ELISA APPLICATIONS

FOOD INDUSTRY

ELISA plays a major role in the food industry. It is the main platform for identifying food allergens such as those present in milk, peanuts, walnuts, almonds, and eggs. Peng et al. developed a monoclonal antibody based sandwich ELISA for the detection of ovalbumin in food, which is the most frequent cause of food allergy, especially in children. ELISA can also be employed to corroborate the authenticity of the food products. This technique is of great help to avoid possible economic losses caused by fraudulent substitution. In the case of meat and meat-based products, ELISA has proven to be a reliable technique that provides careful monitoring of the product, especially when religious considerations impact the choice of food.

ELISA is also an essential technique for quality control of fish, milk (as well as their sub products), genetically modified foods, irradiated foods, or other harmful food components that can be transferred to human, such as bovine spongiform encephalopathy. Non-meat proteins such as soybean have valuable nutritional properties. Nonetheless, due to the similarity to the meat product, they are seldom added to the meat products undeclared. Careful monitoring of the products with ELISA prevents such adulteration. Unethical competitions for higher economic gain often lead to the potential health hazard through the consumed food and beverage. Production of ELISA kits for food industry applications is challenging as a selection of adequate control and standard samples are necessary to carefully calibrate the assay.

PREGNANCY TESTS

A number of different biomolecular entities including human chorionic gonadotropin (hCG), luteinizing hormone (LH), follicle stimulating hormone (FSH), estriol (E3), and thyrotrophin-stimulating hormone (TSH), which can be expressed due to the pregnancy. ELISA can detect some of these proteins from the maternal blood, saliva, or urine at the early stages of the pregnancy. HCG is one of the common hormones that can be detected by ELISA during the first month after fertilization. Another biomolecule associated with pregnancy is estriol that can be detected with ELISA in the saliva at the 6th week of pregnancy. Specific ELISA pregnancy tests were developed for animals as well.

ELISA can also be used as a reliable method for measuring congenital infections such as HIV or toxicoplasmosis during the pregnancy. To maximize detection sensitivity and accuracy for identifying pregnancy complications in the early stages, marker panels were developed, which are capable of monitoring/measuring multiple markers in the samples. The target biomolecules include activin A, inhibin A, progesterone, A disintegrin and metalloprotease-12, pregnancy-associated plasma protein, pregnancy specific B1-glycoprotein, placental-like growth factor, vascular endothelial growth factor, glycodelin, and human corionic gonadotropin, among others.

CANCER DETECTION

Highly sensitive detection of cancer provides early stage diagnostic, which is crucial for patient survival. Cancer biomarkers, however, are some of the most challenging biomolecular entities as target analytes. Advancements of ELISA technique have promising applications in detection of cancer biomarkers. In this technique, plasma spiked with carcinoembryonic antigen were used as the representative biomarker, proving that a straightforward and cost-effective GNPL-based sandwich ELISA holds a clinical relevance.

Sometimes the tested specimens are hard to be obtained. Therefore, even a small sample volume is highly valuable. For instance, in the case of ovarian cancer, the glycoprotein CA-125 present in the serum is the appropriate choice of biomarker for timely detection. Scholler et al. developed a cost-effective ELISA-based platform for CA-125 detection that requires a few microliters of serum. This microsphere-integrated sandwich assay incorporates CA-125 with other markers and uses the immobilized antibodies on the surface of the spheres to capture the target proteins. This platform has proven to be comparable to the commercially available detection techniques, while requiring only 15 ul of sample.

DETECTION OF INFECTIOUS DISEASES

To date, ELISA-based infectious disease serology marks one of the most reliable means for accurate diagnosis and prognosis. There is a broad range of developed and marketed state-of-the-art assays for the detection of infectious agents. ELISA has offered a high-throughput detection in three classes of infectious diseases:

1. Sexually Transmitted Diseases (STDs) is a class of infectious diseases that has targeted young people and adults in many countries. A number of different ELISA platforms were designed and commercialized for sensitive and selective detection of STDs including HIV, hepatitis, syphilis, chlamydia.

2. Many regional or endemic diseases are wide-spread, particularly in tropical and subtropical regions. They might appear to be mild/symptomless with serious and chronic consequences. Dengue, Chagas, Borreliosis, and Yellow Fever are some of the examples of this class of fatal diseases, among others. While existing techniques lack timely detection of such illnesses, advances in ELISA platforms have shown great promises in offering early and effective diagnosis.

3. TORCH refers to Toxoplasma, “Other infections”, Rubella, Cytomegalovirus, and Herpes simplex, which is a group of viral pathogens that may result in prenatal infections. This class of infectious diseases can be a potential threat to the unborn child. Illnesses such as Syphilis, Hepatitis B, Epstein - Barr virus, Varicella-Zoster virus, and HIV fall under the category of “Other infections” that might also result in serious consequences for the fetus. Commercialized ELISA platforms successfully detect these infectious agents in current clinical practice.

TOXICOLOGY

Toxicology involves studying the adverse effects of chemical compounds on living organisms. This area covers diagnosis and curing the effects of toxins (antigenic agents from plant or animal origins) as well as toxicants (toxic substances released into the environment). The correlation between the dosage of the toxic materials and its effects on the exposed organism, routes of exposure, origins of the toxic substances and characteristics of the affected organs are major considerations in toxicology studies. Direct ELISA has been employed for regular screening of drugs such as amphetamine and methamphetamine in biological fluids. Obtained data indicated that the direct ELISA technique was rapid and reliable for the presumptive screening of amphetamine and methamphetamine in forensic samples.

DRUG MONITORING AND THE PHARMACEUTICAL INDUSTRY

ELISA techniques have also been found to have a variety of applications in screening certain classes of drugs in plasma. The conventional therapeutic drug monitoring (TDM) strategies monitor drug levels in plasma samples. TDM also provides information regarding the treatment procedure allowing physicians to examine if the medication is present in a patient's body. However, the conventional TDM technique is expensive and technically demanding. ELISA is a cost-effective method for measuring the concentrations of the drugs in plasma samples.

TRANSPLANTATION

When transplantation is required, the pre-transplant cross-matching test represents one of the most important steps for a successful relocation of the organ. Complement-dependent cytotoxicity cross-match (CDC-CM) assays were developed almost four decades ago to assess the compatibility of the given organ with the body of the recipient. Selecting recipients without donor-specific antibodies is of crucial importance to increase the survival rate in the patients who are subject to the transplantation. In particular, CDC-CM plays a vital role for recipients who undergo treatments with special drugs/therapeutic antibodies or suffer from autoimmune diseases.

The CDC-CM test, however, requires lymphocytes isolation from the donors, which typically have a limited availability. ELISA-based cross-matching tests have been demonstrated to be an adequate substitute procedure for such analysis. Schlaf et al. reported an ELISA-based cross-matching approach for identifying donor-specific anti-human leukocyte antibodies by using deep-frozen blood or spleen detergent lysate from a deceased donor. This strategy permits the cross-matching comparison to be frequently performed between the recipients' anti-HLA antibodies and the donors' historically identified HLA types to monitor any incompatibility between the examined samples.