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Advances in Agronomy, Plant Breeding and Horticulture

Vol. 7 (3), pp.35 - 39, July, 2019

Examination of constituents of coconut natural product for dietary and therapeutic purposes

Jonathan H. T and Priscilla J. N

Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Abstract

Analysis of constituents of coconut fruit for nutritional and medicinal purposes for people from diverse culture was done to establish the scientific claims for its diverse medicinal applications. The concentrations of glucose, calcium, potassium, sodium, iron, zinc along with that of vitamins C and E in the coconut milk and oil were determined using standard laboratory methods, while pH and specific gravity of coconut milk and oil were also estimated. The mean concentrations of constituents of coconut milk were 2645.7 ± 275.3 mg/L for glucose, 0.46 ± 0.06 mg/L for vitamin C, 0.14 ± 0.02 mg/L for vitamin E, 2130.6 ± 144.4 mg/L for calcium, 24.56 ± 2.61 mg/L for iron, 7.06 ± 0.88 mg/L for zinc, 1127 ± 105.7 Meq/L for potassium and 20.22 ± 2.46 Meq/L for sodium, respectively. Coconut oil contained 347.4 52.9 mg/L of glucose, 0.11 ± 0.02mg/L of vitamin C, 0.05 ± 0.004 mg/L of vitamin E, 102.6 ± 18.2 mg/L of calcium, 4.53 ± 0.61 mg/L of iron, 1.04 ± 0.15 mg/L of zinc, 222.5 ± 54.0 Meq/L of potassium and 3.01 ± 0.20 Meq/L of sodium, respectively. The difference between the concentrations of nutrients in coconut milk and coconut oil was statistically significant (P < 0.05); coconut milk is a richer source of the aforementioned nutrients than its oil; routine consumption of coconut or its medicinal application especially in medical conditions where some of the aforementioned nutrients are implicated could be considered.

Keywords: Coconut, glucose, calcium, potassium, sodium, iron, zinc.

INTRODUCTION

Coconut is a large hard shelled seed of coconut palm, lined with a white edible part, *Cocos nucifera* is the botanical name of coconut palm; it is an important member of the family Arecaceae or Palmae. There are over sixty species under genus *Cocos* but coconut is the only acceptable specie in this genus, consequently every coconut palm in the world is taxonomically the same (Child, 1985). There are two major classes of coconut palm, the Tall and Dwarf. The ones commonly planted for commercial purposes are the tall varieties which flowers 6 to 10 years after planting, they produce medium to large size nut and have life span of 60 to 70 years. The dwarf varieties originated as mutation of tall types, their life span is about 30 years. Although they are highly difficult to grow, the dwarf varieties are valued because they bear fruits early (Woodruff, 1970). The coconut palm thrives on sandy soils with pH 5.0 to 8.0 and is highly tolerant of salinity. It prefers areas with abundant sunlight and regular rainfall (150 to 250 cm annually). Coconuts also need high humidity (70 to 80%) for optimum growth. Botanically, coconut fruit is a drupe, not a true nut. Like other fruits, it has three layers: exocarp, mesocarp, and endocarp. The exocarp and mesocarp together make up the husk, and the mesocarp is composed of fibers called coir. The endocarp or shell is the hardest part of the coconut. There are two types of liquids in coconut, that is, coconut water and coconut milk, they are nutritionally very different. Coconut water is contained in the young coconut fruits. As the fruit matures, the coconut water is replaced by the coconut meat and air. Coconut milk is a sweet, milky white cooking base extracted from the meat of a mature coconut. The colour and rich taste of the milk can be attributed to

the high oil content and sugars. Coconut milk contains a complex blend of nutritional constituents like carbohydrates, vitamins and minerals (Nair, 2009). Coconut oil is extracted from the meat of matured coconut harvested from the coconut palm. Throughout the world, it has provided the primary source of nutrients in the diets of millions of people for generations. Coconut oil is very heat stable and makes an excellent cooking and frying oil. It has a smoke point of about 360°F (180°C). Because of its stability, i t oxidizes slowly and being resistant to rancidity, it can last up to two years due to its high saturated fat content (Bruce, 2004). For thousands of years coconut products have held a respected and valuable place in local folk medicine, one of such claims is that it is antiulcerogenic (Nneli and Woyike, 2008). The claim of diverse medicinal application of this seed necessitates thorough analytical research on it, with a view to ascertaining the scientific basis of some of the claims.

MATERIALS AND METHODS

Samples collection

Fifteen matured coconuts were obtained from different coconut trees in and around Osogbo, Osun state, Nigeria.

Coconut milk preparation

The husk and shell were completely removed with sharp knife; 240 g of coconut meat was grated and soaked with 250 ml of water for 10 min. The grated coconut meat was then filled into a net bag and squeezed to extract the coconut milk.

Coconut oil preparation

The coconut milk extracted from grated coconut meat was heated over a low flame, it was stirred continuously and the mixture became thicker as it boils, after some time the water in the mixture evaporated leaving the oil behind.

