Human Microbes - The Power Within

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Health, Healing and Beyond

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Preface

This book is a journey into one of the human organ that has long been ignored due to its invisibility and dispersed nature. However, technological advances are now enabling the visualization of the microbiome in its undisturbed environment where its various constituents can be seen diligently shepherding the human body to function effectively. All the microbes including the viruses, bacteria and fungi that live on and within the body are referred to as the microbiome. For the purpose of this book that comprises four chapters bacteria are considered as the main component of this body part invisible to the naked eyes.

Chapter 1 describes the emergence of life on planet earth and posits that bacteria were central in the development of virtually all living organisms. The ability of these minute organisms to live independently and to execute a variety of tasks is critical to the survival of other organisms. Further, the contribution of bacteria to the genesis of the chloroplast and the mitochondrion provided the energy boost needed to sustain life in partnership with the sun. While chloroplast is an integral component of organisms involved in capturing solar energy, mitochondria is part of all multicellular life where they are the main energy generator. These intimate cellular interactions between these organelles which originated from bacteria and living systems provided the fuel life needed to evolve. These transformed bacteria are present in virtually all human cells. Indeed, the trillions of microbes that live on and within the human body make humans the way they are. Only with the recent advent of molecular visualization technologies that this microbe-human link is being fully appreciated. The post-2007 human is someone with a microbial body part weighing 2–3 kg in an average adult that fulfills a variety of essential functions.

Chapter 2 elaborates on how this organ is formed and traces its development from the womb till the old age. The various factors like diet, genetic make-up, geography and life-style that are known to influence the maturation of the visible organs including the lungs, the brain and the heart also dictate the nature of this invisible organ. The microbiome is an expansive organ akin to the blood system. Just as the latter that is constituted by the white blood cells, red blood cells and numerous other components, the microbiome is also composed of disparate microbial cells. These microbes are specific to where they are located in the body

and participate in an array of physiological activities that cannot be accomplished in their absence. We will not able to digest numerous food products properly nor produce vital ingredients like vitamins K and amino-acids such as tryptophan without these microbial partners.

Chapter 3 evaluates the abnormal situations that ensue when the microbiome does not function properly. The diseases that manifest following the imbalance amongst the microbial communities are explained. A range of effectors is known to disrupt the fine-balance existing between the visible organs and these diverse microbiota. Unlike the visible organs that are made-up of relatively few specific cells, the functional microbiome is constituted by a large number of disparate microbes. Pollution, diet, exercise, pets, occupation, and hormonal fluctuations are some of the factors known to distress the microbiome. These perturbations can trigger illnesses like gastric ulcer, colorectal cancers, fatty liver disease, hypertension and obesity. The ability of probiotics and prebiotics to re-establish a dysfunctional microbiome and cure diseases is described. Probiotics involve the intake of live-bacteria while prebiotics are more or less like fertilizers aimed at favouring the proliferation of a select group of microbes. These treatments are proving very effective in treating diseases promoted by dysbiosis. These procedures are becoming a common health practice aimed at fostering general wellness.

Chapter 4 provides a glimpse into the future when the molecular functioning of the microbiome will be fully elucidated. If in 10–30 years from now the knowledge regarding this invisible organ has attained the same degree of understanding as the visible organs like the heart, there will be a very momentous societal change. The impact of this information on health education, health delivery systems, modifying human traits, global hunger, and tracking individuals is discussed. For instance, just imagine the presence of a microbiome bank in a hospital and how this will help in patient care; the precise profiling of each individual with the microbes living on and within the body will be a game-changer in medical diagnostics. This will also completely revolutionize molecular forensic identification. The discoveries of unique microbes with distinct characteristics that can ease space travel and help in the production of goods will be of immense economic value. These are some of the fascinating, provocative, and forward-looking ideas discussed in this chapter.

The information synthesized in this book emanates from recent findings on the human microbiome and the possibilities they hold for the future as our understanding on these microbial communities expand exponentially. This discipline is just beginning to emerge as a potent societal game-changer that will affect us all. I am indebted to my wife Dr. Sharina Appanna for assiduously proofreading the original text. I will like to thank all my students who have taught me how to teach and bring complex information to life. I am confident that this attribute is reflected in this book that can be enjoyed by a wide readership including health science students and practitioners.

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About the Author

Dr. Vasu D. Appanna has been teaching and researching for over 30 years on various aspects of how microbes go about surviving in extreme environments. He is in fact 'a bacterial whisperer' and has been able to 'talk' microbes into executing a variety of challenging tasks. For instance, he has tailored microbes to grow in metal-polluted areas, live on glycerol and adopt a lifestyle on limited oxygen. Dr. Appanna has published in excess of 100 articles in scientific journals and lectured extensively around the globe including France, India, Russia, Chile and China. He is the academic editor of numerous journal publications. He has served as Department Chair and Dean of the Faculty of Science & Engineering at Laurentian University. As a prolific researcher he has trained and mentored over 150 highly qualified research personnel. He has also helped identify some of the mechanisms metal pollutants invoke to trigger obesity and neurological diseases. His passion and knowledge of microbes have taken him around the globe in pursuit of biotechnological solutions. Whether it is the search for microbes to mitigate pollution in the Black Sea or to extend the life of oil reserve in Sarov, Russia, or to improve water quality in the aquaculture industry in Vietnam, or to mine valuable metals in the Atacama desert, Chile, Dr. Appanna has been a pioneer in cajoling microbes in performing a desired chore. In this book he has summoned his extensive teaching skills, microbial expertise and background in human health to weave the fascinating facets of our invisible organ.