

Targeting Microbiota 2014: Friend or Foe?

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Pierre-Henri Gouyon (left) believes that “Nothing in biology makes sense except in the light of evolution”

At the 2nd World Congress on Targeting Microbiota at the Institut Pasteur in Paris, on October 16–17, 2014, experts discussed recent progress and current issues related to the diverse microorganisms that live on or in our bodies or that could be used to produce substances providing a benefit for our health. Given the scope of this article, I will take the liberty of reporting only on selected issues addressed during the conference that coincide with my personal and professional interests.

Not to be underestimated

The conference was opened by Marvin Edea, Chairman of the Scientific Committee and member of the Task Force Targeting Microbiota at the Institut Pasteur. He drew parallels with the expectations triggered by studies assessing the health benefits of antioxidants and the hopes raised by the findings on the role of microbiota in human health. He advised against expecting a simple solution for all, given the complexity of the ecosystem and the extent of individual diversity. This complexity was re-

flected in a wide range of topics covered by specialists from fields such as microbiology, immunology, evolutionary biology, and medicine.

The driving force

The scene was set by Pierre-Henri Gouyon of the National Museum of Natural History in Paris, with the quote “Nothing in biology makes sense except in the light of evolution” from the evolutionist Dobzhansky. He explained that while the ultimate goal of transferring one’s genes to the next generation often leads to competition, it could (as seen in the case of the human gut microbiota) also encourage cooperation within or between species. More than once during these two days, the example of the mitochondria, which is thought to be the result of ever closer symbiosis between an arcane microbe and a more advanced cell, was mentioned as a success story illustrative of the benefits of cooperation.

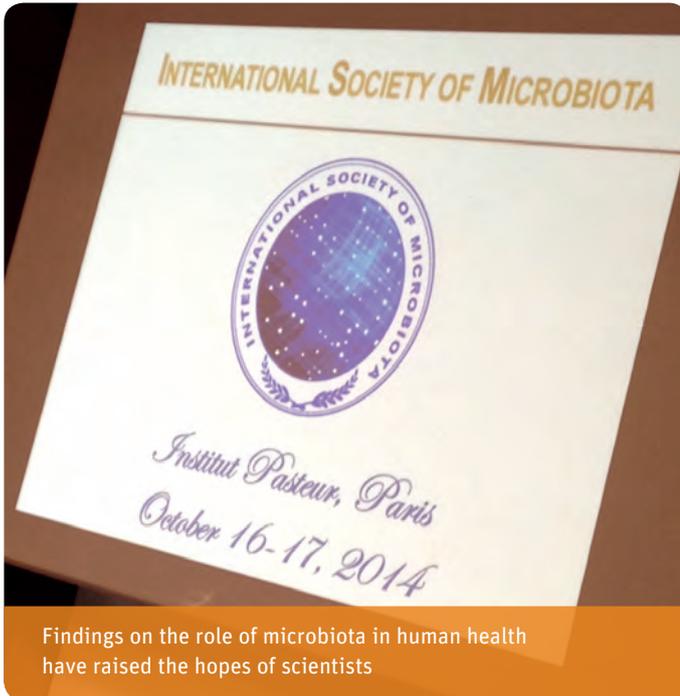
“While transferring one’s genes to the next generation often leads to competition, it could also encourage cooperation”

The intriguing relationship between mitochondria and microbiota

It is thought that our mitochondria derive from an arcane microorganism that was incorporated into the eukaryotic host. Consequently, it shares many features with modern single-cell organisms, such as the double membrane, the circular genome and the protein expression machinery. Moreover, mitochondrial DNA is transferred from the mother to the child, while the colonization of the newborn’s gut also originates from the maternal microbiota. As part of the host defense, intracellular microorganisms are eliminated via autophagy, which is also an important process to eradicate defective mitochondria.

Microbiota in the light of public health

Industrialized countries have witnessed a steady decline in bacterial infections, with a parallel increase in the incidence of non-



Findings on the role of microbiota in human health have raised the hopes of scientists

communicable diseases (NCD). At the same time, it has been shown that obese people tend to manifest a loss of microbial richness in the gut, a condition which is thought to increase the risk of various NCDs. When addressing the impact of the microbiome research on public health, S Dusko Ehrlich (INRA, Metagenopolis) explained that consequently the microbiome could on one hand be used as a marker for various pathologies and on the other be a target for, among other things, nutritional interventions to correct this atrophy. However, he also highlighted that the complexity and the variability of the microbes found in our bodies meant that there would hardly be one standard preventive solution that benefitted everyone.

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Of mice and men

Nadine Cerf-Benoussan of the Institut Imagine in France explained that while the super-organism composed of human and microbe brought many advantages in evolutionary terms, the large number and the diversity of microorganisms also posed a risk and had to be held in check. Her work in germ-free mice showed that re-colonization led to a wide spectrum of immune responses, which seem to balance each other, thereby maintain-

ing the intestine in some sort of equilibrium. They showed that a small number of bacteria species were responsible for triggering mechanisms that led to the complete maturation of the gut immune barrier after birth. In their mice, they identified one in particular, the segmented filamentous bacterium (SFB), which seems to send signals to the host, thereby probably optimizing the immune response towards other microorganisms.

Keeping the balance

The delicate balance between the microorganisms and their host was also the predominant topic of the presentation by Gerard Eberl from the Institut Pasteur, who spoke of the host’s “choice between tolerance and inflammation in the face of mutualists and pathogens.” The host has four major adaptive immune responses at its disposal, which could broadly be characterized as directed at **1)** intracellular organisms, **2)** parasites, allergens and wound healing, and **3)** extracellular bacteria, or else **4)** be (anti-) inflammatory. The balance between these is established early in life, and it has been suggested that a lack of exposure to infections in infancy and childhood leads to epigenetic changes that result in increased sensitivity to allergies. However, the decision between “tolerance” and “inflammation” was also influenced by other external factors such as diet; adequate levels of retinoic acid could shift the response from pro- to anti-inflammatory.

Discussion and conclusions

Research in recent years has greatly improved our understanding of the microbiota and their role in human health and disease. However, the complexity and the multifactorial nature of the system pose a major obstacle to putting this new-found knowledge to practical use. Still, the opportunities that lie within this accumulation of bacteria are too great to be neglected and will likely keep scores of scientists busy for the foreseeable future.

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