The gut microbiota has been shown to play a role in many different diseases and disorders, ranging from colon cancer and inflammatory bowel disease, to allergy of skin and lungs, brain development and cognition, and obesity. The microbiota is made up of ~250 individual-specific microbial species that interact with the host. The major fermentative activities in the colon are the fermentation of carbohydrates and proteins. This leads to the production of microbial metabolites, which are taken up by the host. Carbohydrate fermentation leads to the health-beneficial short-chain fatty acids (SCFA; primarily acetate, propionate and butyrate), while protein fermentation leads to a range of toxic metabolites.

A healthy microbiome is considered to be necessary for a healthy host. The microbiota can be modulated by components in the diet, including probiotics and prebiotics. Probiotics are defined as live microorganisms, which, when administered in adequate amounts, confer a health benefit on the host. Prebiotics are defined as a selectively fermented dietary components that results in specific changes in the composition and/or activity of the gut microbiota, leading to improved host health. Both have been used to correct the gut microbiota dysbiosis observed in many diseases and disorders.

However, in the host is it very difficult to establish the mechanism of action of these components. Therefore, the Dutch Organization for Applied Scientific Research (TNO) set out to develop dynamic, computer-controlled in vitro models of the gastrointestinal tract (nick-named TIM). These models accurately mimic the changing conditions in the GI tract as foods transit through the gut. The systems have been validated using clinical or animal data. The colon model, TIM-2, has been used extensively to study the effect of probiotics and prebiotics on the composition and activity of the gut microbiota. The presentation will provide a number of recent examples of modulation of the gut microbiota.