

Researchers have devised a rice-based ORT solution that matches one the Chinese had for thousands of years. The glucose in [ORS] comes from rice, a starch. Rice happens to be a food staple in Bangladesh. In other developing countries, the food staple may be maize, wheat, or another grain. Instead of sending grain to the factory to process it, why not use it directly?

—William Greenough III, International Child Health Foundation¹⁹⁷

Cereal-based Versus Sugar-based ORT

In recent years an important new dimension has been added to the debate over the use of packets versus home mix ORT. A completely different kind of oral rehydration solution is being explored: cereal-based (or food-based)* oral rehydration therapy. In many ways this is the most promising ORT approach yet. Studies in various countries over the last several years have confirmed that cereal or food-based liquids (with a little salt) are at least as effective and often more effective than sugar-based solutions in preventing and treating dehydration.¹⁹⁸ Thus the debate over packets versus home drinks has taken a new turn.

In addition, the fact that cereal or gruels are traditional foods in many parts of the world also makes them more familiar and acceptable. In many societies a drink or gruel made with a cereal or starchy food has long been a common home remedy for diarrhea. For example, rice water has long been a favorite folk remedy for diarrhea in South-East Asia.¹⁹⁹ Soaked rice in one form or another, often with salt or sugar, has been used to treat diarrhea in Bangladesh and many other Third World countries for hundreds of years.²⁰⁰ And rice gruel, often with a little salt and lemon, is still a traditional home treatment for diarrhea in many regions.²⁰¹

Gruels or porridges for treating diarrhea are traditionally made from other grains or starch foods, including millet or maize (Mozambique), wheat (Egypt), quinoa (Bolivia), and cassava (Colombia). Porridges, as well as rice water, are also traditional folk remedies for diarrhea in China and Indonesia.²⁰² Similarly, in Nicaragua corn flour gruel (along with rice water) is commonly given to children during diarrhea episodes.²⁰³ And gruels made from fermented maize or cassava are a traditional home remedy for diarrhea in many parts of Africa.²⁰⁴

*While we will refer primarily to “cereal-based” drinks, studies have shown that other foods such as potatoes, yams, and even lentils and chicken soup are also effective.

It was not until the early 1980s, however, that Molla, Mahalanabis, Greenough, Patra, and others carried out studies showing conclusively that in a hospital setting cereal-based oral rehydration is as effective as sugar-based oral rehydration.²⁰⁵ Subsequent studies have found that solutions made from rice flour or any of a number of other cereals reduce the volume, frequency, and duration of diarrhea.²⁰⁶ When rice drinks are used in the management of cholera, stool volume is reduced by an average of 35%.²⁰⁷ By contrast, sugar-based drinks—including ORS—do not reduce stool volume.²⁰⁸ Cereal-based ORT (CB-ORT) has also been shown to speed up the resumption of solid food intake and to increase the amount eaten.²⁰⁹

In its 1994 Interim Programme Report, WHO’s Programme for Control of Diarrhoeal Diseases (PCDD) acknowledges that “in cholera, rice-based ORS solution significantly reduces stool output compared with WHO ORS solution. The use of rice-based ORS solution for cholera patients can be recommended for any situation where its preparation and use are practical.”²¹⁰ With the debate over cereal-based ORT intensifying, WHO together with the International Center of Diarrhoeal Disease Research, Bangladesh (ICDDR,B) held a Meeting on ORS Formulation in Dhaka, Bangladesh, in December, 1994. A stated objective of the meeting was to:

determine from completed clinical trials whether there is an ORS formulation that is sufficiently more effective than the current WHO/UNICEF ORS to justify exploring the many non-clinical issues involved in recommending that it replace WHO/UNICEF ORS.²¹¹

A meta-analysis of many studies reconfirmed that rice-based ORS is superior to standard ORS for adults and children with cholera, reducing stool output by 35%, and again concluded that “rice ORS may be used to treat such [cholera] patients wherever its preparation is convenient.”²¹²

Nevertheless, WHO has resisted endorsing cereal-based ORT, either as a manufactured product (CB-ORS) or as a specially formulated home solution (CB-ORT). Although some of its published guidelines include rice water and/or porridges in their list of recommended home fluids (RHF), these do not provide sufficient information about the concentrations of starch or salt needed to make an optimal rehydration drink. For years, WHO's PCDD has been reluctant to officially fully endorse rice-based ORS, insisting that "further studies are required before any recommendation can be made concerning its use in acute non-cholera diarrhoea in children."²¹³ (For experimental reasons, however, in 1989 it quietly became involved with the baby-food corporation, Galactina, in starting what was to become commercial production of rice-based ORS. See page 97).

