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EDITORIAL

Prokaryotes versus Eukaryotes: Which is the host and which is the guest?

Procariotas vs. Eucariotas: ¿Cuál es el hospedador y cuál es el huésped?

Germs are often perceived by many as ''harmful''. Nothing could be further from the truth. Many beneficial bacteria far outnumber their pathogenic varieties and are crucial to life on Earth. All ecosystems in the planet have prokaryotic microorganisms communicating with eukaryotic taxa. Life on Earth depends on species cooperation (mutualism). Eukaryotes and prokaryotes interact at several levels. The endosymbiotic theory states that some important eukaryotic organelles developed from single-celled symbioses. This theory states that 1.5 billion years ago, mitochondria, plastids (e.g., chloroplasts), and probably other organelles were free-living bacteria that became endosymbionts. Biochemical and molecular evidence suggests that proteobacteria created mitochondria, while cyanobacteria created chloroplasts. Numerous facultative heritable endosymbionts control reproduction. They should help their hosts defend against natural enemies, tolerate environmental stress and reproduce, as many do not control reproduction.[1]

Microorganisms, including not only fungi, archaea, protozoa, bacteria, but also viruses, have frequently co-evolved with their hosts over long periods. Research into microorganisms that are useful for preventive and therapeutic purposes in public health has focused on the interaction between the host and their microbiota. Yeasts, fungus, bacteria, protozoa, archaea, and bacteriophages make up the extraordinarily diverse gut microbiota of animals. Beneficial bacteria abound in the gastrointestinal tract (GIT) of metazoans, which harbors more microorganisms than any other organ, and its microbiota can strongly affect animal biology. Over 50 genera and 500–1,000 species inhabit the GIT. The microbiota directs gut-associated lymphoid tissue assembly, educates the immune system, affects the intestinal mucosal barrier integrity, modulates epithelial lineage proliferation and differentiation, regulates angiogenesis, modifies the enteric nervous system activity and extracts and processes nutrients from the diet. There is a connection between brain activity and gut microbiota. The cognitive functions of the brain are controlled by the gut microbiota. Metabolism, central immune and peripheral immune systems communicate through the microbes of the GIT .[2]

The microbiota metabolizes proteins, breakdown products of protein, sulfur-containing compounds, and endogenous and exogenous glycoproteins. Fermentation intermediates are converted into short-chain fatty acids by certain species, improving digestive physiology. Age, nutrition, environment, stress, genetics, drugs, geographical area, and treatment can affect microbial life and induce dysbacteriosis that is associated with chronic diseases and infections, decreasing performance in animals and humans. The variety of the gastrointestinal microbiome is impacted by antibiotics. The loss of essential taxa and alterations in the host's metabolism can result from antimicrobial treatment. The antibiotic resistance in the remaining taxa is further enhanced if this happens. Therefore, antibiotic-resistant bacteria proliferate and spread to replace antibiotic-susceptible germs, which are eliminated. Antibiotic use can lead to an increase in the overall bacterial population in the gastrointestinal tract, despite a decrease in the diversity of the microbiome. Furthermore, emerging evidence indicates that the SARS-CoV-2 virus has the potential to change the structure and function of the gut microbiota, with prospective consequences for both systemic and gastrointestinal health.[2,3]

Food nutrients are essential for meeting the host's basic needs and shaping the microbiome, which determines health and disease. Many studies have connected Western diets to an obesogenic gut microbiota, insulin sensitivity, inflammatory markers, diabetes, cancer, metabolic disorders, and glucose tolerance. The alarming rise in autoimmune diseases as a result of a Western diet may be linked to a breakdown in the ancient relationship between our bodies and a healthy microbiota.[2,3] Thus, a transcendent view of vertebrate biology requires understanding how indigenous microbial communities affect host development and adult physiology.