Laboratory investigations

Determination of pH

The pH of coconut milk and coconut oil samples were determined using pH meter 27 (Radiometer ® Copenhagen).

Determination of glucose concentration

Glucose concentrations were determined using Trinder's 1969 method.

Determination of vitamins C and E concentration

Vitamins C and E were estimated with High Performance Liquid Chromatography (Pye Unicam GCV Chromatograph).

Determination of calcium, zinc and iron concentration

Calcium, zinc and iron concentrations were determined using Atomic Absorption Spectrophotometry (Buck Scientifics, USA: Model 210VGP) based on the method of Fick et al. (1979).

Determination of sodium and potassium concentrations

Sodium and potassium concentrations were estimated using Flame Photometer (Corning 410 manufactured by Sherwood Scientific Ltd, United Kingdom) based on the method of Dvorak et al. (1971).

Statistical analysis

Statistical analysis was performed using student's paired t-test and $P \leq 0.05$ being considered statistically significant. Results of the biochemical analysis are reported as Mean ± SD.

RESULTS

Data on nutritional constituents of coconut milk and coconut oil are presented in Table 1. The mean concentrations of the macro and micro constituents of both coconut milk and oil are as stated in Table 1. It is noteworthy that some of the constituents are present in concentrations that are similar and sometimes higher than what could be obtained in some known food preparations. Although the higher concentration of the nutrients in coconut milk could account for the higher specific gravity obtained, interestingly, the higher concentration of ascorbic acid produced an increase and not a decrease in the pH of coconut milk rather than the reverse. Also, the marked increase in concentration of nutrients of the milk in comparison to the milk clearly showed the richness of coconut meat which was the main source of the milk.

DISCUSSION

That coconut was very rich in macro nutrients-glucose, calcium, sodium and potassium and also in micro nutrients: iron and zinc, has been documented in this study. It was also observed that a significant difference ($P < 0.05$) existed between concentration of nutrients in coconut milk and coconut oil. This difference could be due to the method of processing leading to the production of coconut oil.

From the foregoing, elements that are more abundant in coconut milk and oil even more than other known fruits or even drug concentrations are glucose, calcium, iron, zinc, potassium and sodium

Glucose

Amongst the known functions of glucose in the body are maintenance of tissue protein, fat metabolism and as the

Table 1. Mean (±SD) concentration of constituents of coconut milk and oil.

Parameter	Coconut milk	Coconut oil	T-value	P- value
pH	6.50 ± 0.070	6.00 ± 0.050	5.298	P < 0.05
Specific gravity	1.008	0.915	-	-
Glucose (mg/L)	2645.7± 275.3	347.4 ± 52.9	31.159	P < 0.05
Vitamin C (mg/L)	0.46 ± 0.06	0.11 ± 0.02	21.749	P < 0.05
Vitamin E (mg/L)	0.14 ± 0.02	0.05 ± 0.004	12.636	P < 0.05
Ca^{2+} (mg/L)	2130.6± 144.4	102.6 ± 18.2	57.473	P < 0.05
Fe^{2+} (mg/L)	24.56± 2.61	4.53 ± 0.61	30.227	P < 0.05
Zn^{2+} (mg/L)	7.06 ± 0.88	1.04 ± 0.15	23.411	P < 0.05
K^{+} (Meq/L)	1127 ± 105.7	222.5 ± 54.0	32.767	P < 0.05
Na^{+} (Meq/L)	20.22±24.6	3.01 ± 0.20	27.666	P < 0.05

main fuel of central nervous system activities (Ernst et al., 2000), Some of this glucose go straight to work in brain cells and red blood cells, while the rest is transported to the liver and muscles, where they are stored as glycogen (Worthington-Roberts, 2007). The required dietary allowance (RDA) for glucose is 50 g per day (Larsen, 2007). This study showed that coconut milk provides 2.6 g of glucose per the total number of coconut fruit used in this work; this is equivalent to 5.2% of daily dietary requirement. In practical terms, this quantity could satisfy the requirement of specific organs or could be specifically utilized in conditions where such a low concentration is required after proper standardization.

Calcium

Calcium is an important component of a healthy diet and one of the essential minerals necessary for life. Calcium plays an important role in building stronger, denser bones early in life and keeping bones strong and healthy later in life. The RDA for calcium per day is 1000 to 1500 mg (Larsen, 2007), hence, from the aforementioned data, the average coconut fruit used in the experiment could yield 142% of calcium RDA, thereby providing higher concentration of calcium compared with calcium supplements like calcium carbonate drugs which can only provide 40% of elemental calcium (1000 mg of calcium carbonate tablet contains only 400 mg of calcium) (Tsang, 2004). Therefore, with proper standardization, it could be adapted in the treatment/management of patients suffering from hypocalcemia considering the quantity of elemental calcium contained in an average fruit.

