A wealth of genetic information is to be found in the human gut

BACTERIA, like people, can be divided into friend and foe. Inspired by evidence that the friendly sort may help with a range of ailments, many people consume bacteria in the form of yogurts and dietary supplements. Such a smattering of artificial additions, however, represents but a drop in the ocean. There are at least 800 types of bacteria living in the human gut. And research by Steven Gill of the Institute for Genomic Research in Rockville, Maryland, and his colleagues, published in this week's *Science*, suggests that the collective genome of these organisms is so large that it contains 100 times as many genes as the human genome itself.

Dr Gill and his team were able to come to this conclusion by extracting bacterial DNA from the feces of two volunteers. Because of the complexity of the samples, they were not able to reconstruct the entire genomes of each of the gut bacteria, just the individual genes. But that allowed them to make an estimate of numbers.

What all these bacteria are doing is tricky to identify—the bacteria themselves are difficult to cultivate. So the researchers guessed at what they might be up to by comparing the genes they discovered with published databases of genes whose functions are already known.

This comparison helped Dr Gill identify for the first time the probable enzymatic processes by which bacteria help humans to digest the complex carbohydrates in plants. The bacteria also contain a plentiful supply of genes involved in the synthesis of chemicals essential to human life—including two B vitamins and certain essential amino acids—although the team merely showed that these metabolic pathways exist rather than proving that they are used. Nevertheless, the pathways they found leave humans looking more like ruminants: animals such as goats and sheep that use bacteria to break down otherwise indigestible matter in the plants they eat.

The broader conclusion Dr Gill draws is that people are superorganisms whose metabolism represents an amalgamation of human and microbial attributes. The notion of a superorganism has emerged before, as researchers in other fields have come to view humans as having a diverse internal ecosystem. This, suggest some, will be crucial to the success of personalised medicine, as different people will have different responses to drugs, depending on their microbial flora. Accordingly, the next step, says Dr Gill, is to see how microbial populations vary between people of different ages, backgrounds and diets.

Another area of research is the process by which these helpful bacteria first colonise the digestive tract. Babies acquire their gut flora as they pass down the birth canal and take a gene-filled gulp of their mother's vaginal and fecal flora. It might not be the most delicious of first meals, but it could well be an important one.
FDA approves viruses for treating food

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WASHINGTON (AP) - A mix of bacteria-killing viruses can be safely sprayed on cold cuts, hot dogs and sausages to combat common microbes that kill hundreds of people a year, federal health officials said Friday in granting the first-ever approval of viruses as a food additive.

The combination of six viruses is designed to be sprayed on ready-to-eat meat and poultry products, including sliced ham and turkey, said John Vazzana, president and chief executive officer of manufacturer Intralytix Inc.

The special viruses called bacteriophages are meant to kill strains of the *Listeria monocytogenes* bacterium, the Food and Drug Administration said in declaring it safe to use on ready-to-eat meats prior to their packaging.

The viruses are the first to win FDA approval for use as a food additive, said Andrew Zajac, of the regulatory agency's office of food additive safety.

The bacterium the viruses target can cause a serious infection called listeriosis, primarily in pregnant women, newborns and adults with weakened immune systems. In the United States, an estimated 2,500 people become seriously ill with listeriosis each year, according to the Centers for Disease Control and Prevention. Of those, 500 die.

Luncheon meats are particularly vulnerable to *Listeria* since once purchased, they typically aren't cooked or reheated, which can kill harmful bacteria like *Listeria*, Zajac said.

The preparation of bacteriophages - the name is Greek for "bacteria-eater" - attacks only strains of the *Listeria* bacterium and not human or plant cells, the FDA said.

"As long as it used in accordance with the regulations, we have concluded it's safe," Zajac said. People normally come into contact with phages through food, water and the environment, and they are found in our digestive tracts, the FDA said.

Consumers won't be aware that meat and poultry products have been treated with the spray, Zajac added. The Department of Agriculture will regulate the actual use of the product.

The viruses are grown in a preparation of the very bacteria they kill, and then purified. The FDA had concerns that the virus preparation potentially could contain toxic residues associated with the bacteria. However, testing did not reveal the presence of such residues, which in small quantities likely wouldn't cause health problems anyway, the FDA said.

"The FDA is applying one of the toughest food-safety standards which they have to find this is safe," said Caroline Smith DeWaal, director of food safety for the Center for Science in the Public Interest, a consumer advocacy group. "They couldn't approve this product if they had questions about its safety."

Intralytix, based in Baltimore, first petitioned the FDA in 2002 to allow the viruses to be used as a food additive. It has since licensed the product to a multinational company, which intends to market
it worldwide, said Intralytix president Vazzana. He declined to name the company but said he expected it to announce its plans within weeks or months.

Intralytix also plans to seek FDA approval for another bacteriophage product to kill *E. coli* bacteria on beef before it is ground, Vazzana said.

Scientists have long studied bacteriophages as a bacteria-fighting alternative to antibiotics.

Questions.

#1. Gut bacteria may help humans digest what macromolecules from plants?

#2. When do humans first acquire an intestinal microflora?

#3. What genus of bacteria is infected by the bacteriophages recently approved for use in treating food?

#4. Why are lunch meats (as opposed to other meat products, for example, ground beef) prone to spreading this particular organism?