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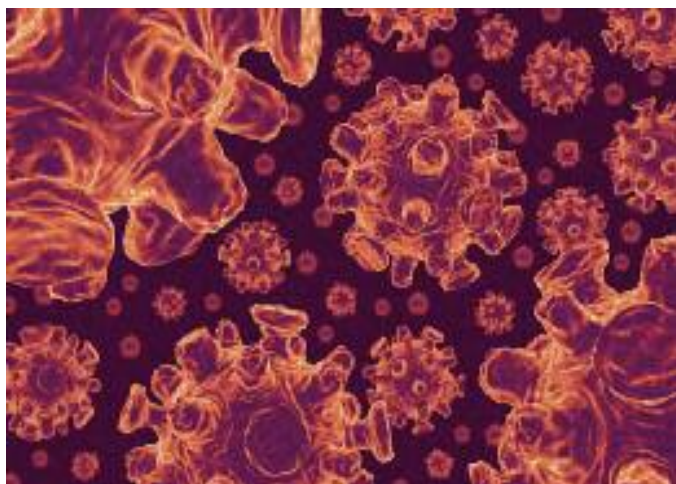
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Boosting Your Well-Being

Understanding Your
Good Bacteria

Ayurveda: India's Potent
Healing System



the human terrain

By CLAIRE SYKES



YOUR BODY TEEMS with a world of microorganisms. Trillions of bacteria, viruses and fungi munch away at your skin, crank out enzymes in your mouth and breed like crazy—all while you eat, work and play. The thought of all these critters might be a little discomfoting.

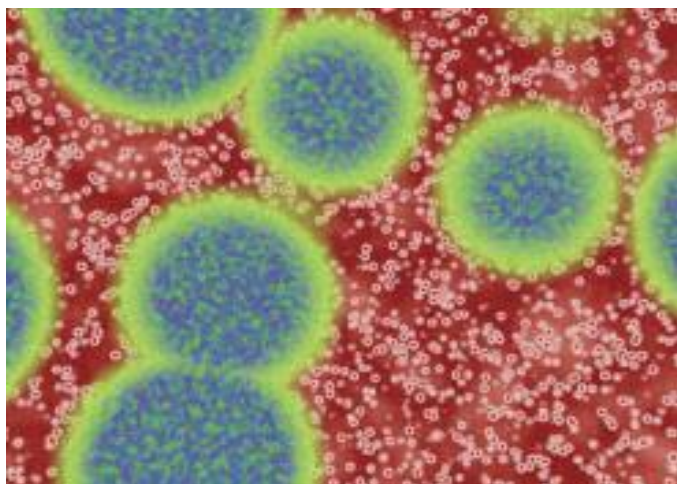
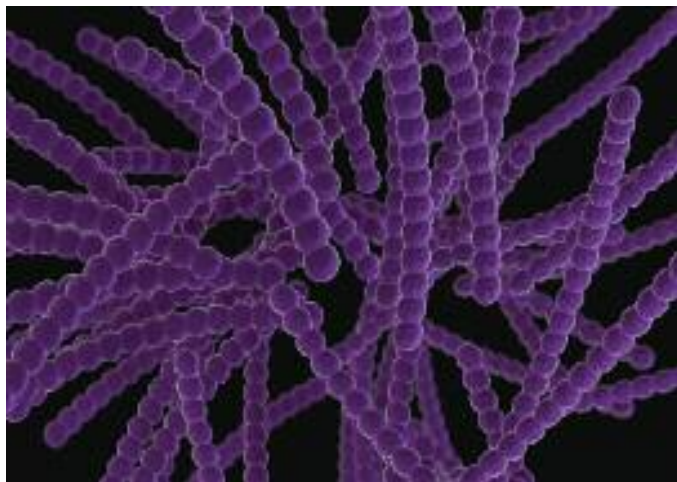
For the most part, though, you wouldn't be alive without them.

Though microorganisms have been wriggling under scientists' microscopes for centuries, little is known about how they affect human health. However, recent technological advancements now allow scientists to explore how colonies of microbes interact

with the human body in something called the Human Microbiome Project (HMP).

