Journal of Pediatric Gastroenterology and Nutrition
6:392–399 © 1987 Raven Press, New York

Efficacy of Mung Bean (Lentil) and Pop Rice Based Rehydration Solutions in Comparison with the Standard Glucose Electrolyte Solution

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Summary: Children with acute diarrhea and moderate dehydration between 3 months and 5 years of age were randomly assigned to receive treatment with standard WHO oral rehydration solution (ORS) ($n = 33$) and two other solutions in which the 20 g/L glucose was substituted by 50 g/L of pop rice ($n = 31$) and 60 g/L of mung bean (lentil) powder ($n = 29$). Satisfactory oral rehydration, as assessed clinically and by changes in PCV and total serum solids (TSS), was achieved in 90.9% with WHO ORS, 96.8% with pop rice, and 96.6% in the mung bean ORS treated group ($p > 0.05$). The purging rates (ml/kg/h) until recovery were 2.49 ± 1.5 (pop rice); 2.91 ± 2.0 (WHO), and 3.41 ± 1.7 in the mung bean group ($p > 0.05$). The percentage of patients recovering from diarrhea within the 72 h study period was 58.0 (pop rice), 48.4 (WHO), and 44.8 for mung bean group ($p > 0.05$). Though differences in stool volumes and duration in the three groups were not statistically different, there was a trend toward improvement in efficacy with the pop rice ORS in several parameters: greater weight gain, higher percentage decline in TSS, higher urine output despite lower ORS intake, and lower purging rates. The intake of semisolids in the 24–72 h study period was also higher in the pop rice group as compared to the other two groups ($p < 0.05$). The number of breast feeds and intake of artificial milk was however similar in all groups ($p > 0.05$). **Key Words:** Rehydration—Pop rice—Mung bean—ORS.

HYPOTHESIS

Glucose-mediated enhanced sodium absorption forms the physiological basis for the composition of oral rehydration solutions (ORS) recommended for use in diarrhea by the WHO (1).

Rice and green gram lentil (mung bean) are widely used natural foods for children in the Indian subcontinent. Two studies have shown a reduction in stool output and duration of acute diarrhea by using 30 g/L and 50 g/L of pop rice powder instead of the 20 g/L of glucose in the standard ORS (2,3). At greater concentrations of rice in ORS, the solution becomes more viscous, and there is an apprehension of inducing carbohydrate malabsorption.

The improved efficacy of pop rice ORS may be due to several factors. The digestibility of rice in infants and children is about 80–86%, which allows an optimal glucose concentration to be achieved (2). The hydrolysis takes place at a slower rate, which allows larger amounts of rice to be used at a relatively lower osmotic load than the glucose provided in standard ORS. Rice also contains glycine and lysine, which are known to promote absorption of sodium and water (4). Addition of glycine to the glucose based ORS was shown to improve its efficacy in infants and children with acute, moderate diarrheal dehydration (5).

Like rice, green gram yields glucose, amino acids, and oligopeptides upon hydrolysis, which would enhance sodium absorption through an inde-

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pendent carrier system. However, a critical issue is that natural foods used in rehydration solutions should be hydrolysed intraluminally at rates adequate to reach optimal glucose concentrations and without excess osmotic load.

There are significant differences in the composition of mung beans and pop rice (Table 1). The carbohydrate content is lower in mung beans and the amount available for hydrolysis is also lesser. Like pop rice, mung beans also contain glycine and other amino acids (6–8). Mung beans contain 24.5 g % protein as compared to 7.5 g % in pop rice (6). This may be important both for promoting sodium absorption and for its nutritional value, which are important considerations in management of acute diarrhea. Unlike rice, mung beans are rich in potassium (6).

