

食物有害物質的快速生物檢測方法

Fast Biosensor for Detection of Harmful Substance in Food

快速、靈敏及成本低廉的篩選工具

A rapid, sensitive and low cost technology for food and drug screening

專利申請編號及國家：10/401,867 (美國), PCTON 2004000253 (國際專利合作條約)

特色與優點

- 「開啟式」螢光生物傳感器
- 靈敏：可檢測低至10 nM 溶於水中的青霉素G
- 快速，容易操作
- 只對 β -內酰胺抗生素及 β -內酰胺抑壓劑產生作用
- 可用作「高處理量」篩選：即可同時檢測多個樣本，從而減少人力物力
- 不需要昂貴的儀器
- 低成本

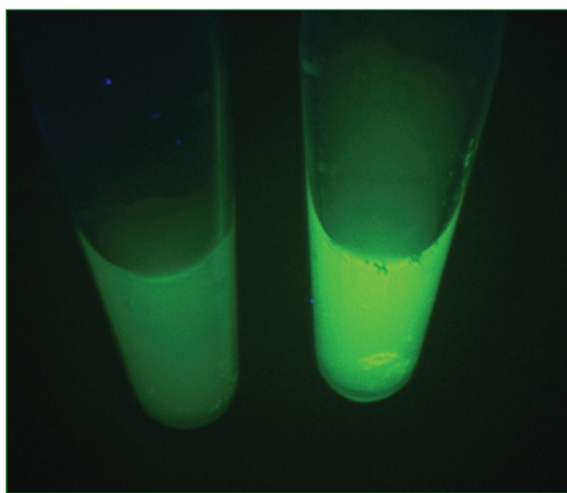
應用

- 檢測食物及環境中的 β -內酰胺抗生素
- 測試牛奶及牛肉製品中所含抗生素的份量能否通過美國食品及醫藥管理局的規定
- 檢測製造乳酪過程中抗生素的份量，過多的抗生素會抑壓細菌的成長及乳酪的生產
- 檢測血液中的 β -內酰胺抗生素
- 用作「高處理量」藥物篩選以尋找新的抑壓劑

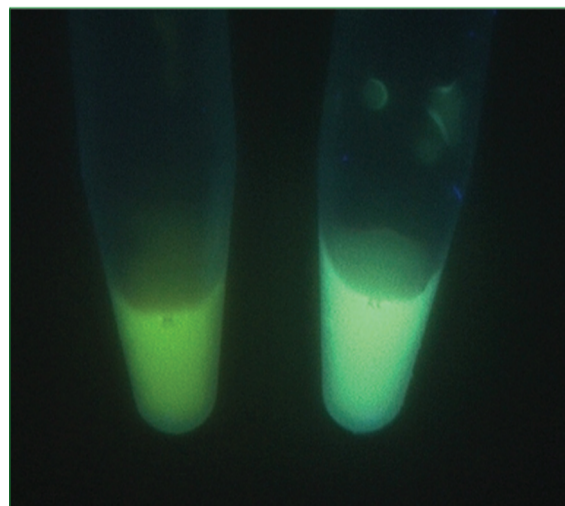
獎項

第五屆中國國際發明展覽會金獎 (2004年9月)

