
ORIGINAL ARTICLE

Coconut Water as One of the Optional Oral Electrolyte Solutions

by

MUZIEF MUNIR and I. MUSTADJAB.

*(Department of Child Health, Medical School, Sam Ratulangi University/
Gunung Wenang Hospital, Manado, Indonesia).*

Abstract

In an attempt to overcome mild and moderate dehydration, caused by diarrheal diseases with the outlook of reducing its mortality rate, it seems to be very important to find out many varieties of oral electrolyte solutions which are available in the communities.

Our study was performed to evaluate the effectiveness of salt in half strength of coconut water solution as one of the optional oral electrolyte solutions. Children under five years of age with diarrhea were used as subjects in this study, and were divided into two groups, i.e. the coconut water group and the oralolyte group (Kimia Farma).

The willingness to drink (acceptability), the frequency of diarrhea and vomiting, the severity of dehydration before and after rehydration, and the symptoms and signs of side-effects such as abdominal cramps and hyperkalemia were recorded.

From this study it is clear that finely ground salt in half strength of coconut water can be used as an optional oral electrolyte solution with satisfactory results and without any harmful effects.

Received 7th. August 1979.

Introduction

Diarrheal disease is one of the main child health problems in Indonesia where its morbidity rate is still high, especially among the children of under 5 years old. Recently many hospital reports have claimed noticeable decline in their mortality rate.

As the health coverage — especially for rural communities which comprise 80% of the total population — is abridged, while the role of the hospital in supporting the health conditions of rural communities is also limited, these reports did not represent entirely the real situation in the community (Bahrawi, 1976).

This disease is closely related to socio-economic conditions, geography, environmental sanitation, beliefs, and the availability of health services. Thus, in overcoming this disease all the above-mentioned factors should be taken into consideration.

Many efforts have been made to overcome this disease, particularly in preventing severe dehydration with the outlook to decrease its mortality rate to the lowest possible level. Those efforts are namely: rehydration centres throughout the country (Harun Nurasid, 1971), oral electrolyte solutions (King, 1974; Pitono et al., 1976; Sunoto et al., 1977), sucrose electrolyte solution and salt sucrose solution (Munginah et al., 1977).

Encouragement to use oral solutions to overcome mild and moderate dehydration by applying simple, appropriate

technology and materials which are available in the community, will reduce the prevalence of severe dehydration. Hence, the mortality rate of this disease is decreasing.

Coconut water, besides containing electrolyte, vitamins, amino-acids and RNA = DNA phosphates, fat and glucose, is also isotonic to the body water (Tulacke et al., 1961; Ranti et al., 1965). With a simple modification, this solution seems to be very ideal for oral electrolyte solutions.

This study was performed to evaluate the effectiveness of salt in diluted coconut water; and especially whether or not it can be used as one of the oral electrolyte solutions in remote areas.

Material and methods

The subjects in this study were 43 children under 5 years of age with mild and moderate dehydration caused by diarrhea, examined at the outpatient clinic of the army hospital Teling, Manado, Indonesia. All these patients were admitted to the hospital to ensure the validity of our evaluations.

The patients were divided into two groups by using odd and double count methods, namely the coconut water group rehydrated by salt in half strength of coconut water, and the oral electrolyte group rehydrated by oral electrolyte solutions which are manufactured by Kimia Farma.

Solutions of salt in half strength of coconut water were prepared as follows:

1. First of all, a survey to determine the weight of one pinch of finely ground salt was done.

For this purpose 72 mothers and paramedical personnel were asked to take finely ground salt between two fingers (thumb and index finger) as in cooking practices. The weight was measured with an automatic milligrams weight scale manufactured by Backer & Soa.

It was found that the mean weight of one pinch of finely ground salt was 220 mg (ranging from 140 - 300 mg).

2. One part of coconut water (1 glass of 200 cc) was diluted with one part of water.

Six pinches of finely ground salt were added to this solution. The mean weight of 6 pinches of finely ground salt was 1.3 grams.