TABLE 1. *Constituents of mung beans* (Vigna aureus) *and rice (per 100 g dry weight)*

	Mung beans	Pop rice
Edible protein (%)	100	100
Moisture (g)	10.1	14.7
Protein (g)	24.5	7.5
Carbohydrate (g)	59.9[a]	79 [b]
Fat (g)	1.2	1.1
Minerals (g)	3.5	3.8
Fibre (g)	0.8	0.3
Energy (kcal)	348	325
Sodium (mg)	27.2	10.9
Potassium (mg)	1150	154
Nature of carbohydrate (%)		
Starch	48.70	Almost entirely
Cellulose	4.2	0.25
Hemicellulose	—	—
Sucrose	1.16	0.5
Stachyose	1.26	—
Raffinose	2.31	—
Fructose	—	0.05
Verbascose and glucose	2.31	—
Amino acid content (g per 100 g dry wt)		
Total nitrogen	3.84	1.09
Arginine	1.92	0.52
Histidine	0.65	0.14
Lysine	1.76	0.25
Tryptophan	0.23	0.08
Phenylalanine	1.34	0.30
Tyrosine	0.38	0.31
Methionine	0.30	0.16
Cystine	0.23	0.09
Threonine	0.76	0.25
Leucine	1.95	0.54
Isoleucine	1.34	0.32
Valine	1.22	0.41
Glycine	0.99	0.29

From data in refs. 6–8.
[a] About 83% available for hydrolysis.
[b] Almost completely available for hydrolysis.

This study aimed to assess the efficacy of mung bean and pop rice ORS in comparison to the WHO ORS in the treatment of acute diarrheal dehydration.

MATERIAL AND METHODS

All the children suffering from acute diarrhea and referred to the oral rehydration unit of the pediatric service at the All India Institute of Medical Sciences, New Delhi over 10 consecutive months were considered for this study. The following eligibility critera were necessary for inclusion in the study: (a) males, (b) passage of more than four loose or watery stools in the preceding 24 h, (c) age between 3 months and 5 years, (d) duration of diarrhea ≤5 days, (e) obvious clinical signs of dehydration but without shock, (f) weight for height >70 percent of 50th percentile of reference value (9). Criteria for exclusion were: females, persistent vomiting (>4 vomits during 2 h prior to admission), bloody diarrhea, fever higher than 39°C, any associated nondiarrheal illness, use of antibiotics during the illness, and lack of obvious clinical signs of dehydration. Only one patient was excluded for persistent vomiting. Patients fulfilling the entry criteria were then randomly assigned to three treatment groups A, B, and C with the help of sealed envelopes. It was originally planned to study 33 patients per group but due to declining admissions only 93 patients were investigated.

Composition of Oral Rehydration Solutions

Pop rice contains 79 g % of carbohydrate that is almost completely available for hydrolysis. Mung beans contain about 60 g % carbohydrate and in our laboratory, upon in vitro hydrolysis, approximately 83% is available for complete hydrolysis. It is not known whether this rate of hydrolysis will be matched in vivo.

In view of the lower glucose release per 100 g by mung beans, a proportionately higher amount (60 g) of mung beans than pop rice (50 g) was used in preparing 1 L of the solution for the study.

Pop rice does not contain significant potassium, while mung beans contain 1150 mg of potassium per 100 g; both contain only traces of sodium (6).

The ingredients for each litre of the solution prepared were weighed individually. The final concentration of the solutions used for the three patient groups was similar in terms of sodium (90 mEq/L), chloride (80 mEq/L), bicarbonate (30 mEq/L), and potassium (20 mEq/L). In preparing mung bean ORS, an additional 0.2 g of potassium chloride was added per litre as against 1.5 g/L for pop rice solutions. The protein content per litre of the solution was 14.7 g for mung beans ORS and 3.75 g for pop rice ORS.

Pop rice is prepared by popping unhusked rice (paddy) on heated sand and is commonly sold as such. Shelled mung beans are sold in all local stores. Both rice and mung beans were procured from the local market and made into powder form before use.

The pop rice powder or glucose and salts were directly mixed in boiled water; mung bean powder was boiled in water for 20 min to prepare a homogeneous solution before the salts were added.

