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NANO-BIOSENSORS AS NEW TOOL FOR DETECTION OF FOOD QUALITY AND SAFETY

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ABSTRACT. Nanosensors can be defined as sensors based on nanotechnology. The aim of some nanobiosensor projects at potentially high volume applications in the public health sector, as preventing food poisoning where markets might be significant, while the other aim to improve on existing clinical practises by allowing the more quantification and rapid detection of bacteria and viruses. It should increase the safety of the food for the customer.

Key words: nano-biosensor, food pathogen, nanotechnology, food safety, nano-technology, nano-sensory, microbiological quality, food.

INTRODUCTION

The water and food security and safety improvement security depends on the ability to identify, detect and trace water and food pathogens. Food borne viruses' outbreaks was Calicivirus, which include Norovirus. Other major food borne outbreaks causes were *Staphylococcus spp., Bacillus spp., Clostridium spp., Shigella* and pathogenic *E. coli*. [Palchetti, Mascini 2008].

In food analytical methods for pathogen detection must have the adaptability to detect different analytes, the specificity to distinguish between different bacteria, and the sensitivity to detect bacteria directly and on-line in real samples without preenrichment to meet users' expectations. To manufacture and design the device must also be inexpensive and simple. Biosensor technology is maintained to satisfy these requirements [Palchetti, Mascini 2008, Ozimek, Pospiech, Narine 2010].

In the recent years many workers are starting to combine nanotechnology with various biosensing techniques to develop the so-called "nano-biosensors". This strategy could be seen as the key to yielding devices, which demonstrate rapid responses combined with high sensitivities. Indeed, these trait have nearly become standard attributes of this technological combination and arise from the extremely high surface and small size nanostructures' areas as nanotubes, nanowires and nanoparticles. Mainly biosensors can be a thrilling alternative to the traditional methods for the detection of toxins and pathogens in food [Bogue 2008, Connolly 2008].

The aim of this paper was to check the possibility to use some nano-detectors for quick tests of microbiological pollution of the food. It would enable to introduce the easy method of the food control at the different point of the supply chain from the producer to the customer.

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DEVELOPMENTS ON BIOSENSOR

For food pathogen detection, over recent years a lot of effort has gone into the development and study of biosensors. The biosensor sensitivity depends on transducers properties and on the biorecognition element. In the near future the more specific ligands selection and the new electrochemical platforms development based on nanomaterials will give important benefits. Furthermore, emerging nanofabrication techniques will improve other important aspects as the biosensor integration into nanodevices, microdevices and sample treatment [Florescu at al 2007].

NANOBIOSENSOR SAMPLES ON FOOD

A nanoparticle based bioassay is developed by a research group which can rapidly detect *E. Coli* O157:H7 in food. This is one of the most dangerous food-borne diseases which highly infectious strain and also could be fatal, especially in elderly or the children. 60 nm-diametre silica nanoparticles are doped with fluorescent dye molecules and antibodies which react with antigens on the bacteria surface were then attached to the particles. Each of these nanoparticle contains thousands of dye molecules and nanoparticles are suitable to attach themselves to each bacterium. Then the fluorescent signal arising from the dye when the antibodies and antigens react is effectively amplified, allowing the bacterial concentration to be determined readily using fluorescence microscopy and spectro-fluorometric analysis. Figure.1 shows an *E. coli* bacterium and the fluorescence arising from a single bacterial cell. By adding different antibodies to the nanoparticles, the research group was able to detect other spores and bacteria, allowing the technique to check for the presence of multiple contaminants simultaneously [Bogue 2005].