Nowadays, immunology, microbiology, and nutrition intersect amazingly. Symbiotic bacteria can colonize all

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mucosal surfaces after birth, changing the host's immune phenotype. Delaying the microbial colonization of the gut mucosa, the body's main immunological organ, may alter systemic immunity. Several animal and human studies have indicated that certain bacterial strains improve innate and adaptative immunity. The microbiota ''crosstalks'' with the mucosal immune system to control intestinal ecosystem growth, survival, and inflammation.[2,3]

Gut bacteria create hundreds of neurochemicals that affect mood, learning, and memory. The modern microbiome-gut-brain nexus impacts brain chemistry and behavior without the participation of the autonomic nervous system, gastrointestinal-specific neurotransmitters, or inflammation. There is bidirectional communication between the brain and the intestines with an intricate network comprising the immune, endocrine and central nervous systems. Metabolites like neurotransmitters and short-chain fatty acids can be produced by the gut flora. The function of the gut microbiota influences the amounts of linked metabolites found in the brain. Acetylcholine, dihydroxyphenylacetic acid, L-DOPA, dopamine-4-O-sulfate, epinephrine, GABA, histamine, norepinephrine, serotonin, and tyramine may explain the microbiome's modulation of the host's immunological and neurophysiological functions. Microbial endocrinology (neuromicrobiology), a novel subject, shows strong evidence that late horizontal gene transfer from bacteria may be the cause of cell-to-cell signaling in metazoans. Probiotic strains that reduce corticosterone and enhance newborn brain development have been shown to reduce anxiety and depression. The enteric nervous system, the ''second brain'', has more neurons than the peripheral nervous system; therefore, ''thinking with your gut'' is a true statement. Recent research links specific gut bacteria to autism. The gut microbiota affects behavior, and so does the brain. This may explain the anxiety and depression in patients suffering from Crohn's disease, ulcerative colitis, and irritable bowel syndrome patients.[4] High and chronic stress hormones such as adrenaline and norepinephrine make several pathogenic enterobacteria more virulent. Norepinephrine is also found in considerable amounts in the biomass of some bacterial species. This molecule is thought to be created in quorum sensing processes. The stress-related neuroendocrine hormone family of catecholamines is found in all species on Earth, confirming the microbial endocrinology concept that unifies animal and plant kingdoms with the same origin.[2]

Probiotic bacteria have been recognized and used as beneficial live microorganisms for human and animal health since the 20th century, with the aim of modulating the intestinal microbiota. Although current research is still heavily biased toward gastrointestinal applications for probiotics, such as chronic constipation chronic diarrhea, inflammatory bowel disease, irritable bowel syndrome and food allergy, the possibilities for impacting many areas of health are numerous. Other parts of the body containing endogenous microbiota or problems related to the immune system may also be candidates for probiotic therapy. Probiotics have potential for human health issues such as vaginal candidiasis, dental caries, allergies, autoimmune diseases, urogenital infections, atopic diseases, and respiratory infections.[5]

On the other hand, *Wolbachia* is a genus of intracellular bacteria commonly found in both the reproductive and somatic tissues of nematodes and arthropods. These gram-negative bacteria belong to the Anaplasmataceae family within the order Rickettsiales. They are one of the most common parasitic microbes on Earth, and may be the most common reproductive parasites. These bacteria are a biological archetype for fundamental studies of symbiosis and applied results for the prevention of agricultural and human diseases. Their relationship with their hosts is frequently complicated, and in some instances have evolved to be mutualistic rather than parasitic. *Wolbachia* infection prevents some host species from reproducing or even surviving. These alphaproteobacteria endosymbionts are transferred vertically through host eggs, altering host biology in a variety of ways, including parthenogenesis, feminization, sperm-egg incompatibility, and male killing. They can also move horizontally across species boundaries, which makes them widely distributed in a variety of invertebrate hosts around the world.[6] Therefore, when we ponder and contemplate the astonishing and remarkable roles that prokaryotes have on host metabolism, immune function, gene expression, and behavior, we wonder which is hosting which?

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