Administration of ORS and Diet

0–8 Hours

The respective rehydration solutions were offered at the rate of 100 ml/kg of body weight during the initial 8 h. The entire amount thus calculated was given to the mother to be fed by a cup and spoon over the 8-h period. Additional ORS was made available if the initial amount was used in less than 8 hours.

9–24 Hours

During this period, ORS was given only for replacement of the measured ongoing stool losses on a volume to volume basis. Free access to water was allowed. Breast feeding was advised at four hourly intervals for 15 min each. Formula milk (half strength) was offered following each breast feed at the rate of 100 ml/kg/24 h period.

25–72 Hours

The administration of ORS, plain water, breast milk, and full strength artificial milk was as between 9 and 24 h. In addition, cereal mix of uniform composition (30 g cereal to make 100 ml of gruel) and at the rate of 100 kcal/kg of body weight per day was offered until the end of the study.

The duration of the study was 72 hours. Antibiotics or other antidiarrheal agents were not administered to any of the patients until the end of the 72 h study period.

Monitoring

The intake of water, ORS, milk, plain water, and cereal mix was strictly monitored for the entire study period. Stool output was measured by using pre- and post-stool weighing of absorbable napkins. Urine output was monitored with collection bags.

Patients were weighed naked at 0, 8, 24 and 72 h using a beam type scale with a sensitivity of 10 g. At the same time intervals, haemogram, packed cell volume, total serum solids (TSS meter, American Opticals), serum sodium, and potassium were determined by standard methods. At least one stool was examined each day for pH and reducing substances by Clinitest before and after hydrolysis with 1 *N* HCL. Primary identification of bacterial agents in the fecal specimens was done as per the WHO manual (10). Three morphologically similar colonies of *E. coli* were tested for labile toxin by GM_1 ELISA (11) and for stable toxin (ST) by infant mouse assay (12), which only detects STa; specific tests for STb were not performed. WHO ELISA kit was used for rotavirus detection. The protein content of mung dal was determined by micro-Kjedahl method.

Patients were considered to have recovered from diarrhea at the time of passage of the last loose stool preceding two consecutive formed stools.

Statistical Methods

The χ^2 analysis was used on nominal data. A two-tailed Student's *t* test was performed for admission characteristics to changes in weight, ORS, and milk intake.

For purging rates, urine output, intake of water, and semisolids, and recovery from illness, Wilcox nonparametric analysis was used as the distribution was not normal. All cases including the 5 patients given i.v. fluids for short periods during the 72 h study period were included in the analysis.

OBSERVATIONS

The patients in the three groups were comparable for clinical findings, including nutritional status (Table 2). The distribution of enteropathogens was also similar in the three groups with rotavirus and *Escherichia coli* being predominant. There were only two cases of cholera. All the three solutions were well accepted without use of any flavouring agents in making the solutions. Oral rehydration

TABLE 2. *Admission characteristics of patients*

	Pop rice ORS (a) (n = 31)	Mung bean ORS (b) (n = 29)	WHO ORS (c) (n = 33)	P value
Age in months				
Mean (SD)	7.1 (1.4)	6.2 (1.4)	6.6 (2.4)	6.83+
Median	10	8	8	
Range	4–36	3–48	3–60	
Duration of vomiting (h)				
Mean (SD)	51.1 (45.4)	50.7 (46.1)	33.5 (41.7)	5.164+ +
Median	26	28	20	
Range	0–144	0–144	0–96	
Patients with fever (%)	19 (61.3)	17 (58.6)	23 (69.7)	0.91+
Mean no. of stools passed in preceding 24 h	20.3 (18.3)	15.0 (10.4)	18.1 (11.2)	a=b 1.13+ + + a=c 0 b=c 1.15
Diarrhoea duration (h)	60.06 (46.34)	79.31 (45.13)	61.42 (44.85)	a=b 0.17+ + + a=c 0.18 b=c 0.35
Weight for height (% of reference standard)				
80–100%	22	21	16	5.67+
70–79%	9	8	17	
Feeding (%)				
Breast fed				
Exclusively	35.5	27.6	39.4	2.84+
Partially	9.7	13.8	3.0	
Non-breast-fed	54.8	58.6	57.6	
Etiological agents				
Rotavirus	9	9	10	
ETEC	4	4	4	
EPEC	2	1	1	
Campylobacter	2	2	3	
Salmonella	0	0	1	
V. cholerae	0	1	1	
Shigella and *Yersinia*	0	0	0	
Giardia and *Entamoeba*	0	0	0	
Mixed (Rota + ETEC)	1	2	0	
No enteric pathogen	13	10	13	

