DNA and immuno based biosensors system for ultrasensitive, non-invasive and affordable detection of mycobacterium tuberculosis (TB)
A novel method for rapid detection of mycobacterium tuberculosis in urine

Summary

In Resource-constrained countries, affordable methodologies for the detection of disease biomarkers at ultralow concentrations can potentially improve the standard of living. However, current strategies for ultrasensitive detection often require sophisticated instruments that may not be available in laboratories with fewer resources. Here we propose a signal generation mechanism for biosensing that enables the detection of a few molecules of analyte with naked eye detection. The enzyme label of an enzyme-linked immunosorbent assay (ELISA) controls the growth of gold nanoparticles and generates coloured solutions with distinct tonality when the analyte is present.

Electrochemical transduction integrated with nano-based material has attracted much attention because of several important properties. The main advantage of this system is that it is an extremely sensitive sensor, capable of detecting subnanogram levels in real time without any specific label [11]. Moreover, electrochemical biosensor can detect trace amounts of specific analytes from complex fluids without or less sample preparation. Due to these advantages, electrochemical biosensor has emerged as a powerful tool that can greatly provide valuable information on biomedical and chemical analyses. Therefore in this study we proposed nanomaterial based electrochemical PNA biosensor for the determination of M. tuberculosis by using simple non-invasive technique (salivary and urinary sample). Nanomaterial used in this work will be nanographene and quantum dots. PNA will be used as probes for hybridization detection with complementary target of M. tuberculosis of genomic DNA in clinical samples.

Nanosensor for early detection of GanodermaBoninense and soil quality for control of the related disease
A novel method for rapid detection of GanodermaBoninense, oil palm pathogen

Summary

G. boninense causes both basal stem rot (BSR)and upper stem rot (USR) andremains South East Asia's most devastating oil palm diseases with direct loss of the stand,reduced yield of diseased palms and the resultant requirement for earlier replanting. Although it has been clearly identified as the main cause of the disease in oil palms, strategies for the early detection and control of G. boninense are still immature.

We will focus on study of specific markers for detection of G. boninense based on secondarymetabolites, elicitors and protein express upon infection. Phytoalexins are antifungalsecondary metabolites which serve as early defense mechanism by plants upon fungalattack. It is only produced by plants during interaction with fungal pathogen where rapidaccumulation of these compounds occurs at the site of infection to prevent further spread.Several secondary metabolites including alkaloids and phytosterols as potential phytoalexinshave been identified from our earlier research on metabolites produced at early stage of oilpalm-G. boninense interaction before occurence of disease symptoms. The most recentreport

showed production of phytoalexins in systemic tissue away from the site of pathogeninfection possibly in response to signalling molecules such as reactive oxygen speciesproduced by plants upon fungal invasion. Here we propose to develop an early detection ofG. boninense infection of oil palm through application of nano biosensor based on phytoalexinproduction by oil palm. The nano biosensor can either directly detect the volatile phytoalexinmolecules or indirectly using antibody that bind specifically to key enzymes involved in thebiosynthesis of the phytoalexins.

Multifunctional nanofluidic biochip for dengue detection utilizing silicon nanostructure
A novel method for rapid detection dengue

Summary

There is an urgent need to develop rapid, simple, cost-effective medical devices for screening medical diseases for example dengue for early medical diagnosis. Such a system will also be useful in physician offices or for personal use at home. Initial Dengue virus infection symptoms are very similar to those of influenza, measles, malaria, typhus, yellow fever, and other virus infections, which make the diagnosis based on presenting symptoms problematic. ELISA assays for the detection of IgG and IgM antibodies to Dengue virus are available but unfortunately they are compromised by cross-reactivity with other flaviviruses and require at least 5 days post infection to mount a sufficient immune response to produce detectable antibodies in a patient. This might be too late for patients with severe dengue infection as complication e.g. bleeding tendency and plasma leakage occur at the same time.

Thus we are proposing the development of a molecular assay method based on DNA for the detection of dengue virus. This will be combined with lateral flow technology (nanofluidic) incorporating the use of nanomaterial for signal amplification to develop a point of care (POC) biosensor which will enable the early and highly accurate detection of the virus. The product will also have the added advantage of short operation time and labor-free processing.

Development of prototype for metal ion sensor exploiting peptides and ionophore as recognition element
A novel method for rapid detection of toxic metals

Summary

The development of practical sensors for the detection and quantification of metal ions in environmental samples is the subject of considerable research. Single sensor that really can differentiate multiple metal ions are very scarce in the market. Majority of the sensors developed is either qualitative or semiquantitative with very limited detection limit.

