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Short Communication

The Revolution of the Holobiont

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There is a new concept that has been lurking around as of late that promises to change the way we look at nutrition forever. This new idea is the holobiont. The term holobiont was first used in 1991 by Lynne Margulis in biology to describe all of the components of a symbiotic system, i.e. the host and its associated microbiome and virome [1]. The concept soon became predominant and expanded beyond the realm of life sciences to include all living systems.

A holobiont is an individual with an emergent phenotype composed of both his or her own genome and cells (eukaryotes) and the resident microbiota's genetic material and cells/viruses at any given point in time, forming the hologenome [2,3]. The macrobe (the host) has different forms of interactions (opportunistic, competitive or cooperative) with all of its associated microbiota, including bacteria, archaea, viruses, protists, fungi, and microscopic multicellular animals such as nematodes [4]. This new vision of biology, emerging from the ground-breaking researches on the universality and diversity of microorganisms (microbiology), affords a holistic view of biological complexity of human beings [5].

Indeed, the idea of the holobiont can actually be extended to include the entire human body, since it can be correctly seen as a mixture of human eukaryote cells with a multi-species conglomerate of prokaryotic cells [6]. Once this view of ourselves as metaorganisms is established in medical sciences, it will generate a new paradigm shift, the effects of which cannot easily be anticipated.

Given the established microbe—Homo sapiens—symbiosis, scientists are now coming to the conclusion that human biology and health should be interpreted in light of a view of the biomedical sciences that is based on the holobiont concept [7]. Diet, by providing substrates for the bacteria in the colon (the densest and probably the most important of the host-associated microbial communities), contributes to influencing all aspects of human biology and health [8]. Therefore, nutrition, perhaps more than any other medical intervention, seems to be the most powerful tool to modify the host-microbiome interactions.

Nutrition must now start to take seriously the concept of the holobiont and integrate its conclusions into the framework of fostering health, disease management and prevention.

It has been shown that the relationships between humans and resident microbes throughout life include a continuum of mutually beneficial and nonbeneficial conditions (symbiosis, commensalism and parasitism) [9]. These relationships closely involve interactions with carbohydrate structures (glycans) expressed by the epithelial cells of the ecological niches where mutual and commensal bacteria reside [10]. It has also been demonstrated that these glycans are essentially regulated by the ABO gene which defines our blood type so that microbes can recognize, adhere and communicate with our cells through host genetics [11]. Thence, humans can be classified into 4 distinct groups (with four discrete and diverse holobiont types: A, B, O and AB), which have differences in species and composition of the microbiota [12].

By extension to this notion, if we are indeed made up of thousands of species of microbes (from fungi to protists) as the advent of relatively inexpensive tools for characterizing microbial communities confirms, then we must assume the holobiont to be more of an ecological community of organisms [13]. Hence, the hologenome (the totality of genomes in the holobiont), should encompass a broad range of interaction types (from the extremes of parasitic to mutualistic), multiple patterns of gene transmission (horizontal to vertical), and levels of fidelity among partners.

Glycans in general are known (from glycoscience) to be involved in the pathophysiology of every major disease (from inflammation, to cancer), as they regulate the immune system and partake in the energy equilibrium of the cells [14].

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