+, χ^2 test; + +, Rank test; + + +, *t* test. All values not significant P > 0.05.

was satisfactorily achieved in all but five patients who required intravenous fluids. Three of the patients requiring intravenous fluids were in the WHO-ORS group and one each in the pop rice and mung bean groups. The reasons for failure of oral rehydration were high purging rates and persistent vomiting.

The clinical and biochemical parameters during therapy are shown in Tables 3 and 4.

The intake of ORS was lower with pop rice ORS but the differences with other groups were not significant ($p > 0.05$). Despite a lower ORS intake, the urine output was higher in the pop rice group as compared to the other two groups ($p < 0.05$). The purging rates (Table 3) were lowest in the pop rice group during the initial rehydration phase as well as at the time of recovery, but the differences between the three groups were not statistically significant ($p > 0.05$). Although the percentage of patients who recovered from diarrhoea within the 72 h study period in the pop rice group exceeded that in the two other treatment groups, these differences were statistically not significant ($p > 0.05$).

The percentage decline in total serum solids after 8 and 24 h of study was highest for the pop rice group, but the differences with the two other groups were not significant ($p > 0.05$).

The changes in serum electrolyte profiles were similar in the three groups (Table 4). Only one patient in the mung bean group had hypernatremia at admission and the high serum sodium levels returned to normal within 24 h.

Findings related to intake of milk and cereal mix are given in Table 5. During 24–72 h of study, the intake of solid foods (kcal/kg) in the breast-fed and the non-breast-fed infants was significantly greater

TABLE 3. *Clinical parameters during therapy*

	Pop rice ORS (a) (n = 31)	Mung bean ORS (b) (n = 29)	WHO ORS (c) (n = 33)	P value		
				a/b	a/c	b/c
Mean ORS intake in ml/kg						
0–8 h	120 (33)	123 (41)	114 (29)			
0–24 h	161 (56)	172 (58)	157 (63)	0.63	0.72	0.05
0–48 h	201 (84)	222 (92)	217 (103)	1.56	0.81	0.78+ + +
0–72 h	238 (119)	293 (141)	264 (136)	0.91	1.5	0.63
0–recovery[a]	160 (60)	205 (116)	195 (126)			
Mean postadmission wt gain as % of wt						
8 h	3.6 (2.7)	3.3 (2.2)	2.4 (1.9)	0.53	2.01[b]	1.6+ + +
24 h	4.5 (3.4)	3.3 (3.0)	3.8 (2.0)	1.36	0.91	0.73
48 h	4.2 (3.5)	3.7 (2.7)	4.5 (2.8)	0.61	0.81	1.07
72 h	4.9 (3.6)	3.8 (3.0)	4.5 (3.0)	1.26	0.81	0.86
Mean plain water intake (ml/kg)						
0–8 h	nil	nil	nil	a/b/c		
0–24 h	39 (17)	44 (28)	37 (19)	0.914+ +		
0–48 h	85 (38)	93 (63)	86 (41)	0.094		
0–72 h	122 (48)	150 (88)	123 (57)	0.423		
Mean stool output (ml/kg/h)						
0–8 h	3.3 (2.5)	4.1 (3.4)	3.5 (2.7)	0.539+ +		
0–24 h	2.8 (1.8)	3.7 (2.1)	3.2 (2.4)	1.765		
0–48 h	2.2 (1.4)	3.3 (1.9)	2.8 (2.0)	2.394		
0–72 h	2.1 (1.3)	3.1 (2.0)	2.6 (1.8)	2.077		
0–recovery[a]	2.4 (1.5)	3.4 (1.7)	2.9 (2.0)	1.011		
Mean urine output (ml/kg/h)						
0–8 h	113 (103)	70 (57)	97 (64)	2.972+ +		
0–24 h	407 (208)	279 (160)	347 (234)	5.368		
0–48 h	834 (445)	527 (276)	655 (357)	5.484		
0–72 h	1239 (624)	861 (417)	1069 (546)	7.965		
Patients recovering (%) within						
24 h	8 (25.8)	8 (27.5)	6 (18.1)			
48 h	12 (38.7)	9 (31.0)	9 (27.2)			
72 h	18 (58.0)	13 (44.8)	16 (48.4)	1.14+		

