5.8 and 4.1 for coconut water (Table 3). All the pH values were found in the acidic pH range. The pH values of all coconut samples indicated low acid food except immature coconut water. Both mature and immature coconut samples, the pH value of coconut meat was higher than that of the coconut water. It was in agreement with literature value of 3.5 to 6.1 (Website 4).

Determination of Water Content

The determination of moisture content or rather the water content is one of the most important and most widely used analytical measurements in the processing and testing of foods. In this study, water content (%) was determined by the Dean and Stark distillation method. This method is a better one for the determination of water since it is a direct measure of the water content in a given sample. The method is better than the conventional method of loss in weight by heating at 100-105°C is not included and the amount of water is easily seen from the graduated tube. The mean results of water content in mature and immature coconut meat and coconut water samples were shown in Table 3. In comparison between water content of coconut meat and coconut water (mature and immature stages) showed that coconut meat

has lower water content than coconut water. It can be suggested that coconut water is gradually replaced by the coconut meat and air when coconut mature.

Determination of Ash Content

The ash of any food is composed of their non-volatile inorganic components (Website 5). The ash content of coconut is defined the residue remaining after ignition at 575 ± 25 °C for 3 hours or longer if necessary, burning off all the carbon. It is a measure of mineral salts and inorganic matter in the coconut water and coconut meat samples. An important determination of the analysis of a food is the estimation of the amount of ash it contains. The results were shown in Table 3. Ash contents of coconut meat and coconut water (mature stage) were slightly different but coconut meat and coconut water (immature stage) were not significantly different.

Table 3 pH, Water content and Ash content in Coconut Meat and Coconut Water Samples

No.	Sample	pH	Water content (%)	Ash content (%)
1	Mature coconut meat	6.2 ± 0.1	45.89 ± 0.02	1.11 ± 0.04
2	Immature coconut meat	5.3 ± 0.2	91.07 ± 0.07	0.66 ± 0.01
3	Mature coconut water	5.8 ± 0.1	90.23 ± 0.03	0.81 ± 0.03
4	Immature coconut water	4.1 ± 0.1	95.89 ± 0.03	0.62 ± 0.04

Determination of Mineral Contents

Minerals are the constituents remaining as ash after calcinations. There are seventeen known essential minerals and many others trace minerals that are all needed for good health (Website 5). Several trace elements may be toxic depending of the food intake. The Perkin Elmer Analyst 800 Atomic Absorption Spectrometer with deuterium arc background corrector, a Perkin Elmer hollow cathode lamps of Na (589 nm), Ca (422.7 nm) Cd (228.8 nm), Fe (248.3 nm), K (766.5 nm) and As (193.7 nm), and acetylene as an inert gas were used for the determination of minerals in coconut. Mineral contents in coconut meat and coconut water samples by AAS shown in table 4 and figure 3. It was found that coconut meat and coconut water contain most of the minerals such as K, Na, Ca, Mg, Fe and Zn. The chemical analysis of coconut meat and coconut water (mature and immature stages) showed highest percentage of potassium (98.31 - 79.24 ppm) among the minerals. Low content of iron (0.938 - 0.246 ppm) was observed in all of the samples. Arsenic and cadmium were not detected in analyzed samples. Potassium decreases on maturation and sodium shows an increase. Calcium, magnesium and iron contents in coconut water did not exhibit any particular trend on maturation. Therefore coconut is a good source of major minerals like potassium, magnesium and sodium.

Table 4 Mineral Contents in Coconut Meat and Coconut Water Samples by AAS

No.	Sample	Mineral content (ppm)							
		K	Na	Ca	Mg	Fe	Zn	As	Cd
1	Mature coconut meat	98.310	18.82	2.743	10.30	0.938	1.070	ND	ND
		± 0.001	± 0.006	± 0.011	± 0.003	± 0.007	± 0.005		
2	Immature coconut meat	83.050	20.28	2.547	10.50	0.925	1.060	ND	ND
		± 0.001	± 0.007	± 0.011	± 0.005	± 0.004	± 0.002		
3	Mature coconut water	86.440	30.27	5.423	7.517	0.278	0.147	ND	ND
		± 0.001	± 0.028	± 0.052	± 0.004	± 0.004	± 0.003		
4	Immature coconut water	79.240	37.17	5.025	7.115	0.264	0.138	ND	ND
		± 0.002	± 0.023	± 0.063	± 0.004	± 0.003	± 0.005		

