



PRINCIPE FELIPE
CENTRO DE INVESTIGACION

THE FUTURE OF BIOMEDICAL RESEARCH

CIPF Lecture Series

Microbiome: the last human organ

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Next-generation sequencing and metagenomic technologies have bursted the study of commensal microorganisms that live together with human beings, generally known as the microbiome. Many of these microorganisms have not been cultured *in vitro* until now and DNA/RNA studies on clinical samples show an enormous microbiological diversity adapted to each body niche. In our group, we have applied second-generation sequencing techniques to study microbiological communities in the mouth, stomach, respiratory track, maternal milk and gut both under health and disease conditions. These studies have allowed us to determine the polymicrobial etiology of diseases such as dental caries or periodontitis, to identify those microorganisms that could be used as biomarkers for colorectal cancer, or to identify bacteria with potential probiotic use in different diseases. Additionally, the combination of fluorescence-based flow cytometry and sorting in bacteria with next-generation sequencing technologies have allowed us to quantify the number of microorganisms coated with different antibodies as well as to identify bacteria recognized by IgA, IgG and IgM and those able to evade antibody recognition. The application of this technology to fecal samples of one-month old children allows the prediction, for example, of asthma development years before the disease onset, fostering the design of new preventive tools in high-risk children. All these reinforces the diagnostic value of microbiome studies.

The different culture-independent techniques recently applied to study the human microbiome are seeding light on the total diversity and functionality of the human-associated microorganisms as well as their potential for preventive strategies. One example of this has been the comparative metagenomics study of oral samples in patients with or without caries, which revealed a high frequency of a new *Streptococcus* species, subsequently isolated and baptized as *S. dentisani*, which produces bacteriocins that inhibit caries-causing bacteria and buffer extracellular pH, reducing caries risk. This bacterium is being tested as an anti-caries probiotic in clinical trials. A second example is given by oral bacteria that convert nitrate to nitrite and nitric oxide, which lowers blood pressure due to its vasodilator properties. Consequently, there are multiple clinical applications of these microbiome studies and, likely, in the near future human microbiota tests will be regularly performed in hospitals with diagnostic and preventive applications.

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