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Commentary

Protein Microarray: A High-Throughput Method to Track the Interactions and Activities of Proteins

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DESCRIPTION

A protein microarray is a high-throughput technique for tracking proteins' interactions and activities, as well as identifying their function on a wide scale. Its primary benefit is that it can track a huge number of proteins at the same time. The chip is made up of an array of capture proteins attached to a support surface such as a glass slide, nitrocellulose membrane, bead, or microtitre plate. Probe molecules are introduced to the array, which are usually tagged with a fluorescent dye. A laser scanner reads a fluorescent signal produced by any reaction between the probe and the immobilised protein. Protein microarrays are quick, automated, cost-effective, and sensitive, using only a minimal amount of samples and reagents. In 1983, a scientific paper and a series of patents first described and showed the concept and technology of protein microarrays in antibody microarrays. Because it is based on the technology established for DNA microarrays, which have become the most frequently used microarrays, the high-throughput technology behind the protein microarray was relatively straightforward to build. Due to the constraints of utilising DNA microarrays to determine gene expression levels in proteomics, protein microarrays were created. The amount of mRNA in a cell does not always correspond to the expression levels of the proteins it codes for. Because protein, rather than mRNA, is generally the functional component of cell response, a new method was required. Furthermore, DNA microarrays do not show post-translational modifications, which are typically important for determining protein function.

Functional protein microarrays

Functional protein microarrays are made by immobilising large quantities of pure proteins and are used to detect and demonstrate antibody specificity, as well as to discover protein–protein, protein–DNA, protein–RNA, protein–phospholipid, and protein–small-molecule interactions. Functional protein arrays differ from analytical arrays in that they are made up of arrays that include full-length functional proteins or protein domains. In a single experiment, these protein chips are utilised to investigate the biochemical activities of the whole proteome. The arrayed proteins must preserve their original structure in order for meaningful functional interactions to occur on the array surface in any functional protein microarray-based test. The benefits of using an affinity tag to regulate the precise manner of surface attachment include that the immobilised proteins will have a uniform orientation, resulting in more specific activity and a higher signal-to-noise ratio in experiments, with less interference from non-specific interactions.

Detection

Methods for detecting protein arrays must have a strong signal and a low background. Fluorescence labelling is the most popular and extensively used technique for detection since it is extremely sensitive, safe, and compatible with widely accessible microarray laser scanners. Affinity, photochemical, or radioisotope tags are examples of other labels that can be employed. These labels are applied to the probe and can disrupt the response between the probe and the target protein. Surface plasmon resonance, carbon nanotubes, carbon nanowire sensors, and micro-electromechanical system cantilevers are just a few of the label-free detection technologies accessible. All of these label-free detection techniques are still in their early stages and are not currently appropriate for high-throughput protein interaction detection; nevertheless, they show great potential in the future. Near-IR fluorescence detection can be used to quantify proteins on nitrocellulose-coated glass slides. This reduces interferences caused by the nitrocellulose's auto-fluorescence at the UV wavelengths utilised in typical fluorescent detection probes. The detection of antigens and antibodies in blood samples; the profiling of sera to identify novel disease biomarkers; the monitoring of disease states and responses to therapy in personalised medicine; and the monitoring of the environment and diet are all examples of diagnostics. The use of protein microarray for diagnostic purposes is demonstrated via a digital bioassay.

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