The mineral content of undiluted coconut water compared to the mineral content of half strength of coconut water and salt solution can be seen in the following table.

TABLE 1: Mineral content of salt added to half strength of coconut water as compared to that of undiluted coconut water

Composition	Before dilution			After dilution and 6 pinches salt added
	Eiseman et al.	Ranti et al.	Kapojos et al.	
Na ⁺ (meq/l)	5	5	1.9	57
K (meq/l)	49	56	45.3	22.6
Ca (meq/l)	12	9	3.6	1.8
Mg (meq/l)	17	—	0.5	0.25
Cl (meq/l)	63	70	69.3	90.7
HCO ₃ (meq/l)	—	—	5.7	2.9
Sugar (gr/l)	—	10 — 40	55	27.5
pH	—	—	5.3	6

Body weight, frequency of diarrhea, vomiting, faecal form, duration of diarrhea, the willingness to drink (acceptability), severity of dehydration before and after rehydration, the symptoms and signs of side-effects such as abdominal cramps and hyperkalemia were recorded.

The severity of dehydration was determined by the Maurice King's criteria. Routine examinations such as blood examinations, urinalysis, and stool examinations were performed in every case. Blood examinations for detecting malarial parasites, and ENT examinations were conducted when indicated only.

The outcomes of the oral rehydration in this study were determined by the following criteria :

Very good : diarrhea stops within 24 hrs after oral rehydration.

Good : diarrhea stops within 48 hrs after oral rehydration.

Fair : diarrhea stops within 72 hrs or more after oral rehydration.

Fail : the patient falls into severe dehydration.

Tetracycline 50 mg/kg bw/day was given to all cases for 3 - 5 days, without determining the bacteriological cause of diarrhea.

Results

This study consisted of 25 cases in the coconut water group, and 18 cases in the oratolyte group. The sex distribution, mean body weight and age can be seen in Table 2.

TABLE 2: Sex distribution, mean body weight and age

Factors	Coconut water group	Oratolyte group	P
Male/Female	11/14	9/9	0.05
Age (mean \pm SE) (in months)	11.5 \pm 1.2 (2 - 26)	10.4 \pm 1.9 (1 - 32)	0.1
Body weight (mean \pm SE) (in kg)	7.350 \pm 0.36 (5.5 - 11.2)	7.180 \pm 0.27 (3.500 \pm 13.00)	0.05

TABLE 3: Frequency of diarrhea before and after rehydration

Group	No. of cases	Mild Dehydration				Moderate Dehydration				
		Frequency of diarrhea				Frequency of diarrhea				
		Before rehydration	After rehydration (in hrs)			No. of cases	Before rehydration	After rehydration (in hrs)		
			24	48	72			24	48	72
Coconut water	6	3 × (2-3)	0.6 (1-2)	—	—	19	9.1 (2-21)	5.5 (1-18)	1.6 (1-6)	—
Oratroyte Group	3	3 × (2-6)	1	—	—	15	8 (1-16)	10 (1-30)	4.3 (1-25)	3.6 2-21