[a] n = 18 (pop rice); 13 (mung); 16 (WHO).
[b] $p < 0.05$, rest not significant.
+, χ^2 test, + +, rank test; + + +, *t* test. Numbers in parentheses denote SD.

in the pop rice group as compared to patients treated with standard ORS ($p < 0.05$) and mung bean ORS ($p < 0.05$).

Hypokalemia (serum K < 3.5 mEq/L) at admission was present in 12.9 (pop rice), 17.2 (mung), and 18.2% (WHO) of patients. After 72 h of treatment the corresponding percentages were 3.3, 10.7 and 9.4, respectively ($p > 0.05$).

The percentage of patients showing >0.5% posthydrolysis reducing sugars in one or more of the stools passed during the 0–8 hr of study period was 15.8 (pop rice), 10 (mung) and 18.5 (WHO), respectively ($p > 0.05$); the corresponding percentages during the 9–72 h study period were 10.7, 8.3 and 18.8, respectively ($p > 0.05$).

DISCUSSION

In this study, all but a few of the patients between 3 months and 5 years of age and suffering from acute diarrhea with moderate dehydration were successfully rehydrated with the rice and mung bean based solutions. Rehydration was achieved with a similar frequency in the three treatment groups.

The differences in stool volumes in the three groups were not statistically significant, but the mean stool volume in pop rice ORS group at end study was about 15% less than with standard ORS and 30% less than in the mung bean group. Several other parameters also indicate that pop rice ORS may be more efficacious than the standard ORS and more markedly than the mung bean solution: greater percentage decline in TSS, higher urine output with a lower intake of rehydration solution, and greater mean weight gain. Fewer patients in this study recovered by 72 h than was reported in earlier studies comparing pop rice and standard ORS (2,3). This made it difficult to compare the three solutions for their impact on the duration of diarrheal illness. In earlier studies, patients were

TABLE 4. *Changes in laboratory parameters*[a]

