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Derived Nutritional Norm from the Exudate of Raphia Sap and Roles of Its Elemental and Bioactive Constituents in Humans

Francis I. Obahiagbon
Associate Professor, Department of Science Laboratory Technology,
University of Benin, Benin City, Nigeria
Osemwenoyenmwen Obahiagbon
Research Officer, Tissue Culture Laboratory NIFOR, Benin City, Nigeria

Abstract:
This paper is set to derive a nutritional norm for the elemental and the bioactive components of Raphiahookeri palm sap that could serve as Recommended Dietary Allowances (RDA) and to examine their roles in human health. Raphiahookeri palms were tapped and the exudates were collected. The elements were assayed for by using atomic absorption spectroscopy and the bioactive were assayed for by standard methods. The quantity of the exudate to be drunk in order to acquire the RDA for each nutrient was derived from the standard values quoted by the National Academy of Sciences. The volume of the exudate to be drunk is dependent on the quantity of the nutrients required to meet the RDA. Additionally, results revealed that the dietary nutrients detected in the exudate were present in varied concentrations. The nutrient detected could play significant roles in the human body where they function in structural components of organs or tissues, in biochemical reactions (metabolism), as cofactors in enzymes, and in the regulation of acid-base balance in body fluids. The large volumes for some cases per day could be concentrated and drunk/ or use as sweeteners.

Keywords**:** *Raphiahookeripalm, exudate, recommended dietary allowances, elements, bioactive*

1. Introduction

Arising from the importance of dietary nutrients in human, the American Food and Nutrition Board of the National Academy of Sciences/National Research Council [1] updated the Table and called it the Recommended Dietary Allowances (RDAs) for vitamins, amino acids, minerals and other nutritional elements for optimum nutrition in infants, children, adults and pregnant women. They are different from children, adults, males and females. RDAs serve as a nutritional norm for planning and assessing intake and the levels of intake of essential nutrients considered fit or adequate to meet the requirement for healthy individuals. Dr. Alfred Harper, when introducing the vision of the Recommended Daily Allowances in 1974, stated that "However requirements may differ with a body size: among individuals of the same body size owing to differences in genetic makeup; with the physiologic individual-growth rate, pregnancy, lactation and with sex." The exudate is the liquid, which flows when an incision is made on the inflorescence of the *Raphiahookeri* palm. The exudate is drunk by millions of people in Africa and the exudate is abundant. The exudate of *Rahia*hookeri palm is fermented by the yeast, saccharomyces cerevisiae. In some parts of Nigeria, the palm wine (fermented exudate) is used for establishing a marriage covenant between couples, during their traditional marriage ceremonies. Additionally, it is used freely for entertainment as a beverage both in the rural and urban areas. Traditionally, the exudate of *Raphiahookeri* palm is used for the cure of malaria, measles, jaundice and the flow of breast milk in nursing mothers. The active ingredients in the treatment of the above ailments are not yet known. Arising from the abundance of *Raphiahookeri* palms in Nigeria and the growing interest in brewing the sap by processors, this study intends to develop a nutritional noun from the exudate of *Raphia* palm and also examine the roles the minerals in the exudate could play in human health.

2. Materials and Methods

2.1. Selection of Raphiahookeri palms

The matured *Raphiahookeri* palms were selected from the gene pool of the Nigeria Institute for Oil Palm Research Benin City, based on the appearances of three inflorescences on the palms, which is an indication that the palms were ready for the exudate production.

2.2. The Tapping of the Palms

The palms were tapped while standing erect. The exudates were collected into clean plastic jerry cans previously washed and rinsed with deionized water and stored in a refrigerator before analysis.

2.3. Detection of Mineral Elements

The following mineral elements, sodium, copper, potassium, calcium, magnesium, iron, manganese and zinc were assayed for with an atomic absorption spectrophotometer as described by [2]. The phosphorus content was determined by [3]. The chloride content of the sap was determined by the method of [4]. The Nitrogen content was determined by the Kjeldehl method [5].

2.4. Detection of the Water-Soluble Vitamins (Thiamine, Riboflavin and Ascorbic acid).

The thiamine and riboflavin contents were determined by [6]. The ascorbic acid content was determined by the method described by [7].

