COCONUT WATER

A NATURAL ISOTONIC BEVERAGE

COCONUT WATER

A NATURAL ISOTONIC BEVERAGE

By J.C. Gomes, Ph.D. and D.T. Coelho, Ph.D. Food Science and Technology - Department - Universidade Federal de Vicosa 36570-900-Vicosa-MG-Brazil

Coconut water has been used for centuries by all the native population of the Brazilian coast, the people of the Amazon region and the Caribbean Islands and many other parts of the world have also used coconut water as a natural thirst quencher, a source of natural water and for electrolytes replacement when thirst or dehydration occurs. Coconut water has been used by many of these people for centuries and for many excellent and proven reasons. The natural coconut water will provide the body with the same electrolytic composition as we all have in our own blood. The water provides us with all the nutrients our bodies require for total re hydration and fluid replacement or loss. The natural form of coconut water is very low in fat, has no cholesterol, is high in potassium, which is good for the heart, calcium, magnesium and much more to offer us.

These healthy properties arise from its well-balanced chemical composition resulting in a natural isotonic solution, which has a very pleasant flavor.

The chemical composition of natural pasteurized coconut water aseptically packaged is known in the following table. The samples are from Amazon region. Components like lipids (< 0,05% w/v) and proteins (< 0,1% w/v) were not considered for calculations.

Table 1 – Composition of Coconut Water Aseptically Packaged

Sample	*Carboidratos*	*Calories*	*Sodium*	*Potassium*	*Calcium*	*Magnesium*	*Phosphorus*	*MOsmol3*
1	5.5%	22	31	182	5.3	0.5	0.5	300
2	5.5%	22	27	184	5.3	0.5	0.5	312
3	5.6%	22	32	159	5.3	0.5	0.6	321
3	5.5%	22.4	32	147	4.5	0.4	0.2	330

5	5.6%	22	27	140	4.5	0.4	0.2	320
6	5.6%	22.4	27	142	4.1	0.4	0.2	315
7	5.6%	22.4	24	135	4.1	0.4	0.2	310
8	5.6%	22.4	2.6	155	4.1	0.4	0.2	310
9	5.7%	22.8	22	138	4.8	0.4	0.3	320
10	5.7%	22.8	20	142	4.1	0.4	0.3	311

1. grams per 100ml 2. mg per 100ml 3. mOsmol per kg of water 4. Calories per 100 ml

There is a proven world-wide trend, scientifically supported, to drink isotonic beverages in order to avoid hypo and hyper tonic dehydrations. It is very important that electrolytes like sodium and potassium be present in the composition of these isotonic beverages in order to restore losses of sodium and potassium through urinary and skin pathways. Coconut water has them in its composition. The electrolytes and the natural water and the isotonic solutions coconut water has are faster absorbed than in other situations, restoring readily the losses of these nutrients. With a very low carbohydrate content, this product has 22 Calories/100 ml only. The Isotonic properties of this all natural coconut water is demonstrated by its osmol concentration which lies in the range of 300-330 mOsmol per kg of water.

MINISTERIO DA EDUCACAO E DO DESPORTO UNIVERSIDADE FEDERAL DE VICOSA 36570-900 - VICOSA - MG - BRASIL

There are several brands of isotonic beverages in the world market, and some products being sold as coconut water currently. All of them sold around the world are artificial with chemical preservatives added. Coconut water is the truly the only natural isotonic beverage commercially available. Advantages of fluid of plant origin lies on the fact that all nutrients, including water, is filtered through the plant tissues leading to a very pure clean food product. The coconut trees grow in the Amazon Basin, region without other agricultural activities taking place provides us with a very natural pure tropical sweet water. As a result there is no chemical pollution or pesticides to contaminate the biological fluids of the plants grown in that region. Aseptically packaging of coconut water was a great contribution to the availability of this

wonderful product to the general consumer. Usually green coconuts are sold only in the coastal areas of Brazil during warmer seasons, and other parts of the worlds coastal areas during warmer seasons. Coconut water in such a package is expensive because one has to transport large and heavy loads around; about 2 kg for 200 ml of water; and expend large amount of energy to cool the water because the coconut casing must be cooled also. Therefore general home use of coconut water is difficult to achieve. Also the fruit casing of the water keeps its original conditions for short periods resulting in a short shelf like of the product. Aseptically pasteurized Tetra Pack cartooned packaging extends the shelf life for 12 months, without the need for preservatives or other foreign additives.

