

## 高度好冷菌 *Colwellia psychrerythraea* strain 34H の脂肪酸

橋本美佳子<sup>1</sup>、折笠善丈<sup>2</sup>、吉田磨仁<sup>1</sup>、林秀則<sup>3</sup>、奥山英登志<sup>1</sup>

<sup>1</sup>北海道大、<sup>2</sup>帯広畜産大、<sup>3</sup>愛媛大

### Fatty acids of the extremely psychrophilic bacterium *Colwellia psychrerythraea* strain 34H

Mikako Hashimoto<sup>1</sup>, Yoshitake Orikasa<sup>2</sup>, Kiyohito Yoshida<sup>1</sup>, Hidenori Hayashi<sup>3</sup>, and Hidetosi Okuyama<sup>1</sup>

<sup>1</sup>Hokkaido University, <sup>2</sup>Obihiro University of Agriculture and Veterinary Medicine, <sup>3</sup>Ehime University

The marine bacterium *Colwellia psychrerythraea* strain 34H (strain 34H; ATCC BAA-681) is an extreme psychrophile isolated from the near-freezing sediments of the Northeast Water polynya, Greenland<sup>1</sup>. This bacterium has been used as a psychrophilic model organism because of its optimal growth temperature at 8°C<sup>1</sup>, mobility using flagella even at subzero temperatures<sup>2</sup>, and significant production of various types of cold-active extracellular enzymes<sup>1,3</sup>. Industrial use of strain 34H is also expected. This bacterium has been considered to contain eicosapentaenoic (EPA) and/or docosahexaenoic acids (DHA) from the existence of *pfaA-pfaE* genes responsible for the biosynthesis of these long-chain polyunsaturated fatty acids (LC-PUFAs) from its genome sequence<sup>4</sup>. These fatty acids have been regarded as a modulator of membrane fluidity at low temperatures also in this bacterium. However, no biochemical evidence on their presence has been available<sup>5</sup>. In this study, we identified LC-PUFAs including DHA and EPA as very minor fatty acid components of strain 34H cells grown at 5°C and the sum of *cis*-monounsaturated fatty acids including palmitoleic acid was more than 50% of total fatty acids, suggesting that *cis*-monounsaturated fatty acids would serve a principal role adjusting the membrane fluidity at low temperatures in this bacterium.

*Colwellia psychrerythraea* strain 34H (strain 34H; ATCC BAA-681)はグリーンランド近海のポリニヤの海底堆積物から単離された細菌である<sup>1</sup>。その増殖至適温度は8°Cにあり<sup>1</sup>、氷点下でも鞭毛運動を示す<sup>2</sup>など、高度な好冷性をもつほか、各種の低温性菌体外酵素を生産すること<sup>1,3</sup>から工業的な利用も期待されている。Strain 34Hのゲノム配列は2005年に解読された<sup>4</sup>が、その遺伝情報からもこの菌の好冷的な性質が裏付けられている。Strain 34Hはそのゲノムに長鎖多価不飽和脂肪酸(LC-PUFA)合成に関わる遺伝子群(*pfaA-pfaE*)をもつ<sup>4</sup>ことから、LC-PUFAを合成するとみられてきたが、生化学的な証明はなかった<sup>5</sup>。本研究では、strain 34Hの脂肪酸成分を解析した。LC-PUFAとしてドコサヘキサエン酸、エイコサペンタエン酸、アラキドン酸が検出されたが、その含量は何れも著しく低かった。一方で、パルミトオレイン酸を含むモノ不飽和脂肪酸の含量は合わせて50%以上であった。以上の結果から strain 34Hの低温下での膜流動性はLC-PUFAではなく、シス型のモノ不飽和脂肪酸によって維持されていると考えられる。

#### References

- 1) Huston, A.L., Bacterial adaptation to the cold: in situ activities of extracellular enzymes in the North Water polynya and characterization of a cold-active aminopeptidase from *Colwellia psychrerythraea* strain 34H. Ph.D. thesis, University of Washington, Seattle, 2003.
- 2) Junge K. et al., Motility of *Colwellia psychrerythraea* strain 34H at subzero temperatures. Appl. Environ. Microbiol., 69, 4282–4284, 2003.
- 3) Huston A.L. et al., Purification, characterization, and sequencing of an extracellular cold-active aminopeptidase produced by marine psychrophile *Colwellia psychrerythraea* strain 34H. Appl. Environ. Microbiol., 70, 3321–3328, 2004.
- 4) Methé, B.A. et al., The psychrophilic lifestyle as revealed by the genome sequence of *Colwellia psychrerythraea* 34H through genomic and proteomic analyses. Proc. Natl. Acad. Sci. U.S.A., 102, 10913–10918, 2005.
- 5) Okuyama, H. et al., Bacterial genes responsible for the biosynthesis of eicosapentaenoic and docosahexaenoic acids and their heterologous expression. Appl. Environ. Microbiol., 73, 3665–3670, 2007.