2.5. Derived RDAs Equivalent for the Palm exudate

By using the standard Table of RDAs values for each dietary nutrient, provided by the American National Academy of Science/National Research Council [1]. The equivalent volume of the exudate that would contain the individual dietary nutrients were obtained.

3. Results and Discussion

The results obtained from these studies are presented in Tables 1a and 1b.

	Cl 157mg		**Na 4.40mg**		**K 80.00mg**		**Ca 31.40mg**		**Mg 57.20mg**		**Fe 2.2mg**	
	*RDA	**SAP(ml)	*RDA	**SAP(ml)	"RDA	**SAP (ml)	*RDA	**SAP (ml)	RDA	•*SAP (ml)	*RDA	**SAP (ml)
Infants (Ages)												
0-0.5	275-700	100-230	115-350	12921-2614	350-925	727-139!	400	554	40	67	6	122 204
05-1.0	400-1200	172-350	250-750	28090-5601	425-1275	883-1917	600	832	60	101	10	204
Children (Ages)												
1-3	500-1500	215-435	325-975	35517-7282	550-1650	1143-24S1	800	1109	80	135	10	204
4-6	700 -2100	300-610	450-1350	50562-10082	775-2325	1611-3496	800	1109	120	202	10	204
7-10	925-2775	397-804	600-2700	67416-13443	1000-3000	2078-4511	800	1109	170	202	10	204
Adolescents												
11+	1400-4200	601-1217	900-2700	101124-20164	1525-4575	3169-6880	1200	1663	270	455	12	245
Adults	1700-5100	730-1500	1100-3300	123593-24645	1875-5625	3896-8459	800-1200	1663-10000	400-350	667-674	10-12	204-245

Table 1a: Raphia Hookeri Sap: Recommended Dietary Allowance for Some Dietary Nutrients

*Key: * RDAs recommended by Institute of Medicine, American National Academy of Sciences. "National Research Council (2001)*

*** Volume of sap required to meet recommended RDAs*

	Cu 31.40mg		**Mn**		**Zn 0.11mg**		**P 4.4omg**		**Thiamine 0.31mg**		**Riboflavin 0.21mg**	
	*RDA	"*SAP (ml)	*RDA	*'SAP (ml)	*RD A	*"SAP (ml)	-RDA	**SAP (ml)	*RDA	**SAP(ml)	*RDA	**SAP(ml)
Infants (Ages)												
0-0.5	0.4-0.5	33-286	03-0.6	7-14	3	769	300	5348.	0.3	73.71	0.4	189
0.5-1.0	0.6-0.7	39-129	0.6-1.0	12-28	925	769	500	8913	0.4	98.28	0.5	236
Children (Ages)												
1-3	0.7-1.0	56-500	1.0-1.5	17-46	10	800	800	14260	0.7	171.99	0.8	377
4-6	1.0-1.5	83-714	15-2.0	23-69	10	800	800	14260	0.9	221.13	1.1	519
7-10	1 .0-2.0	111-714	2.0-3.0	35-93	10	800	800	144-14681	1.0	245.70	1.2	566
Adolescents												
11+	1 .5-2.5	139-1071	2.0-5.0	58-93	15	1200	1200	21390	1.2	319.41	1.5	707
Adults												
	1.5-3.0	169-1071	2.0-5.0	58-93	15	800-1200	800-1200'	21590-82474	1.2-1.5	295.365	1.4- 1.7	660- 802

Table 1b: Raphia Hooker) Sap: Recommended Dietary Allowance for Some Dietary Nutrients

*Key: * RDAs (rng) recommended by Institute of Medicine, American National Academy of Sciences. "National Research Council (200l)*

*** Volume of sap required to meet recommended RDA*

Fourteen dietary nutrients were detected in the exudate of *Raphiahookeri, which* included electrolytes, trace elements, mineral elements and water soluble vitamins. The dietary nutrients detected and the calculated volumes of exudate containing the dietary nutrients required to meet the RDAs are also presented in Tables 1a and 1b. The volumes of the exudate that contain the nutrients to meet the RDAs varies and depend on the concentration of nutrients in the exudate and age of the consumer.

