【Grant-in-Aid for Scientific Research (S)】

Integrated Disciplines (Complex Systems)

Title of Project : Basic and Applied Studies of Chrononutrition Based on Development of Functional Foods and Nutrients

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Research Project Number : 26220201　Researcher Number : 10162629
Research Area : Eating habit, Food science
Keyword : Circadian, Clock gene, Nutrition, Functional food

【Purpose and Background of the Research】
Circadian 24 hr rhythm systems are important for maintaining the day/night rhythm of bodily functions, such as the sleep/wake cycle, the endocrine system, and the autonomic nervous system. Many studies have investigated the circadian clock system in mammals, which organizes physiological functions including metabolism, digestion, absorption of food, and energy expenditure. Food and/or nutrition can be a synchronizer for the circadian clock systems, and can be as potent as external light-dark signals. Recent studies have also investigated different kinds of food, frequency of consumption, and time of consumption for optimizing the body clock and ensuring healthy habits. In this study, we will try to discover new healthy foods and eating habits, based on the interaction of chronobiology and nutrition (so-called chrononutrition) (Fig.1). The development of chrononutrition based functional foods and nutrition will help us to develop health science in humans. We will prepare various types of food components; i.e. TOKUHO, Chinese traditional herbs (KAMPO), and anti-oxidant polyphenols, such as flavone derivatives.

【Research Methods】
We will investigate the effects of foods, their components, nutrition, and health promoting compounds (TOKUHO) on free-running period, phase, and amplitude of circadian rhythms using fibroblasts, peripheral organs, and PER2::LUC knock-in mice. In addition, we will apply these data to human circadian rhythms. As it is now known that feeding timing affects energy, metabolism, and obesity, a 2-3 meals-per-day schedule will be developed for PER2::LUC mice. When feeding mice functional foods is breakfast, lunch or supper most effective against obesity? Additionally, we will find the most effect functional foods for entraining circadian peripheral rhythm. In the next experiment, we want to test whether these functional food/components can normalize circadian rhythms using established rhythm disorder models such as Clock-/- and db/db-/- mice.

【Expected Research Achievements and Scientific Significance】
We will find new functional foods/components, which affect the period, amplitude or phase of circadian rhythms. Among these functional food/components, we will determine which food/components are most appropriate for breakfast, lunch, supper, and/or a nighttime snack in order to maintain a healthy body. The metabolic syndrome induced by a high fat diet, shift-work, and clock gene dysfunction will be prevented by considering the timing of food/components (chrononutrition). In addition, we will confirm these data in human experiments.
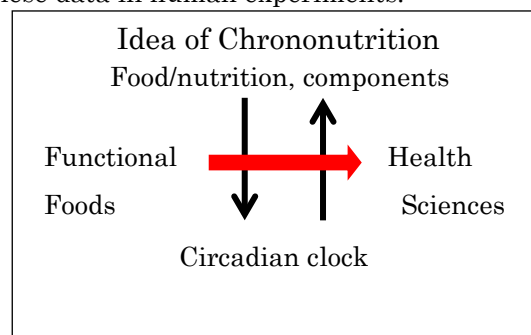

Figure 1

【Publications Relevant to the Project】
1) Tahara Y., Shibata S. Chronobiology and nutrition. Neuroscience 253,78-88, 2013
2) Tahara Y and Shibata S., et al. In vivo monitoring of peripheral circadian clocks in the mouse. In vivo monitoring of peripheral circadian clocks in the mouse. Current Biology 22(11):1029-1034, 2012.

【Term of Project】 FY2014-2018

【Budget Allocation】 89, 900 Thousand Yen

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