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微小重力環境下におけるアミロイド線維形成

Characterization of amyloid β fibril formation under microgravity environment

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Abstract

Amyloids, abnormal fibrillar aggregates of proteins, are associated with various disorders such as Alzheimer's disease. Therefore, an in-depth understanding of the mechanisms of amyloid formation is critical for developing clinical strategies and drugs against these diseases. Nonetheless, accumulating evidence suggests that amyloid formation processes and the consequent morphology of fibrils can be affected by various environmental factors. This is an obstacle for the integrative understanding of the mechanisms underlying amyloid formations. Amyloid formation is also thought to share a phenomenological similarity with protein crystallization. Although many studies have demonstrated the effect of gravity on protein crystallization, its impact on amyloid formation had not been reported. Therefore, we started our "Amyloid" project on 2016 with a collaborative discussion with Japan Aerospace Exploration Agency (JAXA) and Japan Space Forum staffs toward space experiments at the Japanese Experiment Module, KIBO, on the International Space Station (ISS)[1]. Currently, we attempt to evaluate the effects of the microgravity environment on the amyloid formation processes and consequent fibril morphology. Our comparative analyses so far revealed that the Aβ(1–40) fibrilization progresses much more slowly on the ISS than on the ground, similarly to protein crystallization. Furthermore, distinct morphologies of Aβ(1–40) fibrils were formed on the ISS. Slower amyloid growth under microgravity conditions could be ascribed to the repression of the convective agitation and sedimentation, which result in unique morphologies of Aβ fibrils. Our findings demonstrate that the ISS provides an ideal experimental environment for detailed investigations of amyloid formation mechanisms by eliminating the conventionally uncontrollable factors derived from gravity.

References

1) M. Yagi-Utsumi, S. Yanaka, C. Song, T. Satoh, C. Yamazaki, H. Kasahara, T. Shimazu, K. Murata and K. Kato: Characterization of amyloid β fibril formation under microgravity conditions. npj Microgravity, **6** (2020) 17, DOI: 10.1038/s41526-020-0107-y