3.1. Electrolytes (Chloride, Sodium and Potassium)

It was observed from the results that the chloride had the highest concentration, followed by potassium and sodium, respectively. The high concentration of chloride could be attributed to its wide distribution in nature, its subjection to rapid cycling, and being one of the most mobile elements in its ionic form [8]. The volume of sap calculated to contain the concentration of chloride, for all-ages were low relative to those of potassium and sodium. For sodium and potassium, the volume of sap that would contain the quantity of the element to meet the RDAs for all ages were high. Physiologically, chlorine, sodium and potassium acts as electrolytes in body fluid. They help to maintain osmotic pressure and regulate acid-base equilibrium. Chlorine and sodium help to control the passage of nutrients into the cells and movement of waste products out of the cells [9,10]. The chlorine is essential for the activation of intestinal amylase. Chloride is the major anion of extracellular fluid, while sodium is the major cation. Potassium is the principal intra cellular cation. Potassium functions as a cofactor in several enzyme systems, involved in the transmission of nerve impulses and in the regulation of heartbeat[11]. Deficiency diseases or symptoms of potassium include muscular weakness, paralysis, mental confusion, cardiac arrest and small bowel ulcer [9].

3.2. Trace Elements

Two (Copper and Manganese) of the trace elements were detected. The manganese content was higher. The calculated volumes of sap required to contain the concentration of these elements to meet their RDAs for all ages were found to be low. Arising from the sap volume derived to meet the RDA, one could conclude that the exudate is a rich source of the above trace elements. In human nutrition, copper is required for cellular respiration, bone formation, proper cardiac function etc. Deficiency of copper could cause anaemia, Menke's [9]. Manganese has a role in cholesterol biogenesis[12].

3.3. Mineral Elements (Iron, Zinc, Magnesium, Calcium, Phosphorus)

These mineral elements detected in the sap of *Raphiahookeri* were present in varied concentrations, the concentration of magnesium was highest, followed by calcium, phosphorus, iron and zinc respectively. The derived volumes of sap required to meet the RDA for iron was observed to be low for all ages, which suggested that the sap of *Raphiahookeri* is a rich source of the element. The same observation is true for magnesium nutrition in infants and adolescents, while higher volumes are required (adult nutrition) for magnesium, zinc, calcium and phosphorus (for all ages). These results therefore imply that the sap is a not rich in zinc, calcium and phosphorus. However, in animal and human nutrition the importance of these elements in a diet is correlated with the cumulative intake of the total diet. Additionally, the overall sources, that is, cumulative intakes of nutrients from different sources, may be more important than single and isolated sources in the feeding habits of many people [13]. Accordingly, the small amount of zinc, calcium and phosphorus in the sap of *Raphiahookeri* could be regarded as important being part of the cumulative intake for these mineral elements in human nutrition.

3.4. Water Soluble Vitamins/ Bioactive (Thiamine, Riboflavin and Ascorbic acid)

Ascorbic acid had the highest concentration amongst the water-soluble vitamins assayed for. This was followed by thiamine and riboflavin respectively. Low volumes of the sap *of Raphiahookeri* are calculated to contain the quantities of these bioactive to meet their RDAs. This is an indication that the sap is a rich source of these vitamins. Thus, it is nutritionally significant. The children can drink the unfermented sap and thereby meet their daily requirements for the vitamins. In humans, thiamine is important for normal growth and development, blood formation, circulation and carbohydrate metabolism. Thiamine acts as antioxidants, thus protecting the body from the degenerating effects of alcohol consumption, smoking and aging. The deficiency disease of thiamine is beri-beri, a nervous system disorder. Other diseases resulting from thiamine deficiency include, fatigue, enlarge liver, oedema, forgetfulness [14, 15]. Riboflavin plays active roles in the metabolism of protein, fats and carbohydrates, resulting in the release of energy for proper growth and development of the body. In conjunction with iron, it is important in red blood cell formations, which carries oxygen round the body. Riboflavin is also important in the prevention and care of cataract. Deficiency disease or symptoms include, skin lesions, cracks, and sores at the corners of the mouth, hair loss, dizziness, dermatitis etc. [14].

4. Conclusion

The high volumes of the sap that may be required to meet the RDAs for some of the nutrients could be concentrated to reduce the volume and the nutrients would remain in the concentrate. Alternatively, small portions could be taken at intervals where large volumes are involved. The information on this subject has become necessary because no literature reports are available. Secondly, in the rural areas where the palms are grown in Nigeria, the indigenes could be sensitized based on the current information in order to improve their health status.

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