

## **Gum Arabic a superb anti-diarrheal agent**

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### **Abstract:**

#### **Back ground:**

Diarrhoea is the second most common cause of death in young children, after pneumonia. Gum Arabic (GA) is a soluble fibre with moderate emulsifying properties that may result in greater accessibility of electrolytes and associated water to the microvillus membrane. Additional work indicated that GA enhanced absorption of the solutes transported by diffusion and does not act via sodium dependent mechanisms.

**Objective:** The objective of this study was to evaluate the effect of Sweetfibre (gum Arabic preparation) as an additive to WHO-ORS in the management of acute diarrhoea in children.

**Methods:** An interventional randomized controlled hospital based clinical trial was performed in OPEH (March to August 2011). One hundred and eighty children presenting with acute none bloody diarrhoea in the absence of severe systemic illnesses were enrolled in the study. These children were divided randomly into two equal groups (study group1 and control group2), their ages ranged between six and 60 months. The control group received the conventional treatment of diarrhoea according to WHO recommendations and the other group received in addition gum Arabic solution (sweetfibre), 5-10 mg until recovery and continued with 5 mg thereafter. Data were analysed using the SPSS.

**Results:** In the group of children who received gum Arabic; diarrhoea stopped within 24 hours in 90% and 80% were discharged after one day. All of them were improved and discharged within first five days of admission. None of them went into severe dehydration or shock. Only three children developed electrolyte imbalance. The weight at the end of the study increased in 47.8% and decreased in only 5.5%. Sixty one children were followed after 6 weeks only two of them (3.3%) had recurrence of diarrhoea. In the control group diarrhoea stopped within 24 hours in 38.9% and 30% were discharged after one day. 10% did not recover during the first five days of admission. Electrolytes imbalance developed in 23.3%, two children developed severe dehydration and one became shocked. The weight decreased in 35.6% and increased in 15.6%. Sixty seven children were followed, 13 (19.4%) of them developed diarrhoea again.

**Conclusion:** Sweetfibre as an additive to WHO-ORS reduces the duration of diarrhoea and hospital stay. It decreases diarrhoea complications and facilitates regaining weight. It has a prebiotic effect in prevention of diarrhoea. All these indicate its potential as a new antidiarrheal therapy for acute diarrhoea in children.

**Keywords:** prebiotic, antidiarrheal, contamination, isonatraemic, isotonic dehydration.

**D**iarrhoea is the second most common cause of death in young children, after pneumonia. It kills

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more young children than AIDS, malaria and measles combined together. About four billion cases of diarrhoea are estimated to occur every year among children under five years of age<sup>1</sup>. It kills more than 1.5 million children under five years of age every year mainly in low and middle-income countries<sup>2</sup> representing 17 per cent of all deaths in children under that age<sup>3</sup>. Today, only 39 per cent of children

with diarrhoea in developing countries receive the recommended treatment, and limited trend data suggest that there has been little progress since 2000s<sup>4</sup>.

Gum Arabic (GA) is a soluble fibre with moderate emulsifying properties that may result in greater accessibility of electrolytes and associated water to the microvillus membrane. Additional work indicated that GA enhanced absorption of the solutes transported by diffusion (via transcellular and/or transjunctional transport pathways) and does not act via sodium dependent mechanisms<sup>5</sup>. Other evidence shows that GA may exert its pro-absorptive effects by modulating the levels of the free radical nitric oxide (NO) in the upper intestine, either by scavenging NO produced in the enterocyte and diffusing into the lumen, or by inhibiting inducible NO synthase. Fermentation of GA by colonic bacteria promotes bacterial proliferation, and the larger bacterial mass induces increased production of short chain fatty acids (SCFAs) linked with enlargement of the caecum. Indeed incorporation of GA into fibre-free diets resulted in increased weight of the caecal wall or increased proliferation of caecal epithelial cells. Hypertrophy of the caecum enlarges the caecal absorptive mucosa and increases caecal blood flow. The major SCFAs produced are acetate, propionate and butyrate; with propionate production most stimulated by GA<sup>6,7,8</sup>.