But what about diarrhea other than cholera? The meta-analysis of six studies of children with noncholera diarrhea showed that with CB-ORS, stool output was 18% lower than with standard ORS. Subsequent studies have shown that when food was given soon after rehydration, the reduction of stool output with CB-ORT was only 3.4%, a difference not considered significant.

Notwithstanding the above, WHO has until now decided to stick with its standard glucose-based ORS, which is tested, proven, and familiar to health workers and families world-wide. It argues that, since standard ORS is nearly as effective as cereal-based ORS, there is no justification for promoting the latter. This decision may be partly based on justifiable concerns about flooding the market with yet another confusing array of costly and redundant CB-ORS products. (Alas, this is already happening within the private sector.)

Many researchers, including those at the International Child Health Foundation, argue that, even though the physiological advantages of cereal-based over glucose-based drinks may not be great, there are also nonclinical advantages. They object to WHO's position (stated in the objectives of the Dhaka meeting) that an alternative formulation needs to be "sufficiently more effective than the current WHO/UNICEF ORS" in order to "justify exploring its nonclinical advantages." They point out that the nonclinical advantages would deserve exploration even if there were *no* physiological advantages. And if substantial, they could justify preferential promotion of CB-ORT.²¹⁴

The biggest nonclinical advantages of cereal-based rehydration are associated with home-prepared CB-ORT (as distinct from pre-packaged CB-ORS which has many of the same disadvantages as standard ORS). In

many countries, excellent food-based rehydration drinks can be made by building on local traditions. Health workers can help people understand why it is important to add cooked rice to the traditional rice water home remedy to make it somewhat thicker, and how much salt is desirable. Almost any local grain or starch-rich food can give good results.²¹⁵ These include *maize, wheat, millet, and sorghum,*²¹⁶ *gram, lentils, plantain, bananas, potatoes,* and certain local *tubers.*²¹⁷ In short, people can usually make an effective ORT drink out of their locally-available, low-cost food staple.

Why Cereals Work Better

The reason that starch works better than sugar for rehydration has to do with its molecular composition and the principle of *osmosis*. Put simply, osmosis is the pull of water through a membrane from a less-concentrated to a more-concentrated solution (of sugar and/or salt), resulting in more equal concentrations on both sides. (In a sense, osmosis is the struggle for equity at the molecular level.) Sugar molecules are very small, while starch molecules, although made up of many long chains of sugar molecules, are individually relatively large. The osmotic force that pulls water into sugar or starch solution is affected, not by the size of the molecules, but by how many molecules are in the solution. So sugar solutions, consisting of lots of small molecules at a high concentration, have more "osmotic pull" than starch solutions.

Sugar has been used in rehydration drinks because it helps the active transport of water and salt through the lining of the gut into the body. In addition, it provides needed calories, especially in the early stages of diarrhea when the child has no appetite. But there is a problem with sugar that decreases its effectiveness. In a concentrated sugar solution such as ORS (or SSS), the millions of tiny sugar molecules create an osmotic pull that can draw water back out of the bloodstream into the gut. So at the same time that sugar helps transport water and salt into the bloodstream, its high osmotic pull tends to draw part of that water back out. For this reason, a sugar-based solution—whether in packet form or home mix—does nothing to slow the flow of diarrhea. If the sugar solution is sufficiently dilute, more water is carried into the blood than is pulled back, and rehydration takes place. But if the sugar solution is too concentrated, it can increase both the diarrhea and dehydration. Therefore, too much sugar can be dangerous.²¹⁸

Cereals on the other hand, are composed of large starch molecules with a low osmotic pull. With a cereal based drink the osmotic flow is in the opposite direction, push-

ing water from the gut into the bloodstream, rather than pulling it back. Where the starch molecules come into contact with the gut lining, enzymes break them down into simple sugars which are immediately absorbed, carrying with them water and salt. But since the starch solution does not have the opposing osmotic pull of a sugar solution, much more water passes into the body from the gut than comes out. This helps to explain why a cereal drink slows down dehydration and diarrhea more efficiently.

