

仙人掌桿菌、大腸桿菌及醋酸桿菌

脈衝電場抗性之測定

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摘要

本研究檢測菌體對脈衝電場(pulsed electric fields; PEF)的抗性，在不同電場強度下，以3、6、9、12 μs 四種脈衝寬電擊大腸桿菌及仙人掌桿菌。結果觀察到脈衝波寬度愈大存活菌數愈低，大腸桿菌在14.6 kV/cm電場強度，3 μs 脈衝寬，殘存菌數比降低1.91 \log_{10} 值，若脈衝寬增大到12 μs ，只需10.5 kV/cm電場強度，殘存菌數比即可降低3.72 \log_{10} 值。相同的方法處理仙人掌桿菌，亦得到類似的結果。依據在3、6、9、12 μs 四種脈衝寬電擊下的數據計算，得知大腸桿菌的臨界電場強度分別是10.2、9.02、7.11、及6.89 kV/cm；同樣的方法求得仙人掌桿菌的相對臨界電場分別是7.93、7.92、7.02及5.45 kV/cm，臨界電場數值顯示大腸桿菌對脈衝電場的抗性略高於仙人掌桿菌。此外，比能量亦可作為不同PEF處理條件下比較菌體抗性的依據，由比能量與菌數殘存的迴歸方程式，得知減少大腸桿菌與仙人掌桿菌1.0 \log_{10} 菌數比值的比能量，分別是138 J/g及133 J/g，此數值也顯示大腸桿菌PEF抗性高於仙人掌桿菌。使用相同的方法測定醋酸桿菌對PEF的抗性，結果測得9 μs 脈衝寬的PEF處理，菌體臨界電場是8.50 kV/cm，大於大腸桿菌與仙人掌桿菌在9 μs 脈衝寬度下的臨界電場(7.11與7.02 kV/cm)；減少1.0 \log_{10} 菌數比值的比能量是238 J/g，亦超過大腸桿菌與仙人掌桿菌所需的比能量，此結果意味著醋酸桿菌的PEF抗性高於大腸桿菌及仙人掌桿菌。檢測得之菌體PEF抗性數據將可作為PEF能量設計的參考，亦可作為建立PEF操作參數的依據。

關鍵詞：脈衝電場、仙人掌桿菌、大腸桿菌、醋酸桿菌

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Detecting resistances of *Bacillus cereus*, *Escherichia coli*, and *Acetobacter* sp. to pulsed electric fields

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Abstract

The resistances of *Escherichia coli* and *Bacillus cereus* to pulsed electric fields (PEF) were detected. Cell suspensions of *E. coli* and *B. cereus* were treated under various electric voltage fields through 3, 6, 9 or 12 μ s pulse. The survival bacterial cells treated under wide electric pulses were decreased more than those of narrow pulses treatments. For example, the reducing survival cell ratio of *E. coli* was 1.91 \log_{10} , as treated with electric field of 14.6 kV/cm through 3 μ s pulse; however, the reducing survival cell ratio was increased to 3.72 \log_{10} , as the electric field was 10.5 kV/cm through 12 μ s pulse. The similar effect of wide pulse on *B. cereus* was demonstrated, as the same condition of PEF was carried out. In the meantime, critical electric fields of *E. coli* under 3, 6, 9 and 12 μ s pulses were figured out as 10.2, 9.02, 7.11, and 6.89 kV/cm, respectively; critical electric fields of *B. cereus* were also determined as 7.93, 7.92, 7.02 and 5.45 kV/cm. The resistance of bacterial cell to PEF is correlated to the specific energy of that PEF, hence the specific energy required to reduce 1.0 \log_{10} cycle of cell ratio is an adequate parameter for comparing resistance of various bacteria to PEF. The specific energies needed to reduce 1 \log_{10} cycle of *E. coli* and *B. cereus* were 138 J/g and 133 J/g, respectively. *E. coli* is slightly more resistant to PEF than *B. cereus*, as compared to the specific energies of these two bacteria. The same PEF method was also applied to measure the critical electric field and specific energies acting on *Acetobacter* sp.. The results had showed that the critical electric field was decided as 8.50 kV/cm at 9 μ s pulse, and the specific energy required to reduce 1.0 \log_{10} cycle of bacterial cell was 238 J/g. These two parameters implied that *Acetobacter* sp. is more resistant to PEF than *E. coli* and *B. cereus*. The resistance characteristics of various bacteria will be useful for designing PEF system and developing processing parameters.

Key words: pulsed electric fields,
Bacillus cereus, *Escherichia coli*,
Acetobacter sp.

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