The end results of these effects are good body hydration, production of formed stools, and so recovery from diarrhoea.

### Materials and Methods

An interventional randomized controlled hospital based clinical trial was performed in Omdurman Pediatrics Emergency Hospital (OPEH) (March to August 2011). One hundred and eighty children presenting with acute none bloody diarrhoea in the absence of severe systemic illnesses were enrolled in the study. These

children were divided randomly into two equal groups [study (group1) and control (group2)], their ages ranged between six and 60 months. Group 2 received the conventional treatment of diarrhoea according to WHO recommendations and group 1 received in addition GA solution (sweet fibre), 5-10 mg until recovery and continued with 5 mg thereafter. Data were analysed using the SPSS

Major outcome measures, such as duration of diarrhoea and hospital admission, development of complications (severe dehydration, electrolytes disturbance and shock), change in body weight and the recurrence of diarrhoea within the followed six weeks, were compared between the two groups.

### Case definition:

Acute diarrhoea was defined as passage of three or more of unusually loose stools in 24 hr period lasting less than 14 days.

### Inclusion criteria:

Patients aged 6-60 months with acute none bloody diarrhoea who were admitted to the gastroenteritis wards with or without signs of dehydration according to WHO classification.

### Exclusion criteria:

Children with severe malnutrition according to WHO classification (less than -3SD weight for height), associated systemic illnesses (e.g. malaria, UTI, septicaemia, meningitis). Patients with non-viral (bacilli, G.lambliia, E.histolytica), bloody diarrhoea and those with documented antimicrobial ingestion for more than 48 hours preceding admission as well as those whose parents refused to be involved in the study were excluded.

### Results:

Concerning group1; recovery period took less than 24 hours in 91.1% and 82.2% were discharged within 24 hours. All of them were improved and discharged within five days, first five days of admission (Figure 1). None of them went

into severe dehydration or shock. Only one child developed electrolyte disturbance. The weight at the end of the study increased in 47.8%, decreased in only 5.5%, and was static in the remainder. Sixty one of the children were followed up for six weeks, only two of them (3.3%) had recurrence of diarrhoea.

In group 2 diarrhoea stopped within 24 hours in 38.9% and 30% were discharged after one day 10% did not recover during the first five days of admission (Figure 1).

Electrolytes imbalance developed in 23.3%, two children developed severe dehydration and one became shocked. The weight decreased in 35.6% and increased in 15.6%. Sixty seven children were followed, 13 (19.4%) of them developed diarrhoea again.

There were no significant differences regarding duration (table 1), frequency (table 2), hydration status (table 3) and electrolyte balance (Table 4A&B) between the two groups before treatment.

Table 1: Diarrhoea duration of children in the study

Diarrhoea Duration (Days)	Group 1		Group 2		Total	
	No.	(%)	No.	(%)	No.	(%)
1-5	65	(72.2)	56	(62.2)	121	(67.2)
6-9	14	(15.6)	26	(28.9)	40	(22.2)
10-13	11	(12.2)	8	(8.9)	19	(10.6)
Total	90	(100)	90	(90)	180	(100)

*P*- Value = 0.093

Table 2: Diarrhoea frequency of children in the study

Diarrhoea Frequency	Group 1		Group 2 Control		Total	
	No.	(%)	No.	(%)	No.	(%)
3-6	65	(72.2)	69	(76.7)	134	(74.4)
7-10	12	(13.3)	14	(15.6)	26	(14.4)
>10	13	(14.4)	7	(7.8)	20	(11.1)
Total	90	(100)	90	(100)	180	(100)