1. Principles of Body Fluid Volume Control

The electrolyte composition of intracellular and extra cellular fluid are vastly different, but because cell membranes are freely permeable water, osmolalities of intracellular and extra cellular fluid are always the same. Any discrepancy in osmolality between intracellular and extra cellular fluid causes a rapid shift of water until the two compartment have the same osmolality. A reduction in extra cellular osmolality, whether it is caused by retention of water or by loss of solutes, must be followed by reduction in intracellular osmolality to some extent, and this is achieved by intracellular shift of water, the result is always an increase in cell volume.

An increase in extra cellular osmolality may result from loss of water or gain of solutes. When extra cellular osmolality increases by loss of water or by accumulation of a solute that cannot enter the cell freely (e.g. mannitol, sodium, glucose), the osmotic equilibrium occurs by extra cellular shift of water reducing cell volume. However, when extra cellular osmolality increases by accumulation of a solute that can freely diffuse across the cell membrane (e.g. urea and alcohol), the osmotic equilibrium is achieved by diffusion of the solute into the cells, and no change in volume occurs. Osmols that cannot enter the cell freely are effective in causing trans cellular shift of water, and hence are called effective osmols, and osmols that can diffuse freely into cells are called ineffective osmols. The plasma osmolality based on effective osmols is effective osmolality. In summary, effective osmolality determines the intracellular volume; the cell volume is increased, and normal when effective osmolality is normal. For example, accumulation of glucose in the extra cellular fluid causes shift of water from cell and thereby reduces serum Na, by factor of 1.5 mEq/L (1.5 mmol.L)+ for each increase of 100 mg/dl in serum glucose. When hyperglycemia is reserved, the reduction in extra cellular ismolality causes an intracellular shift with serum NA increasing by the same factor.

MINISTERIO DA EDUCACAO E DO DESPORTO UNIVERSIDADE FEDERAL DE VICOSA 36570-900 - VICOSA - MG - BRASIL

2. Water and Electrolytes Losses of the Human Body

Cutaneous Water Exchange - Water is lost from the skin primarily as a means of eliminating heat. Water loss from the skin without sweat is called insensible perspiration. Sweat contains about 1150 mg/L of sodium and 200mg/L of potassium. The amount of water loss from the skin is proportionate to the amount of heat generated as is shown by the following formula: Water loss from the skin - 30 ml per 100 Calories.

Respiratory Water Exchange - The water content of inspired air is less than that of expired air, and respiratory water loss can be calculated from the ventilatory volume and the difference in partial pressure of water vapor between inspired air and expired air. Because the ventilatroy volume Reparatory is determined by the amount of CO_2 production, which in turn depends on the caloric expenditure, the amount of the ventilatory water loss in normal environmental conditions depends also on calorie expenditure:

Respiratory water loss =13 ml per 100 Kcal at normal PCO_2.

By pure coincidence, in the absence of fever or hyperventilation, the quality of water lost from the lung during normal respiration is about equal to the amount produced by metabolism. Respiratory water loss increases with hyperventilation or fever.

Gastrointestinal Fluid Exchange - The net activity of gastrointestinal tract to the duodenum is secretion of water and electrolytes. The net activity from the jejunum to colon is reabsorption. Most of the fluid entering the small intestine is absorbed there, and the remainder is absorbed by the colon, leaving only about 100ml of water to be excreted daily in the feces. The contents of the gastrointestinal (GI) tract are about isotonic with plasma, and any fluid that enters the GI tract becomes isotonic through secretion and reabsorption. Thus, if water is ingested and vomited, solute is the lost from the body.

Abnormal Losses from the Gastrointestinal Tract - Losses of fluid and electrolytes from GI tract may occur from a variety of reasons: (1) diarrhea, (2) vomiting or gastric drainage, and (3) drainage or fistula from the bile ducts, pancreas, and intestine.

Although diarrheal fluid is usually isotonic in terms of the cations (Na and K), Diarrhea caused by no absorbable solutes such as lactulose, mannitol, sorbitol, or disaccharide (as in a patient with disaccharide malabsorption) causes greater water loss than electrolyte loss.

Sequestration of Fluid - Obstruction of bowel may cause transfer of fluid from extra cellular space into the intestinal lumen. Because the composition of the sequestered fluid is similar to that of the ECF, effective arterial volume is reduced without much alteration in composition.

Skin Loss - The loss through skin increases with fever, increased metabolism, sweating, and burns. The fluid lost through the skin is hypo tonic.

MINISTERIO DA EDUCACAO E DO DESPORTO UNIVERSIDADE FEDERAL DE VICOSA 36570-900 - VICOSA - MG - BRASIL

Loss Through Ventilation - Only water is lost through the lung with ventilation, and fever and hyperventilation increase water loss through the lung.

