Controlled, double-blind, randomized clinical trial to evaluate the impact of fruit juice consumption on the evolution of acute diarrhea in infants

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Abstract

Background

Worldwide, acute diarrhea represents one of the leading causes of death in children younger than 5 years of age. A double-blind, randomized study was performed in order to assess the effect of juice feedings on weight gain and stool losses during acute diarrhea in infants.

Methods

Ninety children, mean age of 10 ± 4.8 months, were tested in a metabolic unit. Thirty patients were fed twice-daily up to 15 mL/kg/dose apple juice (AJ), 30 received white grape juice (WGJ), and 30 were given colored/flavored water (WA). Patients were similar among the 3 groups: experienced diarrhea for 50-64 hours prior to admission, and presented moderate to severe dehydration. The infants fed AJ and WGJ ingested 95 and 98 cal/kg/d respectively, whereas those receiving WA consumed 81 cal/kg/d.

Results

The duration and severity of diarrhea and nutritional status were the main endpoint variables. Mean body weight gain was greater among patients receiving WGJ (+ 50.7 g) as compared with the AJ group (+ 18.3 g) or the fed WA (– 0.7 g). The duration of the illness was longer in the infants fed juice as compared with those given WA ($p < 0.05$). Duration of diarrhea in hours was 111.7 ± 48.2, 105.4 ± 44.9, and 80.0 ± 39.6 in patients fed AJ, WGJ, and WA, respectively. The fecal losses were increased among the juice-fed patients ($p = 0.001$); the mean ± SD fecal excretion in g/kg/h was 3.59 ± 2.35, 3.94 ± 2.35, and 2.19 ± 1.63 in each group, respectively. The stool output was highest during the first day of treatment; those fed AJ had the highest volume of fecal losses and those who received WA had the lowest stool excretion. All patients improved while ingesting juice and none developed persistent diarrhea; over 50% of patients recovered within 50 hours of the beginning of treatment. The ability to tolerate carbohydrates was similar among the 3 groups of patients, determined by alterations in stool pH and breath hydrogen excretion testing following juice feedings after recovery.

Conclusions

Intake of juices resulted in more fecal losses and more prolonged diarrhea as compared with water feedings, but feedings led to higher calorie intake and more weight gain, particularly when fed juice with equimolar concentrations of fructose and glucose.

Background

Worldwide, acute diarrhea represents one of the leading causes of death in children younger than 5 years of age. The average duration of an acute episode of diarrhea is 5 days, but in some cases the diarrhea may persist more than 14 days. This leads to deterioration of the nutritional status and a poor prognosis. Whereas 0.7% of acute diarrhea cases may be fatal, mortality may be 10 to 35% in the persistent diarrhea patients [1]. Previous studies have demonstrated that proper management of hydration and appropriate dietary intake during the illness can decrease the stool output, reduce the risk of prolonged diarrhea, and improve the nutritional status of patients [1-3].

The World Health Organization (WHO) has recommended home fluids, including fruit juices, as appropriate feedings and as a measure to improve fluid balance during acute diarrheal episodes in children [1]. On the other hand, the Provisional Committee on Quality Improvement, Sub-committee on Acute Gastroenteritis, and the Committee on Nutrition (CON) of the American Academy of Pediatrics (AAP) recommended that the management of diarrheal disease in young children should include early feedings of age-appropriate foods, while avoiding foods high in fat, and providing feedings with simple sugars, such as teas, juices and soft drinks [4, 5]. Similar recommendations were endorsed by the European Society for Pediatric Gastroenterology, Hepatology and Nutrition which recommended the use of a normal diet without restrictions, including lactose [3].

However, the recommendations for or against juice feedings during acute diarrhea have not been prospectively assessed. Previous data showed that not all fruit juices are equally absorbed [6]. Some juices, such as apple juice (AJ) and pear juice (PJ) contain higher concentration of fructose than glucose and sorbitol, and are poorly absorbed as compared with other juices, e.g. white grape juice (WGJ) which contains equimolar concentrations of fructose and glucose, without sorbitol. We recently demonstrated that children challenged with a single serving of PJ or AJ during the recovery phase of diarrhea presented recurrence of loose stools, whereas those who received WGJ did not [7]. Other reports have shown that AJ ingestion may be associated with chronic diarrhea [8].