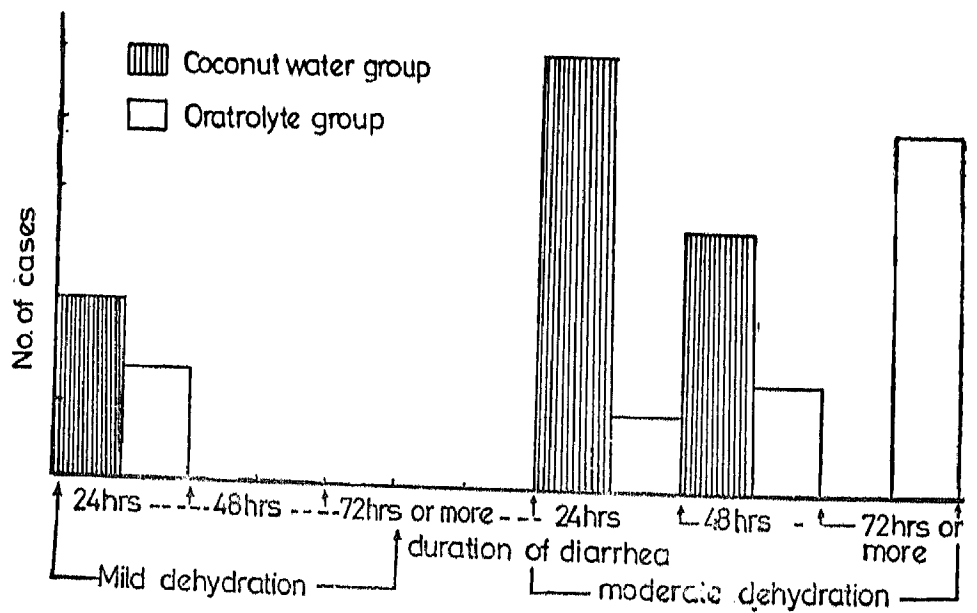


FIG. 1: The duration of diarrhea in both groups after oral rehydration

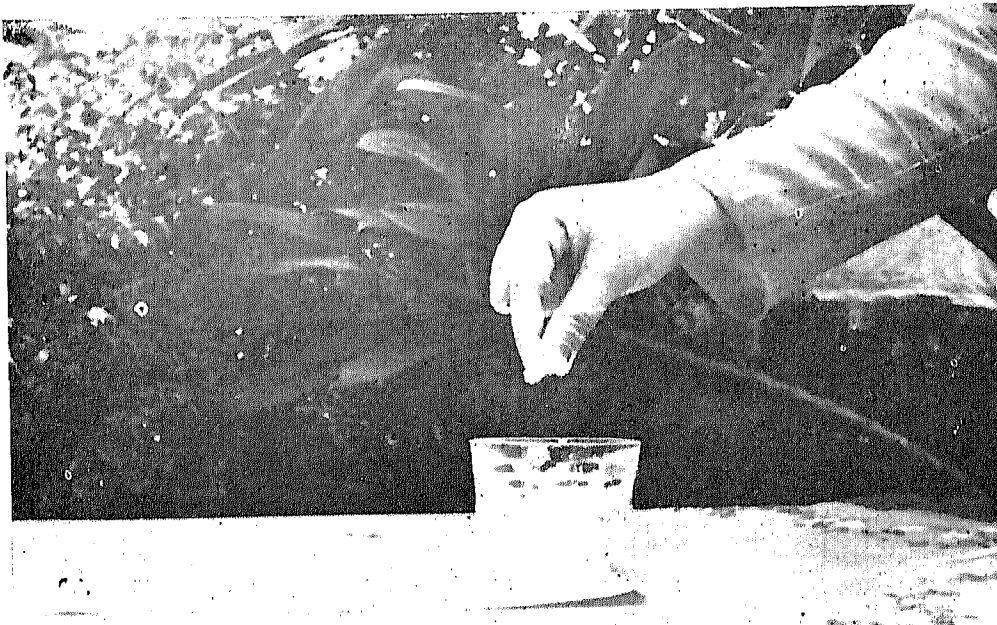
TABLE 4: *Number of diarrheal cases with vomiting before and after rehydration*

Group	Total cases	With vomiting			
		Before rehydration	After rehydration		
			24 hrs	48 hrs	72 hrs
Coconut water	15	12	4	—	—
Oratolyte	18	12	6	2	—

Discussion

The difference of sex distribution, mean body weight, and age of the two groups were statistically insignificant ($p > 0.05$). Hence, the outcomes of this study were not influenced by the above-mentioned factors.

