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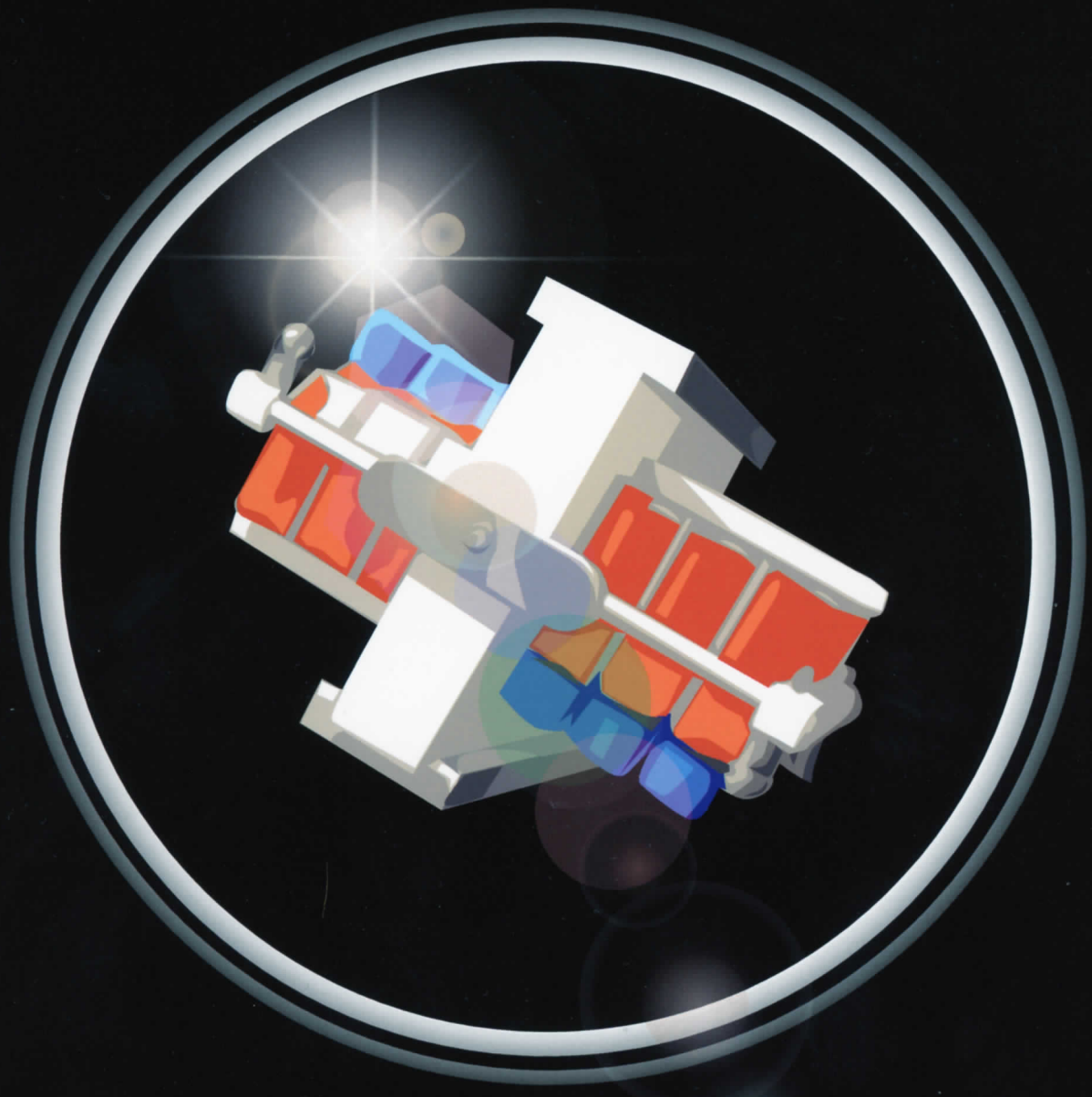

Cell culture in the GRAVITY-CONTROLLED ENVIRONMENT

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MAIN TEXT

Enhanced proliferation and differentiation of human mesenchymal stem cells in the gravity-controlled environment

Tadashi Nakaji-Hirabayashi[1,2,3] | **Kazuaki Matsumura**[4] | **Reiichi Ishihara**[5] | **Tatsuya Ishiguro**[5] | **Hiromitsu Nasu**[5] | **Masatsugu Kanno**[5] | **Shunji Ichida**[5] | **Toshikatsu Hatashima**[5]

[1]Department of Applied Chemistry, Graduate School of Science and Engineering, University of Toyama, Toyama, Japan

[2]Department of Advanced Nano- and Bio-sciences, Graduate School of Innovative Life Sciences, University of Toyama, Toyama, Japan

[3]Frontier Research Core for Life Sciences, University of Toyama, Toyama, Japan

[4]School of Materials Science, Japan Advanced Institute of Science and Technology, Nomi, Japan

[5]New Business Project, Development Division, Kitagawa Iron Works Co., Ltd., Hiroshima, Japan

Correspondence
Tadashi Nakaji-Hirabayashi, Department of Applied Chemistry, Graduate School of Science and Engineering, University of Toyama, Toyama 930-8555, Japan.
Email: nakaji@eng.u-toyama.ac.jp

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Abstract

Background: Human bone marrow mesenchymal stem cells (hMSCs) present a promising cell source with the potential to be used for curing various intractable diseases, and it is expected that the development of regenerative medicine employing cell-based therapy would be significantly accelerated when such methods are established. For that, powerful methods for selective growth and differentiation of hMSCs should be developed.

Methods: We developed an efficient method for hMSC proliferation and differentiation into osteoblasts and adipocytes using gravity-controlled environments.

Results: The results indicate that the average doubling time of hMSCs cultured in a regular maintenance medium under microgravity conditions (0.001 G) was 1.5 times shorter than that of cells cultured under natural gravity conditions (1.0 G). Furthermore, 99.2% of cells grown in the microgravity environment showed the expression of hMSC markers, as indicated by flow cytometry analysis. Osteogenic and adipogenic differentiation of hMSCs expanded in the microgravity environment was enhanced under microgravity and hypergravity conditions, respectively, as evidenced by the downregulation of hMSC markers and upregulation of osteoblast and adipocyte markers, respectively. Most cells differentiated into osteoblasts in the microgravity environment after 14 days (~80%) and adipocytes in the hypergravity environment after 12 days (~90%).

Conclusions: Our results indicate that hMSC proliferation and selective differentiation into specific cell lineages could be promoted under microgravity or hypergravity conditions, suggesting that cell culture in the gravity-controlled environment is a useful method to obtain cell preparations for potential clinical applications.

KEYWORDS

cell culture, gravity-control, mesenchymal stem cells, osteogenic and adipogenic differentiation, proliferation