We have demonstrated that combinatorial preparative method can be used to synthesize peptides having the desired number of amino acids and in the preprogrammed sequence. We have reported that with careful choice of amino acids and the right combinations, the peptides show very high selectivity towards heavy metals such as cadmium, copper, mercury, lead and arsenic. Our main interest in developing peptide functionalized nanosensors has been for detection of trace-level heavy metals in sources of fresh water such as rivers, lakes and ground water.

Folic acid-conjugated chitosan-based quantum dot system for multiple application sites of cancer cell imaging and therapy
A novel method for detection of cancer

Summary

Researchers globallyexpended time and resources to explore the knowledge towards ending the threat of cancerous diseases by researching novel approaches that will simplify clinical examination and treatment processes by the use of rapid and sensitive methods. The introduction of site specific and sensitive tools will contribute for early diagnosisof tumors and also supports toselectivelycure cancer cellsfor targeteddrug delivery with no adverse consequences to healthy neighboring tissues.

An integrated nanotherapeutic system which can diagnose, deliver targeted therapy and further monitor the response to therapy and disease statushas been the subject of interest in clinical oncology. This can be achieved by taking advantageof transforming the unique physicochemical properties of nanoparticles (NPs) to assume multiple functionalities that suet both as diagnostic and therapeutic functions simultaneously.In this way, the development of multifunctional NPscan expand the scope and expectations of research in nanomedicine which leads to a) an early diagnosis and enabling personalized in-time disease management, b) aggregating different functionalities of nanomaterials to form single stable nanoplatforms capable of specific targeting the diseased cells, and c) achievement of cargo delivery functions with simultaneous cell imaging. In that view, we hypothesized that the application of FA-conjugated chitosan-loaded quantum dot system can solve the issues associated with the diagnosis-based cancer therapy approach. For the purpose of this research we shall briefly discus the role played by FA as targeting agent, quantum dots specifically Zn:Mn quantum dots in imaging and chitosan serving as vehicle for anticancer drug delivery.

Study on Novel and Practical Fruit Grading and Oil Quality Monitoring Technology in Palm Oil Mills
A novel method for detection of free fatty acid in crude palm oil

Summary

Palm oil is most-consumed vegetable oil in the world among all vegetable oils, accounting for about 33% of total vegetable oil production (2011/2012, USDA Foreign Agricultural Service). Among different palm oil producing countries, Malaysia is the second largest producer of palm oil, producing up to 18,400 thousand metric tons with an export of nearly 86% (2011/2012, USDA Foreign Agricultural Service). The palm oil industry contributes significantly to the economy of Malaysia, which has more than two-third of its agricultural land (4.05 million hectares) under oil palm tree plantation. There is a constant demand for the production of high quality palm oil with lower production costs. The maturity or ripeness of the oil palm fruits dictates the quality of palm oil produced and overall marketability. One of the challenges in processing of fruits during oil production is the grading of oil palm fresh fruit bunches (FFBs) for their maturity. The conventional method involves manual detection of FFB maturity or counting of number of loosened fruits per bunch. The manual sorting of oil palm fresh fruit bunches is a time-consuming, labor-intensive process resulting in bias and human error, which drastically affects the growers'

profitability. Therefore, there is a need for a reliable, rapid, and accurate sensing technique for the detection of oil palm FFB maturity.

This project shall focus on the development of automated grading system based on microwave and optical technique for the determination of the quality of oil palm fruits and bunches at the mills. For microwave technique, the grading system shall be based on the relationship between actual oil content, moisture content and microwave reflection coefficient. The project shall involve both theoretical and experimental works. As for the optical technique, Near Infrared (NIR) and Visible spectra will be utilized for the detection system. The second part of the project will be a study on Free Fatty Acid (FFA) monitoring in FFB and extracted oil. Quality of palm oil is determined by various factors and free fatty acid (FFA) is one of the most frequently determined quality indices during production, storage and marketing (price dictated by FFA content). Currently FFA is determined by manual titration of the sample against potassium hydroxide in hot 2-propanol solution, using phenolphthalein as indicator. The method, however, uses large amounts of organic solvents and involves manual operation. Therefore alternative cheaper, greener and practical method is required for FFA monitoring. For monitoring of FFA in extracted oil, we proposed to study utilization of enzymatic reaction via flow analysis for real time detection of FFA in extracted oil.