Iron

Iron is of great importance in human nutrition for healthy blood and vitality. Although it is considered as a trace element, it is responsible for oxygen transport and cellular respiration. Dietary iron is of two types; Heme iron and Non heme iron, heme iron is present in red meat, fish and poultry and it is absorbed better at 15 to 20% than non heme iron. Non heme is the one that can be found in cereal, vegetable and fruits in which coconut belongs; for non heme iron, absorption is 1.5% but its absorption can be increased with the help of vitamin C which is also present in coconut (Anne, 2006). The RDA of iron for a male child is 20 mg, a female child is 35 mg and an adult is 24 mg (Anne, 2006). This study shows that coconut can provide 122, 70 and 102% of required dietary allowance for female children, male children and adult respectively and with the concentration of iron and vitamin C in coconut meat, consumption of coconut can be used medically to correct secondary anemia due to reduced absorption of iron secondary to vitamin C deficiency in the gastrointestinal tract.

Zinc

Zinc is an essential component of many metalloenzymes which are involved in virtually all aspect of metabolism. The metabolic functions of zinc are based largely on its presence as an essential component of many metalloenzymes. Zinc is second to iron as the most abundant trace element in the body; tissues and fluid that are rich in zinc are prostrate, semen, liver, kidney, retina, bone, and muscle. Important zinc containing enzymes are carbonic anhydrase, alkaline phosphatase, ribonucleic acid (RNA) and deoxyribonucleic acid (DNA) polymerases, thymidine kinase, carboxypeptidases, and alcohol dehydrogenases (Valle and Auld, 1990). Clinical states associated with zinc deficiency like growth retardation, infertility, alopecia among others (Prasad, 1985) can be prevented with dietary consumption of coconut because it can provide 50% of daily dietary requirement of zinc when consumed in the aforementioned quantity.

Potassium

Potassium is not only the most abundant mineral in

human body but it is also one of the most abundant in coconut fruit. Among the many functions of potassium in the body are regulation of the heartbeat and the functions of the muscles (Jorgensen, 1980). A seriously abnormal increase in potassium or decrease in potassium can profoundly affect the nervous system and increase the chance of irregular heartbeats (arrhythmias), which when extreme, can be fatal (Jorgensen, 1980). Potassium need to be continually consumed because human body does not store it while kidney continues to excrete it in the urine even when potassium intake ceases. The RDA for potassium is 3000 to 3500 mg per day (Larsen, 2007); consumption of coconut in the aforementioned quantity gives 32.2% of daily dietary requirement. Dietary consumption of coconut products can therefore help the body to prevent diseases associated with potassium deficiency.

Sodium

Sodium has also been found to be present in coconut. Aside from its role in ionic exchange and balance in the kidneys, it has other numerous health benefits like maintenance of balance of positive and negative ions in the body fluid and tissues, and it also helps in signal transmission and muscle contraction (Soleimani and Singh, 1995). The RDA for sodium is 500 mg (Larsen, 2007). Coconut consumption could be a good substitute for sodium chloride in hypertensives since the sodium content is just about 4% of the RDA. In hypertensives where dietary intake of sodium is expected to be reduced, consumption of coconut will therefore be an alternative source of 'dietary salt' after extensiv experimentation.

Vitamin C

Vitamin C or ascorbic acid is an essential nutrient for humans and certain other animal species, in which it functions as a vitamin. In living organisms, ascorbic acid is an anti-oxidant, since it protects the body against oxidative stress (Padayatty et al., 2003). The requireddietary allowance (RDA) for vitamin C is 75 mg per day for an adults and 30 to 80 mg/L for children (Larsen, 2007). This study shows that coconut can provide 0.6% of total daily dietary requirement. Although vitamin C content of coconut fruit is small relative to other fruits like oranges etc, taking it along with these other ones could serve as good supplement especially since it also facilitates iron absorption in the stomach.

Vitamin E

Vitamin E is a fat-soluble antioxidant that stops the production of reactive oxygen species formed when fat undergoes oxidation (Herrera, 2001; Packer et al., 2001). Vitamin E which is a generic term for tocopherols and tocotrienols was found to be present in coconut. The RDA of adult for vitamin E is 10 to 15 mg per day and children is 5 to 10 mg per day (Larsen, 2007). Just like in vitamin C, coconut fruit is not very rich in Vitamin E; however, its consumption could be a good dietary compliment for this vitamin especially since it can only provide a fraction (0.93%) of vitamin E RDA.

Conclusion

In conclusion, a complete analysis and comprehensive experimentation with coconut milk/oil could provide the much needed sources of some of the essential nutrients which could then be extracted and after proper pharmacokinetics study could be used as natural source of these nutrients in either correcting or preventing some of their deficiencies in clinical medicine. Economically, it could be observed from this study that 240 g of this nut (which in financial terms will be about ₦5 per mg of each of the analytes) could be a good dietary complement (in some cases supplement) if thoroughly investigated. This cheaper cost and the advantage of its use as a natural source could be of immense benefit especially in the less developed poor countries of the world where this fruit is more abundant.

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