

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

Broad Section F



Title of Project : Antiaging system of long-lived termite kings

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Keyword : longevity, antiaging, termite, metabolome, social insects

【Purpose and Background of the Research】

Eusocial insects, such as ants, bees, wasps, and termites, are characterized by a system of caste division (reproductive vs. non-reproductive individuals), where the lifespan of queens (and kings in termites) can reach 100 times longer than the average lifespan of non-social insects. Recent our study revealed that kings of some termite species including *Reticulitermes speratus* have extremely long life span, which is comparable to human longevity, due to their unique reproductive system AQS (Asexual Queen Succession).

Generally, longevity negatively correlates with reproduction. Most animals show a gradual decline in reproduction with age. Nevertheless, termite kings are the most sexually active individuals and also the most long-lived individuals among colony members. How can termite kings maintain high sexual activity over several decades without sacrificing longevity? Because of their unique characteristics, termite kings are expected to facilitate the discovery of the novel mechanisms underlying the extremely long longevity.

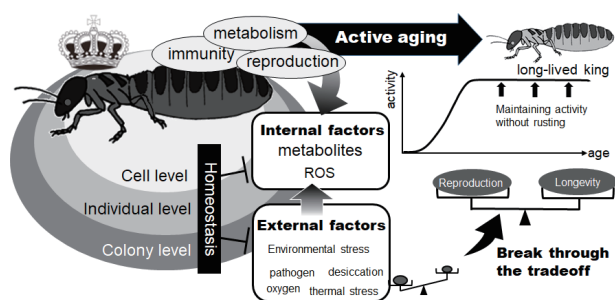


Figure 1. Research scheme

【Research Methods】

To identify metabolic pathway and the metabolic activity of the kings changing as aging, we perform metabolic flux analyses using doubly labeled water method and isotope distribution from ^{13}C -labeled compounds.

Kings and queens have no symbiotic protozoa in their hindgut, and food supply is made exclusively through trophallaxis from workers. Based on our

long-term behavioral monitoring, we found that workers provide a special royal food for kings and queens. We are going to identify the key compounds of the royal food by using MS/MS and also perform in vivo function analysis of the candidate compounds.

Royal chambers, where kings and queens are harbored, have a lower oxygen concentration in comparison with other parts of the termite nests. To investigate how the hypoxic condition influence on kings' reproduction and longevity, we perform comparative analysis of their metabolism by keeping kings under different oxygen conditions.

【Expected Research Achievements and Scientific Significance】

Having healthy active life for a long time is one ideal of the human society. Through this study, we will be able to find a number of novel factors underlying the extreme longevity of termite kings, which acquired such a long longevity in the history of evolution independently of mammals. Identification of novel molecular mechanism underlying the extremely long lifespan of social insect royals would have a high interdisciplinary impact in biology.

【Publications Relevant to the Project】

- Matsuura K. et al. (2018) A genomic imprinting model of termite caste determination: Not genetic but epigenetic inheritance influences offspring caste fate. . Am Nat 191: 677-690.
- Matsuura, K. et al. (2009) Queen succession through asexual reproduction in termites. Science 323:1687.

【Term of Project】 FY2018-2022

【Budget Allocation】 149,600 Thousand Yen

【Homepage Address and Other Contact Information】

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