Miscellaneous Losses - These include drainage from the pleural and peritoneal cavity, seepage from burns, and fluid loss during hem dialysis and peritoneal dialysis.

Renal Loss - The kidney may lose sodium and water excessively in a number of situations, which include diuretic therapy, aldosterone deficiency or unresponsiveness to aldosterone, and relief of urinary obstruction.

3. Principles of Water and Electrolyte Therapy

Goals of Salt and Water Replacement - The goal of therapy is to restore the patient to a state of normal hemodynamics and to restore the body fluid osmolality. There are several components in the program of water and electrolyte therapy: (1) existing deficits must be identified and corrected, (2) daily basal requirements for sodium, potassium, and water must be supplied, and (3) ongoing losses must be quantified and provided for.

Basal Water Requirements - The basal requirement for water depends on insensible losses and sensible (urinary) losses of water. Without fever, the amount of water lost from the skin is 30ml/100 Kcal or 8 ml/kg body weight or 3.6ml.lb. Because, in the absence of fever and hyperventilation, water loss from the lung is about equal to the amount of water produced in metabolism, only the water loss form the skin needs to be

included in estimating the basal requirement of water. Urinary loss of water depends on the total amount of solute excreted and urine osmolality. The solute excretion depends mainly on salt ingestion and urea productions, the latter being a function of protein intake and catabolism.

Isotonic Dehydration - Salt may be lost isotonically through the GI tract directly from the ECF by such means as external drainage of pleural effusion and ascites. More often salt is lost with equal or larger water loss, and then the osmolality of the body fluids is subsequently adjusted to isotinicity by oral intake or urinary excretion of water. Because water moves across cell membranes only in response to change is ocmolality of the ECF, isotonic fluid loss is borne completely by the extra cellular fluid space. This is a clinical case.

Hypertonic Dehydration - The primary aberration in hypertonic dehydration is water deficit. Two major mechanisms account for abnormal water deficit; inadequacy of water intake and excessive water loss. Dehydration due to excessive water loss usually develops more rapidly than does dehydration due to reduced water intake.

Hypotonic Dehydration - Fluids lost from the body are almost always either hypotonic or isotonic in relation to sodium concentration, and loss of such fluid cannot cause hypo tonicity of body fluid. Hypotonic dehydration occurs usually because the patient loses a sodium - containing solution and replaces it with water or solution containing fewer cations (sodium +potassium) than the fluid that has been lost.

MINISTERIO DA EDUCACAO E DO DESPORTO UNIVERSIDADE FEDERAL DE VICOSA 36570-900 - VICOSA - MG - BRASIL

Daily Water Requirements - In the absence of fever and sweating, water loss through the skin is relatively fixed, but the urinary water excretion varies greatly, and depends on the total amount of solute excreted and on urine osmolality. For example, for a total solute excretion of 600 mosm per day, the urine volume will be 500 ml at urine osmolality of 1200 mosm/ L, and 15 L at 40 mosm/L. For such a person , if the kidney is capable of usual maximal concentration, the minimum water requirement would be 1100 ml (500ml for urinary water loss plus 600 ml for skin loss at 2000 calories per day). On the other hand, the maximal allowable water intake would be 15.6 L (600 mosm/40 mosm/L = 15 L) if the kidney can dilute urine osmolality to only 600 mosm/L with the impaired concentration mechanism, the minimum water requirement would be 1.6 L. Similarly, if urine can be diluted to only 300 mosm/L, the maximal allowable water intake would decrease to 2.6 (600/300 +0.6)L.

Clearly, in the absence of abnormality in urine concentration and dilution, a large variation in water intake will cause neither dehydration nor over hydration. However, underestimation of water need to safer than over-estimation for variety of reasons.

First, the amount of water gained when urine dilution is impaired tends to be greater than the amount of water lost with impaired urine concentration. Second, clinical impairment in urine dilution, as with the syndrome of inappropriate ADH secretion (SIADH), is more common than impairment in urine concentration, as with diabetes insipidus. Finally, in conscious patients thirst is a powerful protection against hypernatremia, whereas patients often lapse into hyponatremic coma without specific complaints. Scientific writings and studies on the benefits of drinking natural coconut water have been done at many universities throughout Brasil. Many of these studies and findings will help educate the world on the significance of drinking this pure natural water. By: J.C. Gomes, Ph.D. & D.T. Coelho, Ph.D. Food Science And Technology Dept.