*P*- Value = 0.355

Table 3: Dehydration status of children in the study

Dehydration Status	Group 1		Group 2		Total	
	No.	(%)	No.	(%)	No.	(%)
Some	70	(77.8)	75	(83.3)	145	(80.6)
Severe	15	(16.7)	11	(12.2)	26	(14.4)
No	5	(5.5)	4	(4.5)	9	(5)
Total	90	(100)	90	(100)	180	(100)

*P*- Value = 0.638

Table 4A: Serum sodium level on admission of children in the study

S.Na+	Group 1		Group 2		Total	
	No.	(%)	No.	(%)	No.	(%)
Normal	87	(96.3)	88	(97.8)	175	(97.2)
Low	3	(3.3)	2	(2.2)	5	(2.8)
Total	90	(100)	90	(100)	180	(100)

*P*- Value = 0.650

Table 4B: Serum potassium level on admission of children in the study

S.K <sup>+</sup>	Group 1		Group 2		Total	
	No.	(%)	No.	(%)	No.	(%)
Normal	75	(83.3)	72	(80)	147	(81.7)
Low	15	(16.7)	18	(20)	33	(18.3)
Total	90	(100)	90	(100)	180	(100)

P- Value = 0.563

**Discussion**

More than half (54.4%) of the children in the study population were of the age group 6- 12 months. This is the age when weaning starts. So improving weaning practices is important in preventing diarrhoea in children.

Mothers should be educated on ways of preparing, delivering, and storing weaning foods which minimize the risk of contamination.

61.1% of the study population are from urban areas mainly Omdurman city. This may reflect the spread of the primary health care centres in the peripheries and the increased awareness of people in the urban areas about the importance of seeking medical advice.

A family of 10 or more members was not found in the study. Most of the children in the study (66.1%) belonged to families of 5- 9 members.

Comparing the study groups for the risk factors of diarrhoea is a big issue and is out of the scope of this study. But an important factor that leads all other factors and cannot be left is the level of education of parents. Still there is a significant percentage of illiteracy among those who reside in the capital and its peripheries. This may reflect migration to the capital. About two thirds (67.2%) of children in the study had presented with diarrhoea for five days or less. This may reflect the awareness of parents about the importance of early seeking of medical advice. Diarrhoea was watery in 72.8% and this goes with the diarrhoea of small intestinal origin like that caused by rotavirus. Fever is an associated symptom in 75.6% of children in the study and is a physical sign in 61.6% of them. Presence of fever does not necessarily indicate bacterial cause of diarrhoea.