ND = Not Detected

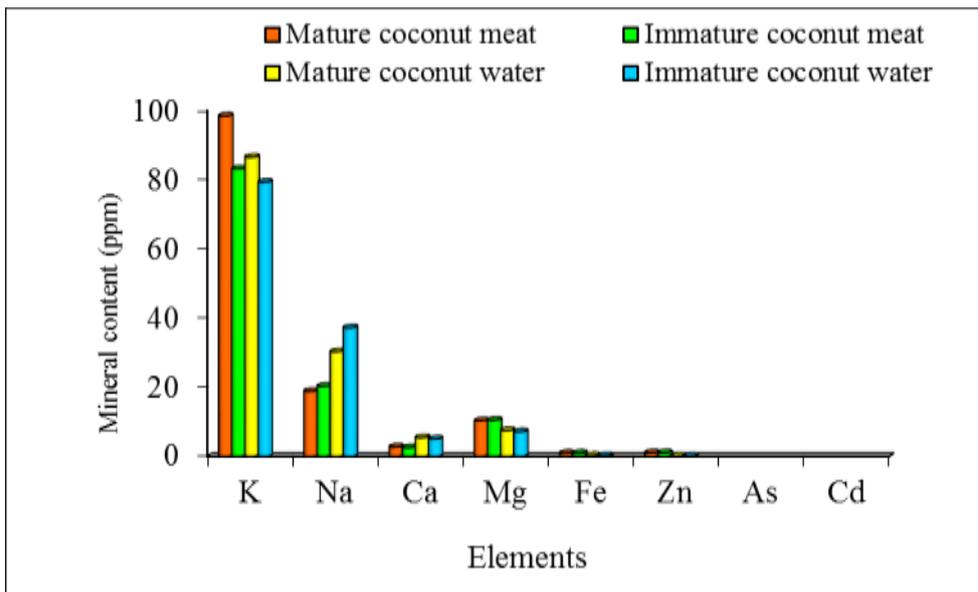


Fig. 3 Histogram of mineral contents in coconut meat and coconut water samples

Conclusion

In this research coconut mature and immature stages were subjected to analyze for comparison of physicochemical properties of coconut meat and coconut water. High protein content was found to be present in mature coconut meat (2.41 %) and immature coconut meat (0.90 %) and mature and immature coconut water were 0.31 % and 0.13 %, respectively. Fat content of mature coconut meat sample was 6.83 %. Mature and immature coconut meat samples had higher fat content than coconut water samples. The fiber contents of mature coconut meat and immature coconut meat were 7.19 % and 0.61 %, respectively. Coconut water samples were absence in fiber. Coconut meat had higher carbohydrate and calorie contents than the coconut water in mature and immature stages. The pH values of mature and immature coconut meat were found to be 6.2 and 5.3 whereas 5.8 and 4.1 for coconut water. Water contents of mature and immature coconut meat samples were 45.89 % and 91.07 % and coconut water samples were 90.23 % and 95.89 %, respectively. The results showed 1.11 % of ash in mature coconut meat and 0.66 % of ash in immature coconut meat. Ash contents of mature and immature coconut water samples contain 0.81 % and 0.62 %, respectively. Coconut meat and coconut water contained most of the minerals such as K, Na, Ca, Mg, Fe and Zn. The chemical analysis of coconut meat and coconut water (mature and

immature stages) showed highest percentage of potassium among the minerals. Low content of iron was found to be present in all of the samples. As and Cd were not detected in analyzed samples. Therefore coconut is a good source of major minerals like potassium, magnesium and sodium. The results of compositions of coconut samples showed a significant increase in protein, fat and carbohydrate and calorie contents but decrease in water content as coconut mature. It can be concluded that coconut meat are a good source of protein, dietary fiber, fat and carbohydrate. This research work will be benefit for the consumer's health information about the nutritional values of eating coconut meat and coconut water in mature and immature stages.

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Online Materials

1. Coconut Research Center
(<http://www.coconutresearchcenter.org/html>)
2. *Cocos nucifera* information
(<http://www.hear.org/species/cocos-nucifera/html>)
3. Coconut, Plant of Many Uses
(<http://www.botgard.ucla.edu/html/botanytextbooks/economicbotan/Cocos/index.html>)
4. Data Analysis Manual for Coconut Researchers
(http://www.bioversity_international.org/nc/publications/issue/data_analysis_manual_for_coconut_researchers.html)
5. Coconut: A Guide to Traditional and Improved Varieties
(<http://www.fordham.edu/halsall/source/1354-bnbattuta.html>)