In this double-blind, randomized clinical trial we measured the effects of juice intake during acute diarrheal illness. AJ, WGJ, or colored and flavored water (WA) feedings were given twice daily as part of an age-appropriate dietary intake. While feedings of juice increased the stool loses and the duration of diarrhea, juice intake also produced increased weight gain, particularly among those fed the juice containing equimolar quantities of fructose and glucose.

Methods

The study was conducted in a double-blind design. There were 90 infants with severe diarrhea admitted to the Fima Lifshitz Metabolic Unit at the university Hospital Professor Edgar Santos, Federal University of Bahia, Salvador, Bahia, Brazil. Thirty patients in each group were randomly assigned to receive one of 3 feedings: AJ, WGJ, or WA. The composition of each is shown in Table 1. These were packaged by the manufacturer (Welch's, Concord, MA) in identical bottles and had same appearance and color. The WA was colored and flavored to resemble juice. Thirty identically labelled bottles containing 300 mL each were provided per patient. A new bottle was opened for each of the twice daily feedings. The investigators involved with the care of the patients in the study were not aware of the code identifying the bottle content or of the type of juice that the infant was randomized to be fed. To establish the randomization list, permuted blocks of variable length, with four blocks for each group, were used in order to avoid imbalance between treatment groups.

The patients studied fulfilled the inclusion criteria, ie, male, age 4 to 18 months of age, presenting with an episode of acute diarrhea (defined as more than 3 watery stools in the previous 24 hours, duration of diarrhea less than 3 days). Patients were excluded from the study if they presented other conditions or a concurrent serious illness, had history of chronic diarrhea or were exclusively breast fed prior to the time of the illness. An informed consent was elicited from the mothers of all patients admitted into the protocol. The study was approved by the Institutional Review Board of the hospital and of the university.

All patients were hydrated according to WHO guidelines [9]. Children with severe dehydration were given intravenous fluids at a rate of 40 mL/kg/h for 4 to 6 hours (composed of 1:1 glucose 5% and NaCl 0.9%). If after the initial hydration the patient was still severely dehydrated, a second dose of fluids was infused. Once the infants were no longer severely dehydrated they were given oral hydration solutions (ORS). Those admitted with moderate dehydration, not requiring intravenous fluids, were treated with ORS given at a dose of 100 mL/kg over 6 hours. The maintenance hydration phase started once the acute dehydration was treated. This was continued throughout the duration of the illness. During this phase, the patients received ORS on a volume to weight replacement of ongoing stool loses and emesis. After rehydration was achieved, the infants were started on their usual diet [9]. Additionally, all infants were offered a serving of up to 15 mL/kg/dose of AJ, WGJ, or WA, twice daily (10 am and 3 pm) throughout the diarrheal episode.

Twenty-four hours after the illness improved (defined as 2 formed stools passed during 24 hours or no stools for 12 hours), patients fasted for 6 hours and were given the same dose of juice for a juice tolerance test. Breath hydrogen (BH2) excretion was measured every 30 minutes for 3 hours using a SC Microanalyzer (QuinTron Instruments, Milwaukee, WI). A peak rise in BH2 of at least 20 ppm was considered a positive response [10].

Body weight was measured on admission, after rehydration, and daily thereafter until discharge. Nutritional assessment was determined using weigh-for-length using NCHS curves as reference. Nutritional intake and the amount of fluids ingested were measured in all patients throughout the study. Stool weight, urine volume, and vomitus weight were quantitated using metabolic techniques and specially designed beds to accurately collect stool loses throughout the study. Breast milk intake was estimated by weighing the patients before and after breastfeeding. All diarrheal stools were tested for pH and sugars using Clinitest tablets (Bayer, Tarrytown, NY). Standard laboratory techniques were used for measurement of serum sodium, potassium and hemoglobin, and hematocrit on admission, and as clinically indicated. Stools were analyzed for pathogens and rotavirus by ELISA. All patients were re-evaluated one week after discharge.

The following endpoint variables were quantified: duration of illness, severity of diarrhea assessed by the number, type and consistency of the stools, amount of fecal loses (measured in g/kg/day), vomitus loses, and the amount of fluid intake required to maintain fluid balance. Body weight changes were measured utilizing the weight of the patient attained after rehydration compared with the one prior to discharge. The presence of carbohydrate intolerance determined by the fecal pH and sugar excretion as well as by the BH2 levels after juice intake were also endpoint variables.

