

A Tempered View of Bacteria

The world is a very crowded place. No region is without incredible numbers of living organisms striving to survive, most of them microorganisms such as bacteria. The volume of living matter – the global biomass – amounts to hundreds of billions of tons. And of the countless creature-species constituting this immense mass, the largest contingent is that form of life called the bacteria. Indeed, if all of the global bacteria were gathered in one location and measured, its total biomass would exceed the biomass of any other class of life. Certainly its collective weight would far exceed the gathered weight of all of the world's mammals, including the 6.7 billion humans currently resident in the globe. A conservative estimate argues that over 100 trillion living bacteria reside within the interior of the average adult human being.

The overwhelming majority of those primitive creatures called bacteria eke out a rudimentary existence with neither capacity for, nor thought of, causing disease in humans. There are a rare few bacterial species, pejoratively referred to as germs, that can bestow mortal mischief upon vulnerable humans thus giving a bad name to the entire biological class of bacteria. Most of these one-celled organisms pursue their primordial lives in soil and water; rarely if ever do they interact with humans; and by reducing complex organic chemicals to simpler, more soluble substances, they sustain the world's agriculture with neither ostentation nor complaint. These microbial laborers also populate the human gastrointestinal tract where, in consort with digestive enzymes, they break down ingested foods to more soluble substances such as glucose and amino acids.

Are the majority of bacteria harmless? Perhaps the question should be reworded: Are the majority of bacteria necessary, even vital, for our sustenance, our very survival and indeed, for the survival of the living globe? The answer is an emphatic yes. (But, of course, that is only a gut reaction.)

Consider now a major form of insect life, the detritivores, those creatures that sustain themselves on a diet of wood and other plant products. There are many in this category including wood lice, earth worms, dung flies, certain beetles, and particularly termites. These invertebrates fulfill a major ecological function in digesting vast amounts of wood and other plant matter and thus contributing materially to the global recycling of organic matter. The social creatures called termites, categorically condemned because of their harm to manmade wooden structures, are nonetheless essential to our global economy. They maintain a symbiotic partnership with anaerobic (oxygen-avoiding) bacteria in their digestive system. They provide an oxygen-poor, protective environment for the bacteria; and these bacteria then generate the enzymes necessary for the termite to decompose wood and other cellulose products into simpler organic nutrients.

A similar synergy exists between the abundant bacteria within the gut of ruminant animals such as cows, deer and camels. Thus an apparently banal diet of hay and grass, with the assistance of this cohort of intestinal bacteria, can be converted into a menu meeting all of the nutrient and micronutrient requirements of these mammalian species.

The human gastrointestinal tract, an uninterrupted thirty foot tube of infinite ingenuity, cannot support the body's dietary needs without the active cooperation of the anaerobic bacteria within its cavity. The gastrointestinal system of the newborn may be free of bacteria, but contact with the exterior soon seeds the small and large intestines with commensal bacteria. By adulthood, the average gut may harbor kilograms of bacteria, most of them sturdily working in behalf of their host-human.

These resident bacteria attack the chemically complex ingredients of the usual human diet, transforming them into simpler and more absorbable food stuffs. And thus, in the words of one physiologist, "Endowing us with functional features that we have not had to evolve ourselves." It is as though these bacteria, laboring as an auxiliary digestive organ, have fulfilled a necessary metabolic function to such a faithful degree that the benefited creatures, from primitive insects to complex mammals, have never bothered to develop certain digestive enzymes through the customary evolutionary process.

These special bacteria have thus given us a gift akin to bestowing upon us such beneficences as hearing aids or eye-glasses. It has been a mutual aid pact since the intestines offer a congenial, warm and oxygen-poor environment for generations of these synergistic bacteria.

What might happen if we were deprived of these supportive bacteria? When experimental mice are raised in a totally germ-free environment, they will require specially pre-digested foods since a normal diet will prove inadequate to sustain them. This happens, too, when humans are medicated with certain antibiotics to sterilize their gut of intrinsic bacteria. Again, the digestive system is out of kilter until the intestinal bacterial flora have been replaced from the exterior.

The world is indeed a complex place, with some species surviving by evolving a variety of protective mechanisms, some by learning to be the predator rather than the prey, and some by entering into complex, mutually advantageous, cooperative enterprises with other creatures in systems called metabolic synergy.

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Disclosure of Financial Interests

Stanley M. Aronson, MD, has no financial interests to disclose.

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