The high concentration of potassium chloride in coconut water where ion K is 45-56 mEq/l (Eiseman, 1954; Ranti et al., 1965; Kapojos et al., 1970), could give side-effects of abdominal cramps, an increase in the frequency of diarrhea and vomiting, and may also cause hy-

FIG. 2: *The technique of taking finely ground salt with two fingers*

perkalemia with paresthesia of the extremities, listlessness, mental confusion, paralysis, hypotension, heart block, and cardiac arrhythmia (Martindale, 1978).

Harun Nurasid et al., (1977) reported in their study that the results of undiluted coconut water given orally to children with cholera were good without any side-effects such as hyperkalemia. Diluting coconut water to its half strength will reduce potassium concentration from 45-56 to 22-28 meq/l and this prevents the occurrence of side-effects.

The technique of taking finely ground salt with two fingers, thumb and index finger, is originated from cooking practices in the community; so this technique is universally accepted without being influenced by educational levels

or any socio-economic conditions in the community. It is clearly shown that the mean weight of one pinch is 220 mg, so that two glasses of half strength of coconut water need only 6 pinches of finely ground salt to get a sodium concentration of 57 meq/l. Hence, the concentration of sodium and potassium of this solution is quite similar with the stool's composition of infantile diarrhea (Mahalanabis, 1970).

From this study it can obviously be seen that the frequency and the duration of diarrhea in the coconut water group were less than those in the oratolyte group. The mean frequency of diarrhea of the coconut water group before and after 24, 48 and 72 hrs of oral rehydration was 9.1, 5.5, 1.6 and 0 respectively.

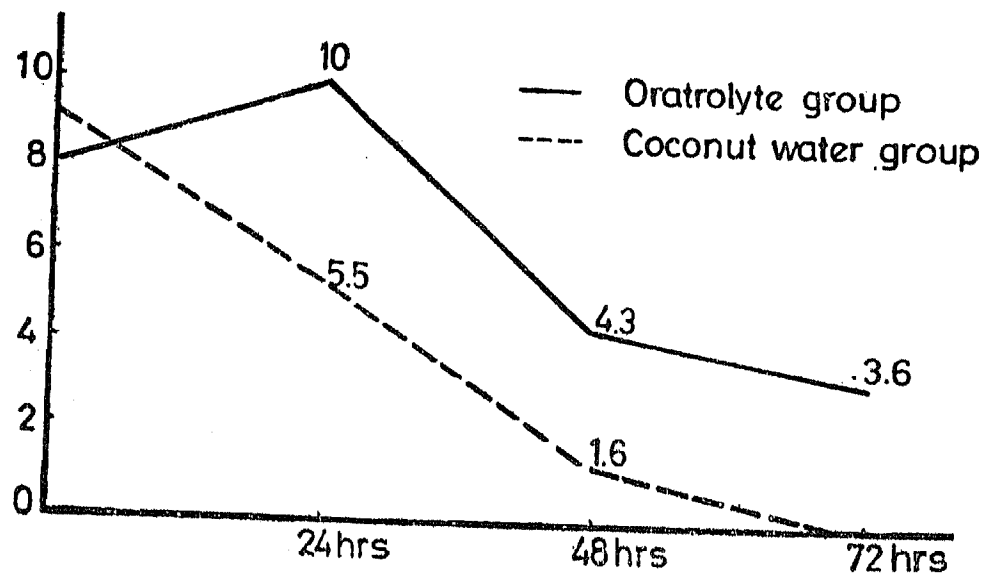


FIG. 3: The frequency of diarrhea before and after rehydration

Thus the frequency of diarrhea decreased sharply from 24 hrs, and stopped at 72 hrs after institution of salt-coconut water solution orally. On the contrary, the mean frequency of diarrhea in the oratolyte group increased in the first 24 hrs and decreased after 48 and 72 hrs of oral rehydration (Fig. 3).

Sunoto et al., (1977) also reported from their study the increase of frequency of diarrhea in the first 24 hrs after oral rehydration using a pedialyte solution.

