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Theoretical study of interaction between allergy and intestinal microbiome

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Recent studies show that human immune system interacts with intestinal microbiome. A certain group of intestinal bacteria is known to be possible suppressor of undesirable immune response [1]. They produce short chain fatty acid such as butyrate and induce regulatory T cells [1]. Regulatory T cells are suppressor of exaggerated immune responses [2]. Therefore, collapse of the ecological balance of intestinal microbiome may cause dysregulation of immune system. On the other hand, mutant mice with regulatory T cells that have limited diversity of T cell receptor repertoire cause inflammation to commensal intestinal microbiome driven by T helper cells [3], suggesting that immune cells develop hypersensitive response to commensal microbiome and that regulatory T cells suppress the reactions.

This suggests us that intervention targeting intestinal microbiome may provide a novel strategy for treatment of allergic symptoms. In this talk, we develop a simple mathematical model that describes interaction between intestinal microbiome and immune system. We consider dynamics of T helper cells (trigger of allergic response), regulatory T cells (suppressor of allergy), and intestinal microbiome. Differentiation process of these two types of T cells is described as a model of immune system, the structure of which was developed in our previous study [4].

Analysis shows that the model has results of three different types differing in stable steady states: (1) the case with a single stable positive steady state representing "healthy condition", (2) the case with a single stable steady state representing "allergic condition", and (3) the case with two stable steady states, representing "healthy" and "allergic" conditions, respectively. Steady states representing healthy condition has a low level of helper T cells, a high level of regulatory T cells, and bacteria; whilst those representing allergic condition has opposite features (high helper T cells, low regulatory T cells and bacteria). Considering these three different situations, now we have two strategies for allergy treatment. The first strategy is to eliminate steady state which corresponds to allergy, by realizing the condition for case (1). We derived a formula for the absence of allergic state. The second strategy is to reduce the abundance of helper T cells at the steady state. We tested bacteria-related parameters for their effectiveness in suppressing the level of helper T cells. This study is the first attempt in modelling association between intestinal microbiome and immune system and in finding out a therapy method for allergy by intervention of intestinal microbiome.

[1] Furusawa, Y. *et al.* 2013. *Nature* 504, 446-50.
[2] Sakaguchi, S *et al.* 2008. *Cell* 133, 775-787.
[3] Nishio, J. *et al.* 2015. *Proc Natl Acad Sci U S A* 112, 12770-5.
[4] Hara, A and Iwasa, Y. 2017. *J. Theor. Biol.*425, 23-42.

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