

## Food based Oral Rehydration Therapy: Towards a Better Cholera Treatment

Chandrika Murugaiah<sup>1\*</sup>, Praneetha Palasuberniam<sup>1</sup>, Mohamad Salih Falah<sup>1</sup> and Hassanain Al-Talib<sup>2</sup>

<sup>1</sup>Faculty of Medicine and Health Sciences, University Malaysia Sabah, Jalan UMS, Kota Kinabalu, Sabah, Malaysia

<sup>2</sup>Faculty of Medicine, Laboratory Medical Science Cluster, Drug Discovery and Health Community of Research, Universiti Teknologi MARA (UiTM) Sungai Buloh, Selangor Darul Ehsan, Malaysia

### Abstract

Prompt restoration of lost fluids and salts is the primary goal of cholera treatment. Oral rehydration therapy (ORT) with high-osmolarity mixture of glucose and salts has been recommended by the World Health Organization (WHO) and proved to be safe and effective in treating and preventing dehydration in cholera patient. The standard WHO-oral rehydration salt (WHO-ORS) prevents millions of deaths each year. Studies of food-based ORS versus WHO-ORS, demonstrated an improved outcome such as reduce purging, short duration of watery diarrhoeas, early recovery and low hospitalization rate. Moreover, food-based ORS provide additional nutrients to supplement WHO-ORS. In the short term, recommending food-based ORS will probably benefit a greater number of cholera patients.

**Keywords:** Oral rehydration salt (ORS); Oral rehydration therapy (ORT); Food based oral rehydration therapy; Cholera; Prevention; Infectious disease; Diarrhoea

### Introduction

Cholera is an acute intestinal infection characterized by the sudden onset of profuse watery diarrhea caused by ingestion of food or water contaminated with the bacterium *Vibrio cholerae* [1,2]. In a short incubation period, it stimulates solute and water secretion in the small intestine. Death from cholera gravis caused by toxigenic bacillus *Vibrio cholerae*, serogroups O1 and O139 results from extreme loss of water, electrolytes, bicarbonates and ions in patient [3-6]. This leads to sudden onset of diarrhea associated with vomiting which occurs in most of the patients. Drinking an oral rehydration solution to combat dehydration can be a treatment for cholera [7,8]. The solution of salts and sugars which were developed in 1960s is a live saving treatment in rural areas and an epidemic setting [7,9,10]. This article reviews the use of food based oral rehydration salt (ORS) solutions in treatment of dehydration during management of cholera.

### Oral rehydration therapy

Oral rehydration therapy (ORT) is a type of fluid replacement used to prevent dehydration. In this therapy patients are given solution to make up the salt water deficits and to replenish lost nutrients [11-13]. Before the invention of ORT, diarrheal disease is the leading cause of death in developing countries. In 1993 the World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) celebrated twenty-five years of success with oral rehydration therapy (ORT). Since its introduction, it has gained world recognition as a simple and effective treatment for treating diarrhea in children and adults. The WHO specify indications, preparation and procedures for ORT which consists of a single formulation (sodium, 90 mEq/L; potassium, 20 mEq/L; chloride, 98 mEq/L; citrate, 290 mg/dL; glucose, 2000 mg/dL (111 mmol/L); and osmolarity, 311 mOsm/L) [14]. However, it neither reduces stool volume nor diarrhea duration [15]. This was reformulated back in 2003 after finding the standard ORS formula was ineffective in reducing diarrheal stool output [16] which contains 90 mEq/l of sodium, potassium, 20 mEq/L; chloride, 80 mEq/L; citrate, 10 mg/dL; glucose, 111 mmol/L; and osmolarity, 311 mOsm/L, to avoid possible adverse effects of hypertonicity on net fluid absorption. When a child vomits, WHO recommend taking a pause for five to ten minutes and taking the solution slowly?