The sample size was calculated by the Power program to ensure statistically significant differences on the stool output and duration of diarrhea [11]. The estimated sample size was 26 patients per group assuming a 30% clinical improvement, on the above outcomes, at a power of 80% and at 0.05 significance. Data were analyzed by Analysis of Variance (ANOVA), when data distribution were not normal, a non-parametric test of Kruskal-Wallis were performed. Survival curves Kaplan-Meyers were used [12].

Results

The clinical characteristics and the laboratory data of patients on admission are shown in Tables 2 and 3. The patients in each of the groups were similar in age, duration and severity of diarrhea, presence of fever and vomiting. Also there were no differences in the proportion of patients who received breast feedings or in their nutritional status. Over 46% of patients studied in each group were well nourished, more than 33% showed mild body weight deficits (<1 SD) and the others had mild to moderate malnutrition (>2 SD). Differences in clinical characteristics were not significant among groups.

Mean serum electrolyte levels on admission to the hospital were similar among the 3 groups of patients (Table 3). The hemoglobin and hematocrit levels were also similar among groups, but two thirds of the patients exhibited mild degrees of anemia (hemoglobin < 11g), and 9 infants had more severe anemic (hemoglobin < 9 g). In all instances iron supplementation was prescribed at the completion of the study. Rotavirus was identified in the stools of 55 of the patients, in 4 there was a pathogenic *Escherichia coli*, in 10 there were parasites detected, and in the remaining 21 infants there were no stool pathogens identified.

Daily intake of the patients while in the study is shown in Table 4. The amount of water, milk formula, and breast milk intake did not differ among the groups. However, the infants readily consumed juice; those who received WGJ ingested the most. The total energy intake was higher in the juice fed groups compared with the WA. Juice intake never exceeded the 15 mL/kg/dose and the daily intake was less than the amount offered. The WGJ patients ingested an average of 17% more calories per day, and the AJ infants consumed a mean of 14% more than the WA group. The increased energy intake was not at the expense of the other foods; both milk formula and complementary foods were ingested in similar quantities among the 3 groups of patients. The mean body weight gain was higher among the juice-fed patients; there was a mean weight gain of 18.3 grams in the AJ fed patients and of 50.6 grams in those given WGJ, whereas there was a mean loss of body weight (– 7.0 gm) among the WA patients.

Duration of diarrhea differed among the 3 groups of patients (Table 5).The total duration of diarrhea was decreased among the WA fed patients as compared with the AJ and WGJ groups. The differences in the duration of diarrhea were due to a more prolonged illness while being treated. The illness was shorter among patients given WA instead of juice. However the majority of the patients recovered promptly, regardless of the treatment given (Figure 1). Over 50% of patients improved within 50 hours after treatment was instituted, less than one forth of them had diarrhea persisting more than 96 hours, and none experienced diarrhea more than 7 days.

The severity of diarrhea also differed among the treatment groups (Table 6). The stool output among the WA group of patients was decreased compared with those fed juice. During the first day of treatment, those fed water had a mean stool output of 40% less than those fed juice. With improvement, the differences among the treatments were minimized, and were no longer significant after the second day of the illness. There were also significant differences in the severity of diarrhea among AJ and WGJ feedings (Table 6). During the first 24 hours of treatment the patients receiving AJ had more marked stool losses than those fed WGJ. The mean excretion of stools was 21% higher in AJ fed patients than in the WGJ fed group.

Stool excretion data was treated for possible confounding and co-variables which could play a role in determining the final results. The covariance analysis and the robust regression showed a possible influence of ORS intake in the differences detected among the 3 groups of patients. The stool output was not different when the ORS intake was adjusted for the 3 groups of patients and the urinary output was similar. Emesis losses were not different among the patients; vomiting being present primarily during the first 24 hours of treatment.

There were 2 patients who had severe diarrhea during the treatment period (>10 mL/kg/h). These patients were among the AJ group, one of these patients had acid stools and none had carbohydrates in feces. These 2 patients were given a lactose-free formula, with improvement in stool output. There were 3 other patients, one in each group, who showed carbohydrate intolerance with acid stools or sugars in feces, these patients improved without any dietary modifications. The response to juice feedings (determined by breath hydrogen excretion after improvement of the illness) was not different among the 3 groups of patients. Most infants did not show elevated BH2 excretion levels; there were 17, 16 and 10 patients among the AJ, WGJ and WA groups, respectively, who failed to show BH2 levels above 5 ppm at any time. Only 18 patients demonstrated a BH2 level above 20 ppm; 8 of these were given AJ, 6 were fed WGJ and 4 received WA.