Summary of arguments in favor of cereal-based ORT

In addition to the biological advantages, there are also strong psychological, socio-economic, and other practical arguments in favor of cereal-based ORT as compared to sugar-based ORS, and especially as compared to the standard, high-sugar, high-salt WHO formula. Some of these are listed below.

- **Physiological:** Cereal-based drinks reduce dehydration and also the volume, frequency, and duration of liquid stools (especially with cholera) by up to 40% or 50% more than sugar-based (glucose-based) ORS.²¹⁹ They also reduce vomiting more quickly and effectively.²²⁰
- **Nutritional:** Cereal-based drinks—because of their low osmotic pull—can be prepared with up to three times the number of calories as sugar or glucose drinks, without any risk to the child. It is now recognized that a contributing cause of malnutrition in children of poor families is that the food they are given often has so much water in it that their stomachs fill up before they get enough calories.²²¹ Similarly, large quantities of rehydration drink (or any fluid) take up volume, and hence limit the amount of food a child can consume. Therefore it helps if the drink itself is rich in calories. Also, with a cereal solution, the faster passage of water out of the gut into the bloodstream could mean that space for additional food becomes available more quickly. (Better control of vomiting with cereal-based drinks is another strong nutritional advantage.)
- **Safety:** As with the amount of salt, the amount of sugar (glucose) in the WHO formula is close to the upper limit of safety. If mothers prepare an ORS packet with too little water, which often happens, the ORS drink itself can contribute to dehydration. By contrast, no such danger exists for cereal drinks unless too much salt is used. Even if made more concentrated than usual, it is still safe (and is nutritional-

ly richer). The drink will be useful as long as it remains liquid and the child accepts it.

- **Acceptability to the children:** Children are often already used to cereal gruels as weaning food and accept them more readily than the standard ORS solution. Also, most mothers (who usually taste anything before giving it to their child) prefer the taste of a cereal porridge to a solution of sugar and salt. Many say that ORS tastes bad.²²²
- **Practicality and cost:** For the family that does not have enough money to feed its children adequately, the cost of a few ORS packets, together with that of the travel and time lost from work involved, can be nutritionally devastating. Even sugar is a luxury that is beyond the means of many poor families. However, virtually every family has some basic low-cost or home-grown grain that is their main staple. Thus cereal drinks may improve nutrition not only because they contain more calories than ORS, but also because the very low cost leaves families with more money to buy food. Moreover, by reducing the frequency and duration of the diarrhea, cereal-based ORT reduces another key cost—the amount of time poor mothers must spend administering ORT solution to (and cleaning up after) their sick children. As one author points out,

a sick child with a common rota virus infection, who has diarrhoea, vomiting, and is peevish with fever, will require an enormous amount of mothering time if oral rehydration fluid in sufficient quantity is coaxed into its mouth, spoonful by spoonful.²²³

Considering the Demands on Mothers

There are many competing demands on these mothers' time: caring for other children, cooking, cleaning, hauling water, collecting fuel, tending gardens, fields, animals, and often long hours of fatiguing work to earn money. Studies have suggested that one of the major reasons mothers fail to treat their children's diarrhea with ORS is that they lack the time to do so.²²⁴ Thus the shorter the episode of diarrhea, the better chance a poor child has of receiving adequate care, and therefore of surviving.²²⁵

A study in Jamaica found that the time lost in travel to the health center and waiting in line for ORS packets was one of the main reasons why mothers preferred to buy (inappropriate) medicines in local shops.²²⁶ In considering home management of diarrhea it is important to pay greater attention to the constraints on mothers and

to look for solutions that meet their needs as well as the children's. One way to partially relieve the time burden for mothers is by teaching the sick child's older siblings to prepare and give ORT. Because less precision is needed in preparing cereal based drinks, (and because they taste better than ORS) they lend themselves to this Child-to-child approach.²²⁷

First and foremost, mothers must be consulted and be more fully informed of the issues and choices, so they can be more involved in the strategies and programs that affect them. We need to learn to listen before we begin to advise.