Launched in 2007 as part of the National Institutes of Health's Roadmap for Medical Research, this five-year, \$100 million project involves dozens of scientists around the country. It's also part of the International Human Microbiome Consortium (IHMC), which involves experts from Australia, Canada, Europe, China, Japan and Korea.

In 2002, American Nobel Prize-winning molecular biologist Joshua Lederberg came up with the term *microbiome*, defined as the totality of *genomes*—made up of DNA, the molecule that encodes genetic information—of all the microorganisms in any given



Your body hosts whole colonies of microorganisms, and scientists are exploring the beneficial roles many of them play in human health.

environment, from a spot of saliva to a soil sample. Your body carries ten times as many microbial cells as human ones, which represents a hundred times the number of genes.

Home Sweet Homes

Most of this vast, though individually tiny, swarm lives in the gastrointestinal tract. “The second most populated area is the mouth, because bacteria are introduced by food coming into the body and through contact with our hands and other surfaces,” says Joe Petrosino, PhD, an assistant professor in the molecular virology and microbiology department at the Baylor College of Medicine in Houston.

The remaining microorganisms congregate in the vaginal and upper respiratory tracts, and on the skin. “The skin is the least occupied because it’s a harsh environment,” says Petrosino, who explains that the skin’s exposure to the outside world makes it tough on microbes. As a result they especially like the warm, cozy, damp creases of your inner elbows and armpits.

Microorganisms keep themselves busy. The ones on your skin help to moisturize it when they process its raw fats. Since the majority of microbes live in your intestines, most of them aid in digestion; some even produce nutrients such as vitamin K.

“Recently studies have suggested that gut flora

human terrain

can have an effect on the immune system,” says Sue Garges, PhD, HMP program director. “But we don’t know how, exactly.” Currently, it’s difficult to study intestinal bacteria within their natural environment, the preferred way. “So we’re looking at fecal-sample bacteria, a fairly good representation,” Garges says. “But we could be missing some things.” (To learn about other ways to support a healthy immune system, see the box below.)

Genetic Discoveries

Questions raised by Garges and other researchers prompted the

creation of the HMP. This project represents an effort to understand exactly how microbes interact with human health.

Previously research was laborious and expensive, and could identify the genome of just one individual microorganism strain that could only be cultivated in the laboratory. But now, new technologies can pinpoint the genetic material from entire communities of microorganisms harvested from their natural habitats, and much more quickly and cheaply. Called *metagenomics*, this field of study offers a lot more information, especially about microbe-host relationships.

To identify the microorganisms, HMP scientists will first *sequence*—or determine the order of building blocks within the DNA molecule—600 microbial genomes from 250 healthy human volunteers, as well as those cultured in the laboratory. “Sequencing tells us the genetic structure of a microorganism, not just what species it is,” explains Garges. The information gathered from this sequencing process will be placed alongside similar data from newly collected microbes. The two will share some DNA information, and wherever they don’t match will help to characterize the new samples.

FLEX YOUR IMMUNITY’S MUSCLES

Keeping the friendly microbes in your body happy and healthy is a good first step to keeping your immune system in fighting trim. But in a world awash in fears about the next big epidemic—swine flu? bird flu?—it helps to know what other natural weapons are out there for stocking an immunity arsenal.

Though not as famous as the oil pressed from the tree’s fruit, **olive leaf** has been equally prized throughout the centuries for its fever-fighting abilities. Today we know that olive leaf acts against a number of harmful microbes, including cold and flu viruses.

Long valued in Ayurveda, India’s traditional healing system, **andrographis** (*A. paniculata*) has been found to boost the production of the immune system’s white blood cells. It also promotes the release of *interferons*, substances that help keep viruses from multiplying.

Arabinogalactan (ARA), a fiber taken from the Western larch (*Larix occidentalis*), serves double immune duty: It both feeds probiotic bacteria in the intestines and boosts white blood cell activity. (ARA, andrographis and olive leaf can be found in a combined supplemental formulation.)