Discussion

This is the first double-blind, prospective study designed to evaluate the effects of fruit-juice feedings during diarrheal disease in young children. Two commonly available juices were selected and compared with water intake, as part of an age-appropriate dietary intake. One juice contained equimolar quantities of glucose and fructose (WGJ) and the other provided a higher fructose to glucose ratio and contained sorbitol (AJ). All patients improved while being fed water or any of these 2 juices. However, those receiving juice had more stool losses than those fed water, highest being among the patients fed AJ. On the other hand, the children fed juice ingested more calories and gained more weight than those fed water – those fed WGJ having the best response.

Acute gastroenteritis continues to be a common illness among infants and children worldwide. The disease causes an estimated 2 million deaths annually among children in the developing world. In the United States, diarrhea accounts for more than 1.5 million outpatient visits, 200,000 hospitalizations and 300 deaths per year [13]. Children younger than 5 years of age are at much higher risk of death from diarrhea than older children and adults [13]. Infants less than one year of age are particularly susceptible to this disease and are at the highest risk of death; 43% to 78% of mortalities from the illness among children less than 5 years of age occur in infants less than one year [14-16].

Although the number of children currently dying from diarrhea continues to be unacceptably high, it is substantially lower than the 5 million estimated deaths twenty years ago [17]. The critical factors accounting for the reduction in mortality rates from this illness include widespread use of ORS and the proper nutritional rehabilitation of sick infants [18].

The AAP has emphasized the importance of oral hydration and early nutritional support to aid these patients safely and effectively throughout the diarrheal episode [5]. A rapid realimentation with age-appropriated foods and an unrestricted diet is recommended, as soon as dehydration is corrected. Nursing should be continued in those infants who are breast fed and a standard full-strength formula to be given to those formula-fed children. The old concept of "bowel rest" has no scientific validity and it can serve to aggravate and increase the risks of the disease [19]. Apart from the undesirable metabolic effects of even brief fasts, withholding oral intake may further compound the intestinal absorptive processes and may lead to deterioration of the nutritional status of the patient [20]. Even though feedings increase the stool output and diarrhea, children who are fed attain higher body weights at the end of the illness than those who are not fed. This was evident in this study. Although they exhibited larger stool losses during the first 24 hours of nutritional rehabilitation, patients who were fed juice during the diarrheal illness had a higher body weight at recovery than those fed WA.

Diarrhea, like other infections, decreases the appetite and sick infants often reject most foods, although breast milk is better accepted [21]. The lack of appetite may be mediated by interleukin-1, a hormone released by the cells after infection [22]. The intensity of anorexia may not necessarily correlate with the severity of the illness. A child may lose his or her appetite with even mild diarrhea, with anorexia lasting from a few hours to several days [23]. As much as 20% to 70% of food available may be wasted or not eaten during bouts of diarrhea [23]. Thus feedings of a well accepted energy source may be desirable and necessary to enhance the nutrient intake of sick infants and young children. Fruit juice was readily consumed by the patients in this study, and the intake of this food did not displace the consumption of other nutrients. Juice feedings resulted in a higher energy balance, particularly among the infants fed WGJ. Infants fed juice ingested 14% to 17% more calories than those given WA; those receiving AJ and WGJ ingested 95 and 98 cal/kg/d, respectively, whereas those receiving WA consumed 81 cal/kg/d.

Previous data showed that fruit juices differ in carbohydrate composition and that juices containing equimolar concentrations of glucose and fructose were best absorbed throughout the first 5 years of life [6]. Similarly we have previously shown that this type of juice is better tolerated after recovery from acute diarrhea [6]. The present study confirmed that this juice was better suited during the acute stages of the illness. The fecal losses associated with consumption of WGJ during the treatment of acute diarrhea were lower than those observed during feedings of juice containing higher fructose to glucose ratios and sorbitol. However, the stool output was highest only during the first day of treatment with differences in stool output rapidly disappearing with recovery from the illness. All patients improved within 3-4 days while ingesting juice and none of them developed persistent diarrhea. The ability to tolerate carbohydrates after recovery was also similar among the three groups.