	Pop rice ORS (a) (n = 31)	Mung bean ORS (b) (n = 29)	WHO ORS (c) (n = 33)
Total serum solids (TSS)			
0 h	10.8 (1.1)	10.3 (0.8)	10.5 (1.2)
8 h	9.8 (0.8)**	9.7 (1.0)*	9.8 (1.1)*
24 h	9.3 (0.6)**	9.5 (0.8)*	9.3 (1.1)**
72 h	9.4 (0.5)**	9.4 (0.6)**	9.4 (1.2)**
Percentage decrease in TSS			
0–8	9.7 (7.6)	7.9 (4.6)	6.1 (5.8)
0–24	14.4 (7.5)	8.2 (4.5)	11.3 (8.2)
Hematocrit (%)			
0 h	35.0 (9.1)	33.3 (7.5)	32.0 (6.1)
8 h	30.9 (9.1)	30.7 (6.3)	29.5 (4.9)
24 h	30.7 (6.6)*	31.7 (6.9)	29.3 (4.9)
72 h	30.9 (7.4)	32.1 (5.3)	30.1 (4.0)
Serum sodium (mEq/L)			
0 h	135.7 (4.9)	134.8 (7.8)	134.9 (7.8)
8 h	135.4 (6.1)	136.0 (4.9)	135.7 (5.5)
24 h	138.7 (4.7)	134.5 (4.3)	136.0 (5.0)
72 h	134.8 (5.2)	134.9 (5.9)	136.9 (4.5)
Serum potassium (mEq/L)			
0 h	4.2 (0.8)	4.2 (0.9)	4.0 (0.8)
8 h	3.9 (0.6)	4.3 (0.9)	4.0 (0.6)
24 h	3.9 (0.7)	4.9 (0.7)	4.2 (0.9)
72 h	4.8 (1.0)	4.5 (1.0)	4.5 (1.0)
Hemoglobin (g %)			
0 h	9.6 (1.4)	9.9 (1.7)	9.8 (1.6)
8 h	8.6 (1.1)*	8.9 (1.2)*	9.0 (1.4)*
24 h	9.0 (2.1)	9.1 (1.7)	9.3 (1.7)
72 h	9.1 (1.6)	9.0 (1.2)	9.1 (1.2)

All figures denote mean (SD). All comparisons within group with value at 0 h. $^*p < 0.05$; $^{**}p < 0.01$, rest not significant.
[a] Statistical test: *t* test.

considered to have recovered at the time of the passage of the first semiformed stool, as against the more rigid criteria of two consecutive formed stools in our study. In our experience several patients again pass liquid stools after a single semiformed or formed stool.

Nevertheless, the finding that the percentage of patients recovering by the end of the study was greater in the pop rice ORS group is also consistent with an improved efficacy of this solution.

The reduction in stool volumes with rice ORS in previous studies was greater than was observed in this study. About 30% of the patients in the study by Molla (2) and by Patra et al. (3) suffered from cholera as against only 2 (2.1%) patients in this study. Data on food intake were not provided in either of the two previous studies. Any variations in nutrient intake among patients in these studies could also explain the differences.

Among breast- and non-breast-fed patients, the intake of cereal mix between 24 and 72 h of study was higher in pop rice treated patients than in the WHO ORS group, and these differences were statistically significant. The intake of cereal mix in the pop rice treated patients was also higher than in the mung bean group among breast-fed babies; the considerable differences in age in the non-breast-fed patients make it difficult to compare food intake between these two groups. The higher food intakes associated with the use of pop rice ORS could be important in reducing the adverse nutritional effects of acute diarrhea, particularly because children in the developing countries may suffer several episodes of illness in a year.

Differences in the nutrient intake could have influenced the absorption of sodium and water and thereby the stool volume as well as the duration of diarrhea. The differences in the purging rates in the 0–8 h study period (when no food was given) between pop rice and WHO ORS group were about 6%, being lower in the pop rice group. This difference became more marked by the 72 h study period

TABLE 5. *Frequency of breast feeding, intake of formula milk and cereal mix in different treatment groups*