A Poorly Considered Warning: “Do not use weaning foods to make ORT”

As cereal-based ORT becomes more widely appreciated, a new warning has been sounded by the “experts” regarding its preparation and use. For example, the following admonition appeared in the June 1990 issue of *Dialogue on Diarrhoea*:

It is most important that cereal-based ORT solutions are not confused with food, and that mothers *do not dilute the child's usual foods to make home fluids*.²²⁸ [italics added]

The first part of the above warning makes a lot of sense; the second must be questioned. Nutritionists stress that parents must realize that no rehydration drink is a substitute for other food and that, in addition to the drink, regular foods should be given in frequent small feedings as soon as the child will accept them. Although cereal drinks can provide more calories (energy) than sugar or glucose based drinks, no rehydration drink—because of its necessarily high water content—provides enough calories to meet the child's energy requirements. Worded more accurately, cereal-based drinks alone do not provide enough food to meet a sick child's needs.

However, advising mothers not to use the child's usual foods which are already in the home to make a rehydration drink could cause more child deaths than it prevents. It could deny many families the chance to use the easiest, quickest, safest, most effective, most nutritious, most economical, best tasting, culturally most appropriate, most consistently available, and

most self-reliance-promoting ORT alternative available to them: a cereal-based drink.²²⁹ As we have discussed, in many poor homes around the world, traditional weaning foods can be diluted to form an excellent rehydration drink. Since they are already prepared each day for babies in the home, with no additional time or cost they can be converted for ORT almost instantly, simply by adding water and a bit of salt (if they do not already have it).

Yet certain experts warn us that, if mothers are taught to prepare ORT by diluting weaning foods, they may give this dilute drink as food, thereby leading to low energy intakes and malnutrition. The implication is that mothers are too stupid to understand that the child with diarrhea needs more solid foods in addition to the diluted drink. (To build up a child's strength, it is important for mothers to realize that, in general, weaning foods should be prepared THICK—and if possible with added oil to increase calories.)

Our own experience shows that mothers can readily understand two simple messages: 1) that children should be given food regularly at all times, even when they have diarrhea, and 2) that children with diarrhea should be given lots of liquid, preferably a “special drink” (appropriate to their local situation), which may or may not be prepared from conventional foods.

Our confidence in mothers' ability to care for their children is backed by a WHO report which stated that “children given rice-based solution were not given less rice or rice porridge to eat than children given other types of ORS.”²³⁰ Also, a study by Hirschhorn and others (still unpublished) “shows no confusion of wheat/rice-based



A child with diarrhea requires love and patience, along with ORT.

ORS with regular food; the children actually ate better, gained more weight, and ended diarrhea sooner than did those on ORS packets.²³¹ We hope that WHO will reconsider, and begin to encourage the use of homemade CB-ORT by building on local traditions.

Additional objections to cereal-based ORT

Opponents of cereal-based ORT stress the disadvantages that their use entails: the “added cost of fuel,” the “extra work,” and the “delay caused by the need to cook the mix.”²³² However, *in the homes of poor families in many societies, cereal gruels are the standard weaning food of babies*. They are already cooked and ready for use on a daily basis. All the mother has to do is to scoop some out of the common pot, add a bit of water if it is too thick or salty, and every few minutes give as much to her child as she will take.

Critics also cite the inability of very young infants to digest starch completely, and possible allergic/immunological reactions in such infants to proteins contained in some cereals. Some authorities advise against use in infants less than three months old. But as far as we can determine their arguments are more theoretical than factual. A recent study sponsored by the PCDD found that a rice-based solution was digested and absorbed efficiently in a group of severely malnourished children and infants under six months, and was at least as effective as sugar-based ORS in correcting dehydration and maintaining hydration.²³³

Perhaps the biggest real disadvantage of cereal based rehydration drinks is that they do tend to spoil faster than sugar based drinks—sometimes within 6 or 8 hours (under some conditions within as little as two to three hours). However, when cereal gruels are the traditional weaning food, families often know how to prevent spoiling, either by periodically reheating the gruel or through “souring” or fermentation. This latter process opens up some exciting possibilities for an improved cereal-based rehydration drink.

Building on Local Traditions: “Soured Porridges” as Homemade ORT

One of the most promising possibilities for cereal-based ORT is the use of soured gruels or fermented porridges, which are traditional weaning foods in much of Africa, the Middle East, and in some other parts of the Third World.