### Food based oral rehydration therapy

ORS treatment based on standard glucose and salts have been a single formulation recommended by WHO/UNICEF to replace lost fluid and electrolytes for 44 years [12,13,17,18]. Beside the standard ORS, food based ORS such as rice-based ORS can also be use as rehydration therapy for the management of cholera [2,7,19-22]. Rice-based ORS contains cooked long-chain rice carbohydrate powder instead of the glucose or combined cooked rice with WHO-ORS is found is more effective than glucose ORS. ORT III is a combination of a pinch of salt with 50 grams of rice powder boiled in a liter of water [23]. In many developing countries cholera child and patients are fed with rice porridge added with salt [24,25]. In Bangladesh, "Chira," flat beaten rice soaked in water, "Luta," a thick boiled rice-powder fluid and "jao," a thick fluid preparation of boiled whole rice, is used as rice-salt ORS solution to treat patients with diarrhea [22].

Rice is a staple food of over half the world's population providing approximately 20% of the per capita energy and 13% of the protein [26]. It is the predominant dietary energy source especially in Asian countries, 9 countries in North and South America and 8 countries in Africa [27]. Rice provides 20% of the world's dietary energy supply with low protein content [28], which is rich in methionine and cystine, but not with lysine and threonine [27]. Rice-based ORS is easily available and culturally acceptable in many poor countries [29-32]. It has a low cost gaining its popularities among poor nation, for example in Bangladesh rice-based ORS cost US \$0.15 per patient treated compared with US \$0.37 for glucose ORS [33]. Coloured rice strains such as brown rice have antioxidant properties that may be helpful to human

**\*Corresponding author:** Dr. Chandrika Murugaiah, Faculty of Medicine and Health Sciences, University Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia, E-mail: [chandri20@yahoo.co.uk](mailto:chandri20@yahoo.co.uk)

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health. Red or black rice help to reduce or retard the progression of atherosclerotic plaque development in the body.

Compared to standard 20 gm/L glucose oral rehydration solution, ORS containing 30 gm/L of rice syrup solids had a better net water absorption [34]. It was discovered that rice powder reduced stool volumes and provide shorter duration of diarrheal illness [35], but rice-based ORS is effective but not superior to standard glucose ORS in cholera patient [36]. Many empirical clinical trials have used complex carbohydrate as substrate in oral rehydration solutions (ORSs) instead of glucose and have shown a number of important clinical benefits, such as reduced stool volumes, shorter duration of diarrheal illness, increase in body weights, had the highest recovery and lowest hospitalization rate than that of the standard glucose oral rehydration solution [37-41]. In a study, rice-ORS show early recovery and low rate of prolongation of diarrhoea than glucose-ORS [42]. In infants <6 months of age, rice-based ORS solution was found to be safe and as efficacious as standard glucose ORS solution in the treatment of acute diarrhoea [43]. They passes fewer stools/day compared to those on WHO-ORS [44].

Cereals, other than rice can also be added together with ORS [24,45-49] because they have better nutrition, in the form of carbohydrate, protein, calcium, and phosphate, as well as vitamins and trace minerals. In many parts of the world, these cereals are available at a low cost. It also meets local cultural preferences and is better than sugar based ORS that are deleterious to dental. Food-based solutions are given to children during acute diarrhoea. These food solutions are based on rice-water, ragi-water, arrowroot-water, tender coconut-water, bicarbonate and citrate-WHO-ORS. When tested on rat model, this food solution either decreased cholera toxin-induced net water secretion (arrowroot-water) or reversed it to net absorption, with ragi-water produced maximum net water absorption, significantly greater than the WHO oral rehydration solutions. Children receiving ORT based on sorghum showed substantial reductions in stool output [46]. Those receiving maize, millet, potato wheat-based ORS show in lower total stool output compared with ORS based on glucose [46,48,50]. In treating dehydration, plantain flour-based solution, maize flour- and plantain flour-based ORS proved to be effective and safe [40,51,52].

## Conclusion

In conclusion, the results of recently published studies provide considerable evidence to suggest that food-based ORS are as effective as WHO-ORS. The food-based ORS appear to reduced stool volume and provide shorter duration of diarrheal illnesses. Recent data from clinical trials suggest that food-based ORS is superior to WHO-ORS for patients with cholera [53]. In addition, food-based ORS are advantageous over WHO-ORS in nutritional and taste preferences. Further research efforts must be directed at food based ORS. In terms of diarrhoeal mortality, there are still no conclusive data from adequate and well-controlled studies to demonstrate whether food-based ORS have greater effect on cholera gravis or death.

## Competing Interest

The author reports no conflicts of interest.

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