In 12 out of 21 cases (57%) of the coconut water group diarrhea stopped in the first 24 hrs after oral rehydration, and the rest stopped within 48 hrs; whereas in the oratolyte group where oral rehydration was started within the first 24 hrs, 48 hrs and 72 hrs or more, diarrhea stopped in 13.3% (2 out of 15), 20% (3 out of 15) and 66.7% respectively (Fig 1).

Coconut water contains not only electrolytes such as Na^{*}, K^{*}, Ca^{**}, and Mg^{**}, but also amino-acids which increase sodium and water reabsorption that it will reduce the frequency of diarrhea and the amount of sodium and water loss (Desjeux et al., 1977).

During this study we did not find any side-effects by using salt in half strength coconut water as an oral electrolyte solution, except in one case in the oratolyte group which showed ankle-oedema.

Acknowledgement

We are very grateful to Lieutenant Colonel Dr. Pandoe, director of the Army Hospital Teling, Manado, for his support in this study. And also we would like to express our sincere thanks to all para-medical personnel at the Pediatric Wards for their cooperation and help.

REFERENCES

1. BAHRAWI, W. : The role of environmental factors in epidemiology of diseases in Indonesia. Presented at the Second Asian Congress of Pediatrics, 3-6 August 1976, Jakarta, Indonesia.
2. DESJEUX, J.F., TANNENBAUM, : Effects of sugar and amino acids on sodium movement across small intestine. *Am. J. Dis. Child.* 131 : 331 (1977).
3. EISEMAN, B. : Intravenous infusion of coconut water. *Arch. Surg.* 68 : 167 (1954).
4. HARUN NURASID : Gagasan Rehydration Centers Khusus untuk Anak. Rehydration Course WHO SEARO 144, Surabaya, 1971.
5. HARUN NURASID, TEDDY ONTOSENO and SUBIDANTO PURWODIBROTO : Pemakaian air kelapa muda pada kholera anak. Buku Naskah Lengkap Pertemuan Ilmiah BKGAI, ke V, Desember 1977. Parapat, Sumatera Utara.
6. KAPOJOS *dkk. : Air kelapa dilihat dari sudut medis. Dokumen Universitas Sam Ratulangi, Manado, Indonesia (1970).

7. KING, M. : MCH — Package, Chapter Gastroenteritis of Infants, Presented at the Seminar of Rehydration, Jakarta, 26-29 August 1974.
8. MAHALANABIS, D. : Water and electrolyte losses due to cholera in infants and small children. *A recovery* 45 : 374 (1970).
9. MOENGINAH, P.A., UNTORO and HARUN ALRASJID : Larutan garam-gula untuk rehidrasi. Buku Naskah Lengkap Pertemuan Ilmiah BKGAI ke-V, Parapat, Sumatera Utara, Desember 1977.
10. NALIN D.R. : Sucrose in oral therapy for cholera and related diarrhea. *Lancet* ii : 1400 (1975).
11. PITONO SUPARTO, ISMUDIJANTO : Modified Oral Electrolyte Solution for Infantile Diarrhea. Presented at the fifth Asian Pacific Congress of Gastroenterology, Singapore, 23-29 May 1976.
12. RANTI, I.S.F., BOH, K.T., LIANG, T.I., HOEY, T.E. : Coconut water for intravenous fluid therapy. *Paediatr. Indones.* 5 : 782 (1965).
13. SUNOTO, PIOH, H., WIHARTA, A.S. and SUHARJONO : An oral electrolyte solution in the treatment of acute infantile gastroenteritis. In the Proceeding's Book of the 5th Meeting of the Coordinating Board of Indonesian Pediatric Gastroenterology, Parapat, North Sumatera, 5-12 December 1977.
14. TULECKE, W., WEINSTEIN, L.H. : The biochemical composition of coconut water (coconut milk) as related to its use in plant Teosine. Contribution from Boyce Thompson Institute. Jan. — March 1961.
15. MARTINDALE, W.A. : The extra Pharmacopocria, 27th ed. pp. 1265 (Pharmaceutical Press, London 1978).