Patients were offered up to 15 mL/kg/dose of juice, given twice daily throughout the study. This dose of juice exceeded the recommended allowance by the AAP-CON which limits the intake of juice to one serving of 4 to 6 oz per day to children of this age [4]. However by allowing the patients to ingest this high energy drink at-will during the illness their spontaneous intake could be determined. Children did not consume the full amount of juice offered, only ingested approximately 17 to 21 mL/kg/d; those receiving WA consumed the lesser amounts. Those given WGJ ingested an average of 18 cal/kg/d and those fed AJ consumed 12 cal/kg/d more than those fed WA. The patients given juice feedings also ingested more fluids. One can speculate that fluid intake was higher due to fecal loss replacement and/or thirst induced by juice. A covariance analysis and a robust regression to determine a possible confounding factor did not support that possibility. No differences were found among groups by adjusting the stool output to ORS or fluid intake. However, the ORS volume represented the most important fluid intake, indicating that diarrhea duration and stool losses were the consequence of juice feedings.

The maintenance of a positive energy balance during diarrhea may be of particular importance for the vulnerable infant who is at a higher nutritional risk (even before developing diarrhea) [20, 23]. This illness is considered to be one of the most important risks for the development of malnutrition [24]. Diarrhea and other infections affect the body's economy through a number of mechanisms including the decreased absorption of nutrients [23-25]. The provision of simple carbohydrates in a balanced proportion as present in some juices may facilitate the appropriate consumption of energy even during the illness and may be positive for the infant's nutritional rehabilitation [7]. However ingestion of larger amounts of fruit juice has been associated with prolongation of diarrhea [8]. Additionally, ingestion of juices containing high fructose and sorbitol may also be associated with other negative consequences, e.g. colic [26] and increased energy requirements [27].

The transient malabsorption during the acute phase of the illness may be overcome by absorptive advantages of the carbohydrate composition of specific feedings [7]. Similar results were found with amino-acid based ORS [28] and with the low-osmolality ORS [17, 29, 30]. However the most important therapy for the sick infant is the rapid rehydration, the maintenance of fluid and electrolyte balance and the provision of adequate feedings.

Conclusions

Feedings of juices with different fructose:glucose ratio, with or without sorbitol, and osmolality levels resulted in more fecal losses in the first 24 hours of diarrhea as compared with WA feedings. However the patients given juice ingested more calories and gained more weight, particularly those being fed the juice with equimolar concentrations of fructose and glucose, without sorbitol. All patients recovered with appropriate treatment without anyone developing persistent diarrhea.

Our data strongly support the present recommendation of maintaining normal dietary habits during acute diarrheal episodes. However, juice choices may vary in its effects, as they vary in their composition. Thus, these differences should be considered when recommendations are made for feeding sick infants.

Competing interests

This study was funded in part by unrestricted research grants from Pediatric Sunshine Academics and Welch's. Part of this funding paid for some of the salaries. At no time during the course of the study was Welch's aware of any of the research data. Welch's Inc. has not been involved in the data interpretation or manuscript preparation. Pediatrics Sunshine Academics is a 501C corporation with the mission of supporting Pediatric Endocrinology and Nutrition research.

Authors' contributions

Sandra Valois, MS/RD participated in the design of the study, conducted the experiments, inputed the data and performed statistical analysis. Hugo Costa-Ribeiro Jr, MD/PhD is the Director of the metabolic unit where the studies were performed and he participated in the design and coordination of the study, as well as manuscript preparation. He also oversaw the activities of all personnel and investigators of the unit. Ângela Mattos, MD and Tereza Cristina Ribeiro, MD are the Pediatricians who cared for the patients participating in the study, and made all clinical decisions. Carlos Mauricio Cardeal Mendes, MS performed the statistical analysis. Fima Lifshitz, MD conceived the study, participated in its design, elicited the grant support to carry out the experiments and contributed to the protocol design, and reviewed the data and manuscript.

