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Poo-therapy the new frontier in medical treatment

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It is fashionable to kick off the new year with a detox, which supposedly clears the body of waste products that have accumulated over the year. In fact, the concept of "detoxing" is a modern myth, derided by doctors and dietitians.

However, scientists in the US have come up with the "anti-detox" - a treatment that involves putting waste back in. Welcome to the strange world of "poo-therapy".

A Boston biotechnology company has unveiled a "bacteria pill", designed to unleash a flood of live faecal microbes into a person's body. The pill, which entered clinical trials last month, is the first of a new class of drugs nicknamed "ecobiotics", which aim to treat disease by manipulating the balance of so-called good and bad bacteria so the beneficial microbes always have the upper hand.

While probiotic yoghurts claim to promote good bacteria - claims not always backed up by research - they cannot pack the same bacterial punch as a tailored pill containing purified strains.

The poo pill is a particularly eye-catching development in the wave of excitement about the human microbiome, the term given to the collection of trillions of microbes - a cocktail of bacteria, viruses and fungi - that teem inside and on the surface of the human body. Researchers across the world are uncovering intriguing evidence that bacteria and other microbes may be implicated in serious conditions ranging from digestive problems, such as Crohn's disease and inflammatory bowel disease, to obesity, diabetes, asthma and even mental health.

Just as the Human Genome Project was created to identify every gene and its associated function, the Human Microbiome Project, started six years ago in the US, was created to document the panoply of microbes that underlie some of life's essential processes. Microbes play vital roles in digestion, metabolism, the production of vitamins, the regulation of immunity and response to drug treatment.

The HMP has been scrutinising microbial colonies found in the skin, mouth, nose, colon and vagina (when samples are taken, the human DNA is identified and discarded, leaving behind the microbial genes).

The make-up of a healthy female microbiome is particularly interesting: newborns are bathed in maternal flora during birth, and breastfed infants receive further maternal microbes through breast milk. Both these aspects of early infant life - vaginal delivery and breastfeeding - have been associated with better lifetime health. In another study, Kenyan prostitutes were found to harbour cervical microbes that protected them from HIV infection, strengthening suspicions that the microbiome could be a promising reservoir of disease resistance.

But cataloguing the microbiome is proving at least as formidable as its human genome counterpart: there are 10 times as many microbes as cells in your body, and the total number of genes in all the bacteria and viruses that make up the microbiome probably numbers between 3 and 4 million (in contrast, the human genome comprises about 23,000 genes).

Humans harbour about 10,000 distinct microbe species. The microbiome typically accounts for about 2 per cent of an adult's total body weight; yes, one-50th of you is bacteria.

The bacteria pill has been developed by Seres Health to tackle *Clostridium difficile*, a notorious germ and the enemy of hospitals everywhere.

Healthy people fend off *C. difficile* without difficulty, but patients on antibiotics are vulnerable to infection because antibiotics target bacteria indiscriminately, and wipe out protective microbes and nasty ones with equal vigour. Infections not only result in unpleasant symptoms such as diarrhoea, but can be fatal - more than 1600 National Health Service patients died from *C. difficile* complications in England and Wales in 2012.

If the infections don't respond to potent antibiotics, patients can receive a faecal transplant, in which the diluted faeces of a healthy donor (usually a relative) is fed via the rectum or nasal catheter into the colon to re-establish a healthy gut flora. The procedure, pioneered over the past two years, is successful, but there are downsides: it is invasive, not widely available, and carries a small risk of introducing harmful microbes. And not many patients find it a palatable procedure.

When the existence of the Seres pill, code-named SER-109, was announced last month after two years of preclinical testing, the company's chief executive David Berry hailed ecobiotics as "the future of microbiome-driven disease treatment".

Dr Jeremy Sanderson, a consultant gastroenterologist at Guy's and St Thomas' NHS Foundation Trust, who treats chronic bowel conditions such as inflammatory bowel disease and irritable bowel syndrome, said it was exactly the sort of treatment that scientists should be developing.

"The success of faecal transplants is fascinating. If we can deliver the same with a pill that can keep the bacteria alive long enough to reach the colon, which is four metres down, then that is more acceptable to a patient than a succession of enemas."

That wholesale transfer of bacteria from a healthy donor by either transplant or pill, Sanderson believes, is likely to prove more effective than using probiotic foods to tweak the balance of microbes. As he puts it: "To think that you can cure these serious bowel conditions with a pot of yoghurt is rather optimistic."

Glenn Gibson, professor of food microbial sciences at Reading University, said a pill would be a step forward from "non-discriminatory" faecal transplants, but he still had reservations: "I am not sure of the basis for choosing the 'correct' blend of microbes and how well they would fare in the gut."

The advantage of a pill is that the contents can be controlled and tailored to a particular disease, but it is also a time-consuming, expensive process to pluck out the right bacteria and pack them into a pill capable of delivering the bacteria to the right place.

Another researcher in Ontario, Professor Elaine Petrof, spent two years creating RePOOPulate (yes, really) - a pill containing 33 purified bacteria strains from a healthy donor's faeces - but while the pills worked, the cost of manufacturing them led her to conclude that commercialising the process would be a thankless task. Given that faecal transplants already exist, and that human waste costs nothing to produce, Seres may find ecobiotics a hard sell.

Still, the fact that we share our bodies with trillions of microbes and that we have evolved together, largely harmoniously, over millions of years promises new therapies, but also a rethink on how antibiotics are used. Our bodies are not designed to be sterile, bacteria-free temples - they evolved as microbe-filled shrines, coated and stuffed with colonies of micro-organisms designed to keep us well.

You might want to rethink that New Year detox.

Telegraph, London

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