Until recently, nutritionists in Southern Africa discouraged mothers from giving fermented or soured millet or maize porridges to their children because they thought these traditional weaning foods were disgusting, bad-smelling, and presumably unhealthy. But in fact, studies have shown that these traditional soured gruels are excellent weaning foods.²³⁴ The increased acidity that comes with the non-alcoholic fermentation of cereal porridges by lactic acid-producing bacteria (as in yogurt) delays spoilage. Therefore, soured gruels can be kept safely for up to a week. The fermentation process is also said to make the grain easier for young children to digest. And there is some evidence that the bacteriostatic effect of the acidified gruel may help to combat the infectious agents causing the diarrhea.²³⁵

In Mozambique mothers traditionally use soured porridges for treatment of their children’s diarrhea, often with excellent results. There is growing interest in conducting further research on this. They are ready and waiting in most homes with young children and, since these are the traditional weaning foods, sick children tend to accept them more readily than ORS.

Kishk neshif—a traditional CB-ORT with a storage life of months²³⁶

An Egyptian equivalent of the soured gruels of southern Africa is “*kishk neshif*.” A popular home remedy for diarrhea, *kishk* is a traditional food made with wheat and the whey of water buffalo milk. The whey is separated from the curd by placing it for a while in the stomach removed from a young goat. In the process the whey becomes fermented and develops a sharp smell and acid taste, similar to yogurt. The wheat grain is then washed, pounded just a little (not enough to destroy the form of the grains), boiled, and then mixed with the fermented whey. The resulting *kishk* is rolled into little spheres the size of golf balls and dried in the sun. This *kishk neshif* (dried *kishk*) can be kept for up to a year without spoiling. As a village health worker explained, “The wheat alone will spoil. The whey alone will spoil. But put together and dried they do not spoil.” For the treatment of diarrhea, the rock-hard *kishk neshif* is ground up and boiled in water to form a thin gruel, and a little salt is added.

Kishk is widely recognized by villagers as a good treatment for diarrhea. A taxi driver in Cairo, hearing us talk of *kishk neshif*, commented that it is “good for an upset stomach.” And a Lebanese health worker confirmed this by saying that he had given *kishk* to his child as a weaning food and for diarrhea. However, nutritionists and diarrhea control researchers in Egypt have appar-

ently overlooked *kishk neshif* because educated persons—even in areas where it is traditionally used—look down on it as primitive and disgusting. When one of us first mentioned it to the staff of the National Control of Diarrheal Diseases Project in Cairo, everyone laughed.

The application of soured porridges and *kishk neshif* both, as weaning foods and for oral rehydration, deserves serious study. In the areas where they are traditionally used, they could possibly provide a cheaper, more effective, more sustainable solution for oral rehydration—one that not only combats dehydration but also reduces the problem of child malnutrition, which is the underlying cause of the high death rate from diarrhea.

In summary, soured cereal-based porridges may well answer the major objections often posed concerning cereal-based mixes. They have the following advantages (for much of Africa, the Near East, India, and other parts of the world where they are traditionally used):

Advantages of soured (fermented) cereal-based porridges

- They are traditionally used both as weaning food and as a preferred food for sick children, including children with diarrhea. Thus poor people already believe in their value and are familiar with their preparation and use.
- According to mothers, sick children like and accept soured porridge better than other food, and they say it combats diarrhea.
- In homes where soured porridges are part of the daily diet, or are the standard weaning foods, there are no additional costs—in money or time—for preparing the drink or for obtaining fuel. From the pot that has already been prepared, all the mother has to do is add enough water to make the porridge fairly liquid (and add a small pinch of salt if not already included and if salt is available)* and give it to the child.
- Soured porridges can be kept safely (without risk of breeding diarrhea-producing organisms) for days at room temperature, thus making them safer than other porridges.²³⁷ They are also biologically safer (less contaminated) than the unboiled water used to make sugar-based ORT solutions or to mix ORS packets.²³⁸

*Less salt is probably needed in cereal-based than sugar-based mixes, because the cereals already contain some sodium and because reduced diarrhea permits better absorption of salt from the gut. By recommending less salt, there is much less risk that mothers will add dangerously large amounts. There is also some evidence that cereal-based mixes without any added salt may be effective (although probably less effective than mixes including salt) for the prevention of dehydration in most cases of diarrhea. Mothers in Mozambique report successful results from treating diarrhea with cereal mixes without salt.

