白蛋白的存在對革蘭;氏陽性菌光動力;殺;菌的影響

Effect of Albumin on Photodynamic Inactivation of Gram-Positive Bacteria

中文摘要

光動力殺菌 (Antimicrobialphotodynamic inactivation，PDI) 利用光感物質，在照射特定波長的可見光之下，因單態氧或自由基的產生而對微生物造成毒性。近年來為了解決日漸嚴重的抗藥性問題，使得光動力殺菌得以發展成為另一項治療微生物感染的方式。當菌體存在於生物體感染部位時，週遭的生物性因子的影響決定了光動力殺菌的效果。傷口部位週遭的白蛋白為影響光動力效果的主要原因之一。在本研究當中，將探討白蛋白的存在，對於革蘭氏陽性菌光動力殺菌效果的影響。金黃色葡萄球菌 (Staphylococcus aureus) 與MRSA懸浮在PBS或牛血清白蛋白 (Bovine Serum Albumin，BSA) 中，加入光感物質chlorin e6 (Ce6) 或Toluidine Blue O (TBO) 避光培養後，以紅色發光二極體矩陣進行照光。Ce6為游離型式或 PF127 微胞載體型式。照光之後並加入具有提升光動力殺菌效果之生醫材料CX再與菌體培養。最後將菌液取出，以PBS序列稀釋 (101~106)，再將稀釋菌液滴於TSB agar plate上推盤，於37℃下隔夜培養後進行菌落數計數。實驗結果顯示，相較於在PBS的環境中，金黃色葡萄球菌及MRSA懸浮在有蛋白質存在的環境時，光動力殺菌的效果皆受到抑制。然而將CX合併光動力處理過後，無論以Ce6或TBO，以及對金黃色葡萄球菌及MRSA，均有提升光動力殺菌效果的作用。微胞載體具有避免Ce6在水溶液產生聚集而可增進殺菌效果的功能；PF127-Ce6及free Ce6在白蛋白的存在下，以光動力處理的部分殺菌效果差異較小，然而在加入CX培養後，可進一步提升殺菌的效果。因此，以微胞載體以及合併CX的使用，有助於白蛋白的存在，對於革蘭氏陽性菌光動力殺菌效果的影響。

英文摘要

Antimicrobial photodynamic inactivation (PDI) employs a photosensitizer and visible light to produce singlet oxygen and reactive oxygen species that can cause cytotoxic effect on microorganism. In recent years, the growing resistance to antibiotics among pathogenic bacteria rendered PDI as an alternative antimicrobial therapeutics of infection disease. Under the wound environment, several biological factors may affect the effectiveness of PDI. The presence of albumin around the wound is one of the factors that influence the efficiency of PDI. The purpose of this study is to evaluate the effect of albumin on the photodynamic inactivation of gram-positive bacteria. Suspensions of Staphylococcus aureus and MRSA in PBS or bovine serum albumin (BSA) were treated in dark and red LED light conditions in the presence of photosensitizers using chlorin e6 (Ce6) and toluidine blue O (TBO). Ce6 was prepared in free form or micellar form. After illuminated, a biomaterial that can evaluate the antimicrobial effect of PDI called CX was added to bacteria suspensions. The suspensions were serially 10-fold diluted with PBS to give dilution of 10-1~10-6 times then drop the aliquots on agar plate. Plates were incubated at 37℃ overnight. The number of colony forming units (CFU) was counted. The results in this study show that the PDI sensitivity was inhibited by the presence of albumin compared with suspensions of S. aureus and MRSA in PBS. However, the combination of CX and PDI markedly reduced cell growth of S. aureus and MRSA by using photosensitizers as Ce6 and TBO. A micellar carrier system prevents the likelihood of aggregation of Ce6 provides a better PDI efficiency. There were little differences of bacteria killing between free-Ce6 and PF127-Ce6 under an albumin suspending medium. After the CX was added, the antimicrobial efficacy was also increased. In conclusion, the present findings have demonstrated that using an micelle as the carrier of Ce6, and the combination of PDI and CX, may promote the PDI efficiency when albumin was present.