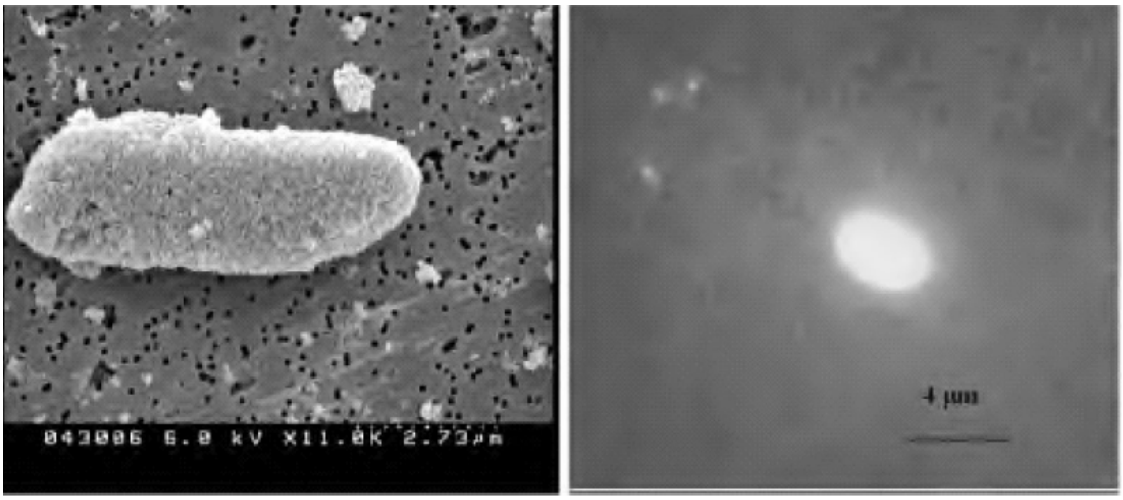

Fig. 1. Electron micrograph of an E. coli bacterium (left) and the fluorescence from a single bacterial cell following incubation with antibody conjugated nanoparticles (right) [Bogue 2005].
Rys. 1. Obraz mikroskopowy bakterii E.coli (z lewej) oraz fluorescencja pojedynczej komórki po inkubacji z udziałem nanocząsteczek antyciała (z prawej) [Bogue 2005].

To detect airborne bio-warfare agents, the need is to prevent mass poisoning through contamination of the food chain and also biosensor technologies under development to detect pathogens in food would play a role in homeland security. Devices that operate in the aqueous phase will be needed because of the requirement of ensuring a contaminant-free water supply. In a probable manner, the most demanding aspect of these requirements is the need to detect several different biological agents

simultaneously and the technological key is surely some form of generic sensing platform that may be modified to respond to each of the target species [Bogue 2005].

An integrated portable genetic analysis microsystem that include capillary electrophoretic (CE) and polymerase chain reaction (PCR) amplification analysis was also reported in another work. By amperometric method *E. coli* detection based on the integration of self-assembled monolayers (SAM), enzyme amplification, microelectromechanical systems (MEMS) and DNA hybridization was reported. This analysis was performed with a few microliters solution volumes in 40 min. 1.000 *E. coli* cells could be detected without polymerase chain reaction with high specificity for *E. Coli* vs. the bacteria *Bordetella bronchiseptica*. [Bogue 2008].

CONCLUSION

The food borne pathogens' identification and detection continue to lean on conventional culturing techniques. These are time-consuming, elaborate and should be completed in a microbiology laboratory and are consequently not suitable for on-site monitoring. The need for a more reliable, rapid, sensitive and specific method of a target analyte detecting, at low cost, is the focus of many research. Biosensor technology has the potential to increase sensitivity and specificity, speed up the detection, enable high-throughput analysis, and to be used for critical control points monitoring in food production.

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NANOBIOCZUJNIKI JAKO NOWE NARZĘDZIE DO OKREŚLANIA JAKOŚCI I BEZPIECZEŃSTWA ŻYWNOŚCI

STRESZCZENIE. Nanoczujniki można zdefiniować jako czujniki oparte na nanotechnologii. Niektóre nanoczujniki znajdują zastosowanie na duża skalę w sektorze służby zdrowia, w celu zapobiegania zatruciom pokarmowym, podczas gdy zastosowanie innych ma na celu poprawę istniejącej praktyki klinicznej poprzez umożliwienie dokładniejszego i szybszego wykrywania bakterii i wirusów. Zwiększenie bezpieczeństwa żywności oferowanej dla klienta powinno być priorytetowe.

Słowa kluczowe: nanobioczujniki, patogeny żywności, nanotechnologia, bezpieczeństwo żywności, nanotechnologii nanosensoryka, jakość mikrobiologiczna, żywność.

NANOSENSOREN ALS NEUES WERKZEUG ZUR BESTIMMUNG DER LEBENSMITTELSQUALITÄT UND LEBENSMITTELSICHERHEIT

ZUSAMMENFASSUNG. Einige Nanosensoren können im großen Maßstab im Gesundheitswesen verwendet werden, um eine Lebensmittelvergiftung zu verhindern, während die Verwendung von anderen Sensoren können zur Verbesserung der bestehenden klinischen Praxis anwendet werden, indem die mehr Quantifizierung und schnellen Nachweis von Bakterien und Viren verbessern. Die Sicherheit der angebotenen an den Kunden Lebensmittel sollte eine Priorität sein.

Codewörter: Nano-Biosensoren, Pathogenen in Lebensmitteln, Nanotechnologie, Lebensmittelsicherheit, Nanotechnologie, Nano-Sensorik, mikrobiologische Qualität, Lebensmitteln.

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