A traditional Native American herb, **echinacea**

(*E. angustifolia* and other species) helps activate *macrophages*, large white blood cells that gobble up infective microorganisms. It is often used together with **goldenseal** (*Hydrastis canadensis*), another North American herb that contains a microbe-fighting substance called berberine.

The Far East has contributed its fair share of immune-boosting botanicals. **Astragalus** (*A. membranaceus*) is one of the most widely used herbs in China, where it is valued for its ability to fight infection by stimulating white blood cell activity. **Eleuthero** (*Eleutherococcus senticosus*) is a Siberian herb that bolsters immunity while also helping the body deal with stress, itself a known immune suppressant.

Asia is also the original home of mushrooms with long histories of culinary usage that help support a robust immune response, including **maitake** (*Grifola frondosa*), **reishi** (*Ganoderma lucidum*) and **shiitake** (*Lentinus edodes*); the last is the source of **AHCC** (Active Hexose Correlated Compound).

A healthy immune system requires adequate supplies of several basic nutrients. **Vitamin C** is the best-known immunity nutrient, thanks to Nobel Prize

winner Linus Pauling’s groundbreaking research in the 1960s. But **vitamin E** works hand-in-hand with C and being deficient in **vitamin A** has been shown to decrease infection resistance. Deficiencies in the minerals **selenium** and **zinc** have also been linked to lowered immune response.

—Lisa James



human terrain

By gathering more specific information about groups of microorganisms inhabiting various body sites, scientists will be able to generate microbiome profiles. Petrosino says, “We can then determine if there is a core group of organisms in the microbiome that some or all humans have in common? Does the human microbiome fluctuate, given someone’s race or geographic location? How does diet and lifestyle impact the microbiome? Can certain microbes shift the state of one’s health?”

The answers may eventually help scientists compare the microbiomes found in healthy individuals with those of people who suffer from allergies, antibiotic-associated diarrhea, chronic periodontal (gum) disease, diabetes, obesity and other maladies. Scientists could explore how the presence or lack of both *commensal* (beneficial or neutral) and harmful microbes contribute to health or disease. In turn, they can examine how disease might change microbial communities in different parts of the body.

“The research could have therapeutic implications,” says Garges. “For example, if scientists discover that people with irritable bowel syndrome have a particular kind of bacteria not found in healthy people, or vice versa, they may be able to get rid of or add the right bacteria in the ill people.”

“New diagnostics and probiotics may be among the first beneficial products we see from the Human Microbiome Project,” says Petrosino. But along with those benefits will be ethical, social and legal concerns. What if your body’s microbes could tell you which diseases you

might get? And what about bioterrorism and biodefense applications? Could others obtain your microbiome information and prevent you from getting health insurance or a job? In answer to the last question Jonathan Eisen, PhD, evolutionary biologist and professor at the University of California, Davis, says, “Just as there are bills in Congress to try to protect people from genetic discrimination, the same could and

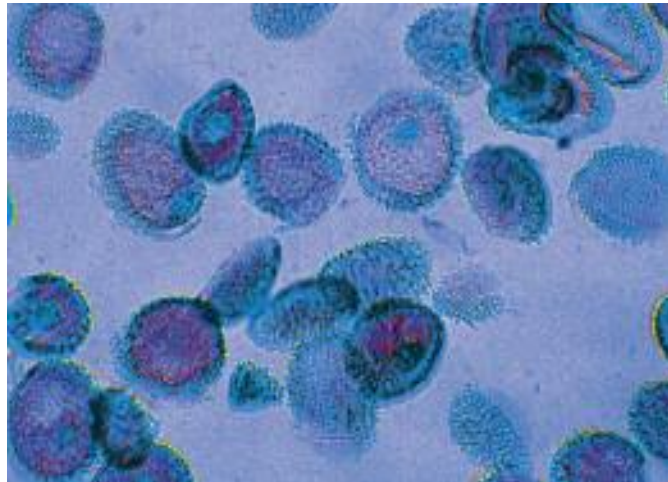
methods used by the HMP are also being used by other scientists in the study of microbes from nonhumans, such as those in the ocean and soils. “We’ll better understand the role microbes play not just in humans, but in the life of the planet.”

