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Bacteria Thrive in Inner Elbow; No Harm Done

By NICHOLAS WADE

The crook of your elbow is not just a plain patch of skin. It is a piece of highly coveted real estate, a special ecosystem, a bountiful home to no fewer than six tribes of bacteria. Even after you have washed the skin clean, there are still one million bacteria in every square centimeter.

But panic not. These are not bad bacteria. They are what biologists call commensals, creatures that eat at the same table with people to everyone's mutual benefit. Though they were not invited to enjoy board and lodging in the skin of your inner elbow, they are giving something of value in return. They are helping to moisturize the skin by processing the raw fats it produces, says Julia A. Segre of the National Human Genome Research Institute.

Dr. Segre and colleagues report their discovery of the six tribes in a paper being published online on Friday in Genome Research. The research is part of the human microbiome project, microbiome meaning the entourage of all microbes that live in people.

The project is an ambitious government-financed endeavor to catalog the typical bacterial colonies that inhabit each niche in the human ecosystem.

The project is in its early stages but has already established that the bacteria in the human microbiome collectively possess at least 100 times as many genes as the mere 20,000 or so in the human genome.

Since humans depend on their microbiome for various essential services, including digestion, a person should really be considered a superorganism, microbiologists assert, consisting of his or her own cells and those of all the commensal bacteria. The bacterial cells also outnumber human cells by 10 to 1, meaning that if cells could vote, people would be a minority in their own body.

Dr. Segre reckons that there are at least 20 different niches for bacteria, and maybe many more, on the human skin, each with a characteristic set of favored commensals. The types of bacteria she found in the inner elbow are quite different from those that another researcher identified a few inches away, on the inner forearm. But each of the five people Dr. Segre sampled harbored much the same set of bacteria, suggesting that this set is specialized for the precise conditions of nutrients and moisture that prevail in the human elbow.

Microbiologists believe that humans and their commensal bacteria are continually adapting to one another genetically. The precision of this mutual accommodation is indicated by the presence of particular species of bacteria in different niches on the human body, as Dr. Segre has found with denizens of the elbow.

Other researchers have found that most gut bacteria belong to just 2 of the 70 known tribes of bacteria. The gut bacteria perform vital services like breaking down complex sugars in the diet and converting hydrogen, a byproduct of bacterial fermentation, to methane.

The nature of the gut tribes is heavily influenced by diet, according to a research team led by Ruth E. Ley and Dr.

Jeffrey I. Gordon of the Washington University School of Medicine in St. Louis. With the help of colleagues at the San Diego and St. Louis Zoos, Dr. Ley and Dr. Gordon scanned the gut microbes in the feces of people and 59 other species of mammal, including meat eaters, plant eaters and omnivores. Each of the three groups has a distinctive set of bacteria, they report Friday in Science, with the gut flora of people grouping with other omnivores.

Despite the vast changes that people have made to their diet through cooking and agriculture, their gut bacteria "don't dramatically depart in composition from those of other omnivorous primates," Dr. Gordon said.

This new view of people as superorganisms has emerged from the cheap methods of decoding DNA that are now available. Previously it was hard to study bacteria without growing them up into large colonies. But most bacteria are difficult to culture, so microbiologists could see only a small fraction of those present. Analyzing the total DNA in a microbial community sidesteps this problem and samples the genes of all bacterial species that are present.

The goals of the human microbiome project include analyzing the normal makeup of bacterial species in each niche on the human body. "The focus in microbiology has been on pathogenic bacteria, but we are trying to identify the commensal bacteria so that we can begin to understand what proteins they make and how they contribute to our health," Dr. Segre said.

Another goal is to understand how pathogenic bacteria manage to usurp power from the tribes of beneficial commensals in the skin or gut, causing disease.

The lifetime of an individual bacterium in the human superorganism may be short, since millions are shed each day from the skin or gut. But the colonies may survive for a long time, cloning themselves briskly to replace members that are sacrificed. Just where these colonies come from and how long they last is not yet known. Dr. David A. Relman of Stanford University has tracked the gut flora of infants and finds their first colonists come from their mother. But after a few weeks, the babies acquired distinctive individual sets of bacteria, all except a pair of twins who had the same set. Dr. Relman said he was now trying to ascertain if the first colonists remain with an individual for many years.

Taking a broad spectrum antibiotic presumably wreaks devastation on one's companion microbiome. If the microbiome is essential to survival, it is perhaps surprising that the drugs do not make more people ill. Dr. Relman said that perhaps there were subtle long-term consequences that had not yet been identified. Much the same set of bacteria recolonize the gut after a course of antibiotics, he said, suggesting that the makeup of the colony is important and that the body has ways of reconstituting it as before.