(Even if the water added is somewhat contaminated, the acidity and the beneficial microorganisms of the fermented gruel may help to reduce any pathogens present.)

- Souring of cereal mush gives the child a head start on the digestive process.²³⁹ (The fermentation process breaks down some of the carbohydrates into sugars, and may also increase the body's ability to make use of proteins, vitamins, and minerals.²⁴⁰) For the same reason, the consistency of the soured porridge is smoother. These soured porridges appear to be more easily digested and handled by a small child than are the non-soured porridges.²⁴¹
- Perhaps most importantly, fermentation decreases the gruel's viscosity (thickness), which permits making a drink that is more energy-rich without becoming thick. This is important because with non-fermented cereal gruels—especially the more watery ones—a child's stomach fills up before she eats enough to provide the energy (calories) her body needs for adequate nutrition. Soured gruels, with proportionately more calories for the same viscosity than non-soured gruels, partially overcome this problem.²⁴² (It is, of course, important that the oral rehydration drink not be seen as a substitute for more solid food—and that mothers, while giving the drink, are encouraged to also give food as soon as the child will accept it. See the discussions on pages 63 and 69.)

Adding germinated flour for higher energy ORT

Another possibility for an improved rehydration drink is the use of germinated flour (flour made from grain that has begun to sprout). As with the fermentation process, the addition of germinated flour (which is rich in the enzyme amylase) to a cereal drink substantially decreases its viscosity. This means that the drink can be made more concentrated (energy-rich) without becoming too thick.²⁴³ Adding a little germinated flour to a cereal ORT mix (fermented or otherwise) results in a drink that provides more calories per unit volume and thus helps to minimize the nutritional deficit during the period when the sick child with acute diarrhea is accepting little or no (other) food.²⁴⁴

In some African countries (e.g., Uganda and Rwanda), as well as some Asian ones (e.g., India), weaning foods are traditionally prepared using both fermentation and germinated grain.²⁴⁵ This offers the possibility of promoting improved low-viscosity, high-energy ORT by building on local customs: a "Super-ORT" based in local tradition. To date most of the research on fermentation and germination has focused on their use in weaning foods. Research on their potential use in ORT is greatly needed and holds exciting promise.

CONCLUSION TO PART 2

Official explanations for the disappointing impact of prevailing ORT initiatives include: poor user compliance, weak health education, inadequate social marketing, difficulties of maintaining production and supply of ORS packets, etc. But as we have seen, the problems are more fundamental.

One problem is the idea that a technological fix can solve an illness so deeply rooted in social and economic inequities. Another problem has been prioritization of product over process: to market ORS packets rather than to facilitate informed, intelligent use of local solutions. The product has been packaged and promoted as a “wonder drug,” thus creating false expectations and undermining efforts to encourage cheaper, home-made, and potentially more effective alternatives. Families are enticed to mispend their limited food money on a fancy, medicalized, and (for most diarrheas) unnecessary product. Thus Oral Rehydration Therapy—when introduced in a disempowering way—can result in additional nutritional deficit to already undernourished children. Last but not least, the ORS technology—like the other Child Survival interventions—was developed in a selective, top-down way. Little effort has been made to

link it to any comprehensive approach to resolve to underlying causes of death from diarrhea: malnutrition and extreme poverty.

It is our thesis that ORT’s failure to fulfill its promise stems largely from the fact that ORT policy-making is concentrated in a few hands. Despite much good will on the part of many, the conservative social climate and deteriorating economic conditions of the 1980s led many international health policy-makers to switch from challenging the unjust world order to trying to mitigate its effects.

Involving disadvantaged people meaningfully in the planning and implementation of health and development initiatives that affect them is not just an ethical imperative, but a pragmatic one. It is a crucial step in the process of empowerment, democratization, and equity that is the key to true development and health for all.

In Part 3 we will try to place in historical perspective the current political atmosphere that dictates health policies and patterns of poor health. We will also look at the ways in which three multinational industries—the producers of breast milk substitutes, pharmaceuticals, and arms—contribute to poor health in the Third World, and particularly to high child death rates from diarrhea.