Probiotic Path to Well-Being

When you’re healthy, the many colonies of bacteria and their microscopic cousins live in harmony with you and in balance with each other. But when microbial populations in the digestive tract go off kilter the immune system doesn’t function well, inviting disease. With a weakened immune system, your body can’t fight the unfriendly microbes that routinely enter your body. Antibiotics can successfully kill them, but the drug takes beneficial bacteria along with it.

“If you disturb your microbial system with antibiotics, even if they save your life, you can be prone to pathogens that might not have hurt you before, because the beneficial microbes killed by antibiotics won’t be there to help you,” explains Eisen. And the bacteria in your body can develop a resistance to antibiotics, rendering the drugs useless and leaving you even more vulnerable to illness.

Enter **probiotics**, live bacteria that bestow a number of health benefits. “Probiotics can help reestablish that microbial balance,” says Gary W. Elmer, PhD, professor emeritus at the School of Pharmacy, University of Washington, and author of *The Power of Probiotics: Improving Your Health with Beneficial Microbes* (The Haworth Press). “Especially if you’re taking



“New... probiotics may be among the first beneficial products we see from the HMP.”

—Joe Petrosino, PhD
Baylor College of Medicine, Houston

likely should be the case for microbial discrimination.”

The implications of the HMP’s work go beyond its effects on humans. This project “adds the study of the human microbiome to the research of a huge collection of scientists who otherwise may’ve ignored this important component,” he continues. The DNA-sequencing



“If you take an antibiotic you should consider taking a probiotic.”

—Gary W. Elmer, PhD
Professor Emeritus,
School of Pharmacy,
University of Washington

antibiotics, you should consider taking a probiotic.”

Bacteria within the intestinal tract generally promote good health. But if you need more of them or different ones, you can find them as supplements, and in fermented dairy products, such as yogurt and kefir, or in some soy products. The best-documented probiotic bacteria come from the *Lactobacillus* and *Bifidobacterium* groups.

“Probiotics have enzymes they emit to catalyze the destruction of noxious chemicals and toxins in the body,” says Elmer. “They also crowd out pathogenic microbes in the gut, by creating an unwelcome environment for them or by consuming certain essential nutrients.”

Not only that, but “probiotics can increase levels of certain helpful microbes in the intestinal tract by feeding them,” says Mary Ellen Sanders, PhD, owner of Dairy & Food Culture Technologies in Centennial, Colorado, a probiotics consultant for food and supplement companies. “There’s some evidence that they can impact the pH [acidity or alkalinity] in the intestines,” she adds, which furthers their effectiveness.

Along with helping to rebalance

your body’s microbial population, probiotics can improve your digestive function and, in turn, bolster your immune system. They’re great for lactose intolerance, irritable bowel syndrome, traveler’s diarrhea and other nasty bacterial intrusions, such as periodontal disease and vaginal infections.

And if you’re already healthy, probiotics can help keep you that way. One strain in the upper respiratory tract, *Streptococcus salivarius* K12, produces special proteins called bacteriocin-like inhibitory substances (BLIS) that have shown an ability to target infectious microbes (*Indian Journal of Medical Research* 5/04).

Another way to boost your stock of beneficial microorganisms is to employ *prebiotics*, or substances that these tiny organisms feed upon. One commonly used prebiotic, *fructooligosaccharides* (FOS), is a mildly sweet fiber that has been

found to promote the growth of healthy gut microbes and may help boost intestinal immunity (*Clinical & Experimental Immunology* 7/04).

The more we learn about microbes, the better we can benefit our own health and that of the earth. Think about the potential benefits if everyone enjoyed the well-being that comes with a balanced microbiome. ■

ETip

Give Your Probiotics the Cold Shoulder

It’s important to remember that probiotic supplements contain living organisms. To keep them as fresh as possible, refrigerate the container, or at least store it in a cool, dark place. Don’t take probiotics with hot beverages or foods.

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