

ScienceWatch – The Germs Within Us



“Considering that 75% of the wet weight of our fecal output is composed of bacteria and each gram contains at least 1×10^{11} organisms from at least 50 genera, belonging to over 400 species, we may be thought of as the outer covering of the most complex microbial ecosystem we know.” - A. Lee

Microbiologist Adrian Lee wrote that quote 30 years ago. Now gene sequencing techniques are enabling scientists to find out exactly how important that “complex microbial ecosystem” is (you’d be surprised).

The germ theory of disease, which states that microorganisms cause infectious diseases, is one of the greatest scientific achievements of all time. Formulated over 100 years ago, it has provided the framework for identifying, controlling and killing “bad” microbes, pathogens, thereby freeing much of humanity from illness. This was accomplished by biologists, chemists, physicists and physicians who rarely paid attention to the “good” microbes living in our large intestine and evolving with us over hundreds of thousands of years.

The “good” microbes are no longer neglected. One hundred trillion bacteria live in our gut, 10 times more than our body cells, and scientists are learning what these helpful microbes (microbiota) do. For example, the bacterium *Lactobacillus johnsonii* usually lives in our intestine where it helps to digest milk. However, during pregnancy it proliferates in the vagina where it colonizes the newborn, helping it digest breast milk.

Our microbiota protects us against pathogens and affects how our immune system forms, keeping it in check so we don’t develop auto immune diseases like asthma and inflammatory bowel disease. Recent evidence links other autoimmune diseases like type-1 diabetes, multiple sclerosis and even autism, to the activities of our microbiota.

Now there is good evidence that our gut bacteria also play a role in controlling obesity. A team headed by Jeffrey Gordon, Center for Genome Science and Systems Biology, Washington University School of Medicine, St Louis, MO, presented the study in the September 6, 2013 issue of *Science*.

To eliminate genetic and environmental effects on obesity, the researchers used the microbiota in fecal samples collected from four sets of identical twins in which one twin was lean, the other fat. They introduced each sample of gut bacteria into a separate group of germ-free mice*. Each mouse was housed separately and fed a low-fat, high-fiber diet. After five weeks, mice receiving fat-twin microbiota (OB) had 15% more body fat than mice with lean-twin microbiota (LN). Gene sequencing showed that the bacteria growing in the mouse guts were the same as those in the human fecal sample they received.

The team repeated the experiment, but now they co-housed each OB-mouse with an LN-mouse. OB-mice living with LN-mice were thinner after 10 days than OB-mice living alone. The bacterial profile of the co-housed OB-mice showed that their microbiota resembled that of the LN-mice. In other words, lean-twin microbiota took over the gut of the mouse previously housing fat-twin microbiota and prevented those mice from getting fat.

Mice are coprophagic (feces eaters), so the scientists expected them to exchange microbes, but were surprised by the microbiota replacement. Gordon said this made sense because the bacterial profile of fat people is less diverse than that of lean people. Therefore, the microbiota of fat people has empty niches that other microbes can colonize, but not the reverse. So why don't lean microbiota infect everyone and cause a leanness epidemic?

To answer that the team repeated the co-housing experiment; however, this time they used a chow mimicking a high fat, low fiber "American" diet. Now OB-mice co-housed with LN-mice grew fat, and their microbiota did not change. Thus, "lean" microbiota can colonize OB cage mates, but only with the right diet. "There's an intricate relationship between our diet and how our gut bugs work," says Gordon. "You have to have the right ingredients."

While many researchers say any microbial treatment of obesity should be done only when they know which bacterial species are responsible for leanness, others are already gearing up for the rush of fecal transplants from thin to fat people.

If you are thin you might be discarding something quite valuable.

Saul Scheinbach

*Germ-free mice, born and reared under sterile condition, are genetically identical. They have poorly developed intestines, immune systems and weak hearts.