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Table 1. Carbohydrate content of fruit juices

Feeding	Osmolality mOs/L	Fructose g/dL	Glucose g/dL	Sucrose g/dL	Sorbitol g/dL	Energy cal/dL
Apple Juice	700	6.2	2.7	1.2	0.5	40.4
White Grape Juice	1040	7.5	7.1	0.0	0.0	58.4
Water	46	--	--	--	--	--

Modified from: Hyams JS, Etienne NL, Leichtner AM, Theuer RC, Carbohydrate malabsorption following fruit juice ingestion in young children. *Pediatrics.*1988;82:64-68.
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Table 2. Clinical characteristics of patients on admission

	Apple Juice n = 30		White Grape Juice n = 30		Water n= 30	
	χ	SD	χ	SD	χ	SD
Age (months)	10.27	4.75	10.27	4.14	11.09	4.00
Diarrhea duration*	56.37	33.90	64.17	38.95	53.47	33.35
Fever duration*	37.77	33.46	47.11	49.62	41.04	38.11
Vomiting*	41.57	35.45	46.97	39.54	44.33	31.44%
Breastfeeding	13 (n)	43.3%	16 (n)	53.3%	09 (n)	30.0%
Well nourished	16 (n)	53.3%	15 (n)	50.0%	14 (n)	46.6%
Nutritional risk**	08 (n)	26.6%	10 (n)	33.3%	15 (n)	50.0%
Mild malnutrition	03 (n)	10.0%	05 (n)	16.6%	01 (n)	3.4%
Moderate/severe malnutrition	03 (n)	10.0%	00 (n)	0.0%	00 (n)	0.0%

* hours
** Nutritional risk indicated body weight deficit < 1 SD, Mild malnutrition < 2 SD and Moderate/Severe Malnutrition > 2 SD. There were no statistically significant differences among groups, Analysis of Variance (ANOVA) p>0.05. Fever was considered above 37.5 C temperature.
n= number of patients and % of patients in each category.

Table 3. Laboratory data of patients on admission*

	Apple Juice n = 30		**White Grape Juice n = 30**		**Water n = 30**	
	χ	*SD*	χ	*SD*	χ	*SD*
Serum sodium (mEq/L)	142.03	5.45	140.96	3.51	140.51	5.39
Serum potassium (mEq/L)	3.99	0.59	3.95	0.81	4.27	0.78
Hematocrit (%)	31.17	3.29	30.93	2.50	32.03	3.55
Hemoglobin (g/dl)	10.28	1.13	10.24	0.87	10.58	1.19
No anemia	06 (n)	20.0 %	02 (n)	6.7 %	07 (n)	23.3 %
Mild anemia ✞	20 (n)	66.7 %	26 (n)	86.6%	20 (n)	66.7 %
Severe anemia✞	04 (n)	13.3 %	02 (n)	6.7 %	03 (n)	10.0 %
Rotavirus	19 (n)	63.3 %	18 (n)	60.0 %	18 (n)	60.0 %
Parasites✞✞	05 (n)	16.7%.	04 (n)	13.3 %	01 (n)	3.3 %

*There were no significant differences among groups by ANOVA p > 0,05.
✞The criteria for mild Anemia was a hemoglobin less than 11.0 g/dl and for severe anemia was a hemoglobin less than 9 g/dl (WHO, 1989)
✞✞The parasites detected were: Ascaris lumbricoides (4), Giardia lamblia (1) Blastocytes hominis (1) Endameba coli (1) and Cryptosporidium parvum (3).
n= number of patients and % of patients in each category

Table 4. Daily intake of patients throughout the study

	Apple Juice n = 30		White Grape Juice n = 30		Water n = 30		P value
	χ	*SD*	χ	*SD*	χ	*SD*	
Calories	95.84	22.42	98.65	30.52	81.43	23.09	0.02*
Formula	54.49	23.43	50.21	34.57	52.68	17.93	0.81
Breast Milk	08.71	11.57	15.80	18.56	05.45	10.96	0.06
Water	30.67	9.25	30.27	9.57	26.98	9.37	0.25
ORS	45.52	31.17	39.12	25.10	25.10	17.91	0.01
Juices	18.61	3.93	20.98	5.35	17.32 #	4.37	0.01**
Total Liquids	157.90	38.26	158.42	50.35	127.70	28.25	0.001***
Total Solids	23.90	11.61	25.12	13.97	26.92	11.59	0.64

* Significant differences among juice groups vs water, by ANOVA (Bonferroni).
*** Significant differences among water vs juices
** Significant differences for WGJ vs the others
# Refers to WA intake
Data are means ± SD. mL/kg/d. Solids are g.