	Pop rice (a) (n = 31)	Mung bean (b) (n = 29)	WHO (c) (n = 33)	P Value		
				a/b	a/c	b/c
Exclusively or partially breast fed						
No. of patients	20	19	21			
Age (mo)						
Mean	9.9 (4.08)	8.65 (3.7)	8.28 (4.14)	1.0	1.27	0.3+ + +
Median	9	8	7			
Range	4–18	3–15	3–18			
Mean no. of breast feeds						
8–24 h	4.2 (2.5)	5.1 (2.3)	5.5 (2.4)	1.15	1.69	0.53+ + +
8–48 h	10.1 (4.5)	12.6 (6.0)	13.8 (5.5)	1.44	2.36*	0.65
8–72 h	15.6 (8.2)	20.1 (10.1)	21.3 (9.6)	1.50	2.05	0.38
Mean intake of artificial milk (kcals/kg)						
8–24 h	7.2 (8.8)	5.1 (8.6)	3.8 (8.8)	2.970+ +		
8–48 h	32.2 (34.4)	20.7 (26.1)	21.3 (33.2)	2.87		
8–72 h	51.9 (50.1)	33.5 (39.4)	39.6 (57)	1.817		
Mean intake of cereal mix (kcal/kg)						
24–48 h	9.2 (12.6)	1.2 (2.6)	4.7 (8.7)	−0.576+ +		
24–72 h	25.3 (26.3)	6.1 (13.8)	10.9 (21.3)	8.653*		
Non-breast-fed						
No. of patients	11	10	12			
Age (mo)						
Mean	18.2 (11.4)	8.2 (4.5)	18.5 (18.4)	2.69*	0.05	1.87+ + +
Median	13	8	9.5			
Range	6–36	3–16	3–42			
Mean intake of artificial milk (kcal/kg)						
8–24 h	19 (10)	27 (15)	24 (14)	1.43	1.15	0.45+ + +
8–48 h	71 (29)	102 (47)	81 (58)	1.80	0.52	0.95
8–72 h	124 (52)	173 (74)	117 (80)	1.59	0.22	1.54
Mean intake of cereal mix (kcal/kg)						
24–48 h	29 (40)	2.5 (5.2)	9.5 (15.9)	6.491*+ +		
24–72 h	59 (83)	7.4 (10.9)	31.1 (35)	4.643		

*, p value < 0.05; rest not significant. + +, Rank test; + + +, *t* test. Numbers in parentheses denote SD.

when the foods were also consumed; the purging rates were now about 19% lower with pop rice ORS treated group than the WHO ORS group. This suggests that, if at all, the higher intakes of solids consumed by the children in the pop rice group was associated with further reduction in stool volumes in addition to providing higher nutrient intake.

Although satisfactory rehydration was achieved with the mung bean ORS, the mean purging rates in this group were higher than WHO-ORS. Several factors could have contributed to the lesser efficacy of the mung bean ORS. The digestibility of carbohydrate in mung beans is lower than with rice, with the result that the minimal effective intraluminal concentration of glucose may not have been achieved. The high protein content of 14.8 g per litre in mung bean solution may, by releasing amino acids, cause an osmolar drag of fluid from the vascular space to the gut lumen. The obligatory urinary losses of water would also increase due to high solute loads resulting from a higher protein intake.

In many developing countries, WHO-ORS packets may not be available for all episodes of diarrhoea irrespective of severity, particularly in remote areas. Solutions made at home from a mixture of rice or mung beans with salt may be possible alternatives for the initial response as soon as diarrhoea commences. The acceptability and efficacy of these home-made fluids in mild cases of diarrhoea need to be determined in a community setting.

If the standard ORS and bicarbonate are not available for treatment of patients with moderate dehydration, the mung bean ORS is a useful alternative because it has the advantage of providing an optimal potassium content similar to that in WHO ORS, without adding any additional potassium. The need for providing potassium while using bicarbonate-free rehydration solutions in patients with dehydration was recently highlighted in a study by Islam and Ahmed (13), where the risk of hypokalemia was found to be threefold higher in the group treated with WHO solution without bicarbonate than with the complete WHO solution.

In conclusion, majority of patients with moderate diarrhoeal dehydration and over the age of 3 months could be satisfactorily rehydrated with a pop rice or mung bean based oral rehydration solution.

There was a trend toward improved efficacy when glucose in ORS was replaced with 50 g/L of pop rice, but not when it was replaced by 60 g/L of mung bean powder.

Treatment with pop rice ORS was associated with an increased intake of solid foods. This may have important implications for reversing the adverse impact of diarrhea on the nutritional status of children particularly because children in developing countries suffer several such episodes every year.

Acknowledgment: This study was supported by the Control of Diarrheal Disease Programme (CDD), WHO, Geneva.

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