Editorial: Finding the Holy Grail in a grain of rice

The production of pharmaceuticals from recombinant DNA-modified plants, dubbed 'biopharming', is being pursued by about two dozen companies – large, small and in between – in North America, Europe and Asia. They are developing scores of products in a wide variety of platforms, including about a dozen food and non-food plants. But the outputs can hardly be said to have been commensurate with the efforts – until now. California-based Ventria Bioscience has just announced an ingenious combined high-tech/low-tech approach to treating one of the prodigious killers of children in the developing world: diarrhoea.

For those of us fortunate enough to live in an industrialised country with ready access to health care, diarrhoea is primarily a nuisance, most often involving bloating, abdominal discomfort, loss of a few pounds, and a day or two off from school or work; but in the developing world it can be deadly. In sub-Saharan Africa and the parts of Latin America and Asia where there is poor access to healthcare, clean water and other resources, diarrhoea is the number-two infectious killer of children under the age of five and accounts for two million paediatric deaths a year. But those numbers may soon be a relic of the past, like mortality from smallpox and bubonic plague.

Since the 1960s the standard of care for childhood diarrhoea in the developing world has been the World Health Organization's formulation of rehydration solution, a glucose-based, high-sodium liquid that is administered orally. This low-tech product was revolutionary. It saved countless lives and reduced the need for costly (and often unavailable) hospital stays and intravenous rehydration. However, this product did nothing to lessen the severity or duration of the condition, which over time leads to malnutrition, anaemia and other chronic health risks. Other strategies to find new treatments and preventive measures – from changes in public policy and improvement of water treatment to the development of vaccines – show promise but have yet to yield significant, cost-effective results.

The solution (literally and figuratively) may be an ingenious, affordable, combined high- and low-tech approach by Ventria Bioscience: an improvement on current oral rehydration that research reported in April suggests could be a veritable Holy Grail: two human proteins produced inexpensively in rice that radically improve the effectiveness of rehydration solutions.

It has been known for decades that breastfed children get sick with diarrhoea and other infections less often than those fed with formula. Recent research done in Peru has shown that fortifying oral rehydration solution with two of the primary protective proteins in breast milk, human lactoferrin and lysozyme, lessens the duration of diarrhoea and reduces the rate of recurrence. The availability of an oral rehydration solution that lowers the severity, duration and recurrence of diarrhoea would be of modest benefit to those of us in the developed world, but it could be a near-miraculous advance in the developing world.

Ventria partnered with researchers at the University of California, Davis, and at a leading children's hospital and a nutrition institute in Lima, Peru, to test the effects of adding these natural human proteins to a rice-based oral rehydration solution. The results were reported at the Pediatric Academic Societies' annual meeting in San Francisco on 30th April.

The researchers found that when lactoferrin and lysozyme were added to rice-based

oral rehydration solution, the duration of children's illness was cut from more than five days to three and a half. This improvement is thought to be caused by the antimicrobial effect of lysozyme, which has long been known to be one of the primary protective proteins in breast milk. The shortened duration of illness is important not only to the patients but to their parents, who often have to take time off work to care for their sick children, further taxing the financial resources of households that already are stretched thin.

The trials also showed that adding lactoferrin and lysozyme to the rice-based oral rehydration solution reduced the volume of excretions and the frequency of recurrence of diarrhoea during the 12 month follow-up period (from 18 per cent in the control groups to 8 per cent in the group that received the added proteins). These effects are probably caused by lactoferrin, which promotes repair of the cells of the intestinal mucosa damaged by diarrhoea. Both of these developments represent significant progress in managing diarrhoea and preventing it from becoming chronic, recurring and debilitating.

What makes this approach feasible is Ventria's invention of a method to produce lactoferrin and lysozyme in genetically modified rice – a technique dubbed 'biopharming' – an inexpensive way to synthesise the huge quantities of the proteins that will be necessary. In effect, the rice plants use carbon dioxide, water and the sun's energy as the raw materials.

Sounds like a great success for Ventria and end of story, right? Not by a long shot. As often happens with biotechnology, after every advance the creeps creep out of the woodwork. One radical biotech opponent remonstrated, 'The chance this will contaminate traditionally grown crops is great. This is a very risky business.'

Rubbish.

Rice is self-pollinating, so outcrossing – interbreeding with other rice varieties – is virtually impossible. But even in a worst case, 'contaminate traditionally grown crops' with what? With two human proteins normally present in tears, breast milk and saliva? Contamination, indeed!

Equally shameful was the comment of Bob Papanos of the U.S. Rice Producers Association: 'We just want [Ventria] to go away,' he said. 'This little company could cause major problems.' The truth is that it is the Luddite rice producers who are causing major problems by their willingness to let the antagonism toward biotechnology by foreign importers of American rice interfere with the development of life-saving new products. One hopes that the courts will rein in their cynical attempts to restrain commerce.

Biopharming has brought us to the verge of a safe, affordable solution to one of the developing world's most pressing health problems. It will be only the first of many to come – if we can keep the troglodytes at bay.

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