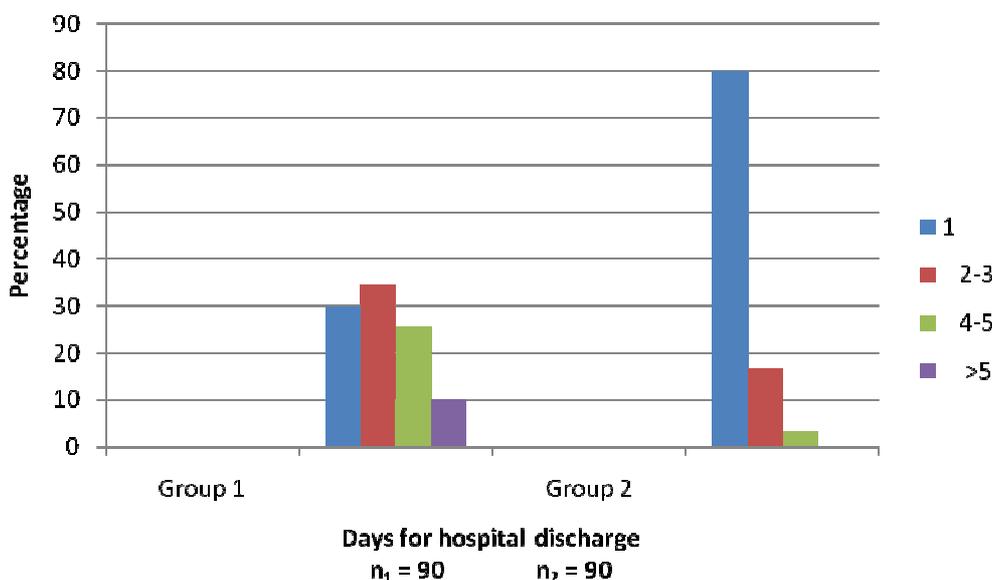


Figure1: Days for stay in hospital

More than one third of children in the study (36.6%) are undernourished (Their weight for height is between 1SD and 3SD). This is a fearful percentage, peering in mind that those below 3SD were excluded from this study. This may reflect the economic, social, environmental and political changes in the Sudanese society.

In humans, the most commonly seen type of dehydration by far is isotonic (isonatraemic) dehydration. This corresponds to the result found in this study in which serum sodium level was normal in 97.2% of children.

Only three (3.3%) children of group 1 Developed electrolytes imbalance compared to 21 children of group 2 (23.3%). This corresponds to the results of clinical trials done in animal models<sup>9-12</sup>. No child from group 1 went into severe dehydration or became shocked.

This ensures the effectiveness of GA in accelerating colonic absorption of salt and water and in decreasing water and salt efflux in the intestine. Estimation of the level of faecal SCFAs would help to substantiate the proposed mechanism. Unfortunately, estimation of faecal SCFAs was not attempted because of technical reasons. It has to be noted that faecal SCFA concentration does not necessarily reflect production.

Diarrhoea stopped within one day in the hospital in 90% of children receiving GA with a highly significant difference from group 2 (P-value=0.00).

Ninety per cent of children in group 1 recovered from diarrhoea and 80% were discharged from the hospital on the first day. This mild discrepancy developed because the criteria for hospital discharge involved other clinical variables beside diarrhoea.

The body weight increased at the end of the study in 47.8% of group 1. This is ascribed to effectiveness of GA in increasing fluids absorption and increasing food intake.

In a study done for the effect of GA in animal models with diarrhoea, an increase

in weight was evident after only four hours following recovery<sup>10,11</sup>.

All the children in group 1 improved and were discharged home within five days. Nine children from group 2 did not improve and remained in the hospital beyond five days. This proves that WHO-ORS is still an effective treatment for diarrheal diseases but it needs help from an additive to make the so called supper ORS. GA provides this help efficiently.

None of the parents of children in the study left the hospital against medical advice or withdraw their consent. This ensures the importance of comprehensive counselling and good attitudes of treating doctors towards their patients.

The recurrence rate of diarrhoea within six weeks following the study was significantly reduced in children who received a daily prophylactic dose of GA compared to those who did not (P-value=0.005). This is due to the prebiotic effect of GA through increasing the mass of the good bacteria in the intestine or by its direct effect on the immune system. The pre biotic effect of GA can be proved accurately by qualitative and quantitative estimation of colonic bacteria at different times in people taking it compared to a control group.

### Conclusion

Fever is the commonest associated symptom in children with acute diarrhoea followed by vomiting. Excluding those with severe malnutrition, 36.1% of children presenting with acute diarrhoea are undernourished.

In children presenting with acute diarrhoea, the most commonly seen type of dehydration is isotonic (isonatraemic) dehydration. Using GA in addition to WHO-ORS in children with acute diarrhoea significantly decreases complication in the hospital like severe dehydration, electrolytes imbalance and circulatory collapse and is highly effective in shortening the duration of diarrhoea, the time of hospital stay, prevents weight loss

and increases body weight in a significant percentage of them. It also, when given in a daily dose appropriate for age establishes a prebiotics effect by significantly decreases the recurrence of diarrhoea.

Considering these conclusions, WHO and FAO classification of gum Arabic as an emulsifier may need to be revised to regard it as fiber poor prebiotic product. Researches on other clinical applications of GA should be encouraged.

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