Table 5. Duration of diarrhea throughout the study and after treatment

	Total Time		Duration During Treatment	
	Mean	SD	Mean	SD
Apple Juice	105.4	44.9	49.4	32.6
White Grape Juice	111.7	48.2	47.5	38.9
Water *	80.0	39.6	26.5	27.4

*Significant differences detect by Kruskal-Wallis p < 0,05. Water vs Juice groups.
Data are hours +/- SD
Total time denotes the duration of the illness from the start of diarrhea.
Duration of After Treatment denotes the duration of diarrhea in the metabolic unit.

Table 6. Fecal losses throughout the study and on the first day after randomization

	Total Losses g/kg/h		First Day Losses g/kg/h	
	Mean	SD	Mean	SD
Apple Juice	3.94	2.35	4.13**	2.90
White Grape Juice	3.59	2.35	3.28**	2.39
Water	2.19*	1.63	1.78***	1.80

*Differences among groups water vs juices (Kruskal-Wallis test) (p= 0.001)
** Differences between WGJ and AJ (p=0.02)
*** Differences between water and juices groups (p=0.001)
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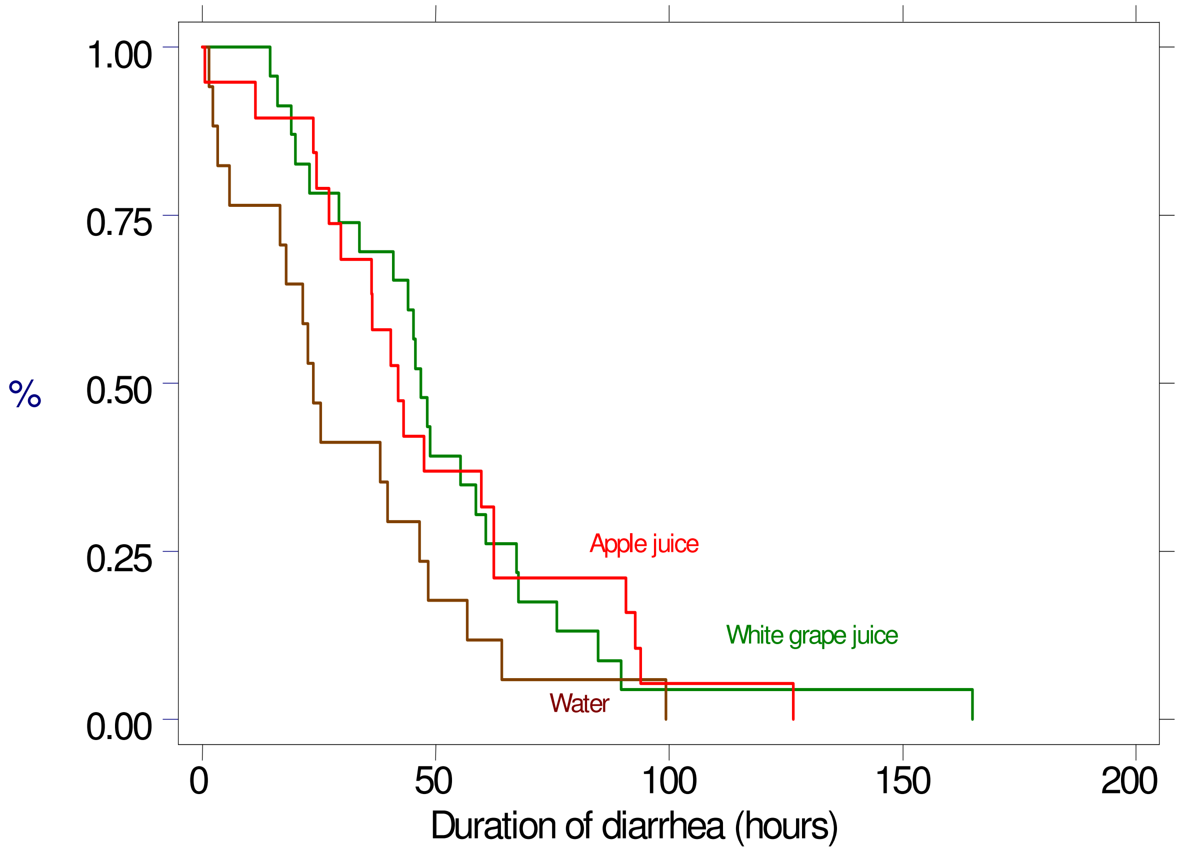
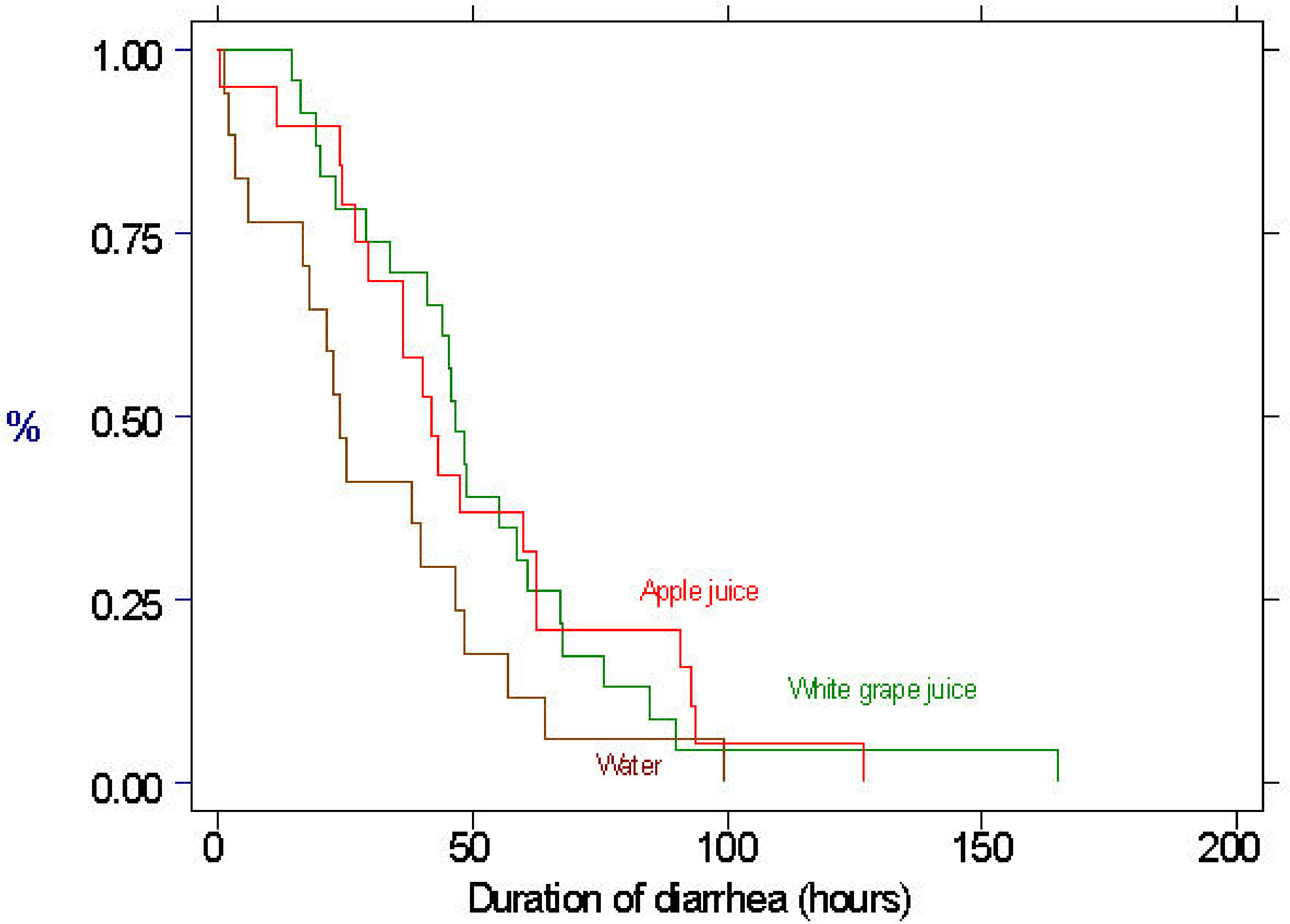
Figure 1. Duration of diarrhea –survival analysis Kaplan-Meier



Statistical differences were found, $p < 0.05$, between water fed and apple juice (P = 0.03) or white grape juice (P = 0.01).

Figure 1. Duration of diarrhea –survival analysis Kaplan-Meier



Statistical differences were found, $p < 0.05$, between water fed and apple juice ($P = 0.03$) or white grape juice ($P = 0.01$).

Figure 1