Interaction between diet and gut microbiota for human health

Miyamoto Junki (Graduate school of Agriculture, Tokyo University of Agriculture and Technology)
m-junki@go.tuat.ac.jp

It has been reported that gut microbiota closely regulate host homeostasis. Although dietary fiber is thought to be an unnecessary nutrient because of its digestion and utilization in the human gut, gut microbial metabolites derived from dietary fibers (e.g., short-chain fatty acids, SCFAs) act not only as an energy source but also as signaling molecules through FFARs (free fatty acid receptors). In the past few decades, it has been demonstrated that gut microbial metabolites, including SCFAs, affect human homeostasis and are involved in metabolic and immunological diseases. A recent study has shown that the maternal gut environment during pregnancy is a key contributor to metabolic programing to prevent metabolic syndrome in offspring. Thus, gut microbiota of pregnant mice provides an environmental cue that fine-tunes energy homeostasis in offspring to prevent the developmental origin of the metabolic syndrome. Moreover, the composition of gut microbiota and its metabolites are also affected by energy depletion. Gut microbiota under energy depletion acts in a different manner between systemic and local (intestine) effects. Therefore, these results may contribute to the development of preventive and predictive medicine via diet. In summary, changing gut microbiota through diet influences human health in the quality and balance of the diet.

Furthermore, it is well known that dietary lipids are not only important nutrients (rich in nutrition) but they also act as signaling molecules through FFARs. The quality and balance of dietary lipids play a pivotal role in human health because the differences in constituent fatty acids in dietary lipids regulate the gut microbiota composition. Although linoleic acid (ω6 polyunsaturated fatty acid) is an essential fatty acid, excessive intake induces pro-inflammatory diseases by producing pro-inflammatory lipid mediators. Recent studies have demonstrated that gut microbiota mediates the saturation of linoleic acid as a detoxifying mechanism and produces novel metabolites in the gut. Interestingly, by using an animal model in gut microbiology, gut microbiota exerted protective effects against obesity and improved glucose homeostasis associated with several mechanisms involving gut microbial metabolites of dietary polyunsaturated fatty acids. In summary, these findings not only represent a central mechanism underlying the interplay between commensal bacteria and the host for energy homeostasis via dietary lipids, but also contribute to the development of functional foods for the prevention of metabolic disorders by tailoring the use of gut microbial metabolites.

References

Miyamoto J, et al. Gut microbiota confers host resistance to obesity by metabolizing dietary polyunsaturated fatty acids. ***Nat Commun.*** 2019; 10: 4007.

Miyamoto J, et al. Ketone body receptor GPR43 regulates lipid metabolism under ketogenic conditions. ***Proc Natl Acad Sci U S A***. 2019; 116: 23813-23821.

Kimura I#, **Miyamoto J#**, et al. Maternal gut microbiota in pregnancy influences offspring metabolic phenotype in mice. ***Science.*** 2020; 367: eaaw8429. # Contribution equally 1st author.