Portable biosensors for the rapid detection of food toxicants

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A chemical sensor is a device that transforms chemical information, ranging from the concentration of a specific sample component to total composition analysis, into an analytically useful signal. Chemical sensors usually contain two basic components connected in series: a chemical recognition element ("receptor") and a physicochemical transducer. The biological recognition system translates the chemical information (i.e., concentration of the analyte) into a chemical or physical output signal. The transducer (i.e., a physical detection system) serves to transfer the signal from the output domain of the recognition element to the electrical, optical, or

piezoelectric, etc. domain. A biosensor is a self-contained integrated device which is capable of providing specific quantitative analytical information using a biological recognition element (e.g., enzymes, antibodies, natural receptors, cells, etc.) which is retained in direct spatial contact with a transduction element.

Increases in food production and the ever-present threat of food contamination from microbiological and chemical sources have led the food industry and regulators to pursue methods of analysis to safeguard the health and safety of the consumer. Although sophisticated techniques such as chromatography and spectroscopy provide more accurate and conclusive results, screening tests allow a much higher throughput of samples at a lower cost and with less operator training, so larger numbers of samples can be analyzed with faster time of analysis and smaller error. Biosensors offer the unique opportunity to overcome these problems; however, biosensors are still at a laboratory testing stage and it is necessary to transfer a laboratory prototype to a scale up production and commercialization. This will have a large impact on both industry and students training. New companies will be launched and, hence, this can significantly contribute to the European Union's aspirations for wealth generation by the creation of small manufacturing enterprises (SMEs). Sensor Technology has been identified as a priority area across the globe and it is essential for European competitiveness to enhance our scientific prowess in this area and capitalize effectively upon it to realize real benefits and commercial products in this highly competitive international arena. New jobs will be created and this will therefore lead to new areas of students training and open routes for launching courses on how to train students in biosensor technology.

Biosensors clearly offer advantages in comparison to standard analytical methods, such as minimal sample preparation and handling, real time detection, rapid detection of the analytes of concern, use of non-skilled personnel, etc. Because of the importance of the ability of biosensors to be repeatedly calibrated, the term multiple-use biosensor is limited to devices suitable for monitoring both the increase and decrease of the analyte concentrations. Thus, single-use devices which cannot rapidly and reproducibly be regenerated should be named single-use biosensors,.etc.

The aim of this presentation is to bring into focus this important research area and advances of biosensors in food analysis and technology and more specifically to those related to the rapid detection of food toxicants. The scope is related to provide a comprehensive review of the research topics most pertinent to the advances of devices

that can be used for the rapid real-time detections of food toxicants such as microbes, pathogens, toxins, nervous gases such as botinilium toxin, *Escherichia coli*, *K. Pneumoniae*, sarin, VX, *Listeria monocytogenes, Salmonella*, marine biotoxins (such as palitoxins, spirolides, etc), staphylococcal enterotoxin B, saxitoxin, gonyautoxin (GTX5), francisella spore virus, *Bacillus subtilis*, ochratoxin and even simple chemical compounds. Biosensors have found a large number of applications in the area of food analysis. Recent advances include portable devices for the rapid detection of insecticides, pesticides, food hormones, toxins, carcinogenic compounds in environment, such as polycyclic biphenols, dioxins, PAHs, etc.