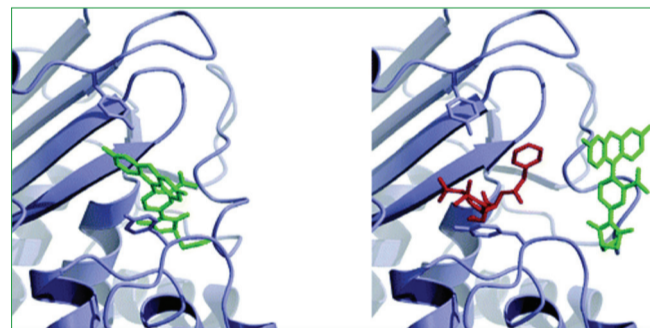
食物及環境中含有殘餘的 β -內酰胺抗生素(青霉素及頭孢菌素)的問題愈來愈受關注。對此，我們最近研發了一個可檢測 β -內酰胺抗生素的生物傳感器。它是利用由致病細菌分泌出來的 β -內酰胺酶而制成的。我們在酶靠近活性部分的一個可移動的環型圈上加插了一個螢光分子探測器。當酶接上了 β -內酰胺抗生素，環型圈便會移動，令探測器附近的環境改變，這改變令螢光分子的螢光變得更強。這個傳感器可探測低至毫微摩爾份量的 β -內酰胺抗生素。它更可用來篩選酶抑壓劑，從而作為藥物篩選工具。



標記了另外一個螢光分子 (Badan) 的生物傳感器。左：未有加入抗生素；右：加入了青霉素G；隨螢光增強外，螢光顏色更有明顯變化
Badan-labeled biosensor in water. Left: no antibiotics added; right: penicillin G added, which shows an increase in intensity



標記了螢光素的生物傳感器。左：未有加入抗生素；右：加入了青霉素G，螢光明顯增強
Fluorescein-labeled biosensor in water. Left: no antibiotics added; right: penicillin G added, which shows a prominent increase in fluorescence intensity



生物傳感器的份子模型。左：螢光分子(綠色)被酶份子包圍在內；右：青霉素G(紅色)的進入把螢光分子擠到外面。
Molecular model of our biosensor. Left: fluorescent molecule (green) inside the enzyme pocket; right: entering of penicillin G (red), which causes the fluorescent molecule to move out.

Patent Application No: 10/401,867 (USA), PCTON 2004000253 (Patent Cooperation Treaty)

Special Features and Advantages

- “turn-on” fluorescent biosensor
- sensitive: can detect antibiotic concentration as low as 10 nM in water
- rapid and easy to operate
- specific to b-lactam antibiotics and b-lactamase inhibitors
- can be adapted to “high-throughput” screening, i.e. detection of large number of samples at the same time, thus reducing time, cost and manpower
- no expensive machines are required
- low production cost

Applications

- Detection of b-lactam antibiotics in food and in the environment.
- To test whether milk or other dairy products are containing trace levels of antibiotics in order to meet the FDA requirement.
- To test the antibiotic level during the processes for making yogurt (thick fermented liquor made from milk). If the antibiotic level is too high, bacteria cannot grow and yogurt cannot be produced.
- To detect antibiotics in blood samples
- For high-throughput drug screening to discover new antibiotic components (enzyme inhibitors)

Award

Gold Award, the 5th China International Invention Expo (September 2004)

Concern about traces of beta-lactam antibiotics (e.g. penicillins and cephalosporins) in food and in the environment is spurring the search for simple, specific, sensitive, and rapid methods of detection. We have designed a biosensor for detecting antibiotics based on enzymes (beta-lactamases) secreted by pathogenic bacteria to destroy antibiotics. The biosensor works on the principle of gross conformational changes in the enzyme when it ‘sees’ antibiotic substrate. We attached an environment-sensitive fluorescent molecule to a flexible loop close to the enzyme’s active site. When the enzyme binds a beta-lactam antibiotic, the loop moves, changing the environment of the probe and causing the probe to fluoresce strongly. Our technology allows the fine-tuning of fluorescence color from the biosensor for different purposes. The sensor responds to beta-lactam antibiotics and beta-lactamase inhibitors. It can detect penicillin G at nanomolar levels. It can also be used for screening enzyme inhibitors and hence finds its application in drug screening.

Principal Investigator

Prof. K. Y. Wong

Department of Applied Biology & Chemical Technology

Contact Details

Institute for Entrepreneurship

Tel: (852) 3400 2929 Fax: (852) 2333 2410 Email: pdadmin@polyu.edu.hk