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Overview of Proteomics

The term “proteome” was originally coined by an Australian scientist, Mark Wilkins (1995), to describe the "PROTEin complement of the genOME". The term "proteomics" is used to describe any and all of the collection of high throughput techniques that have emerged to enable scientists to analyze all the proteins expressed under a certain set of conditions within an individual cell or organism.

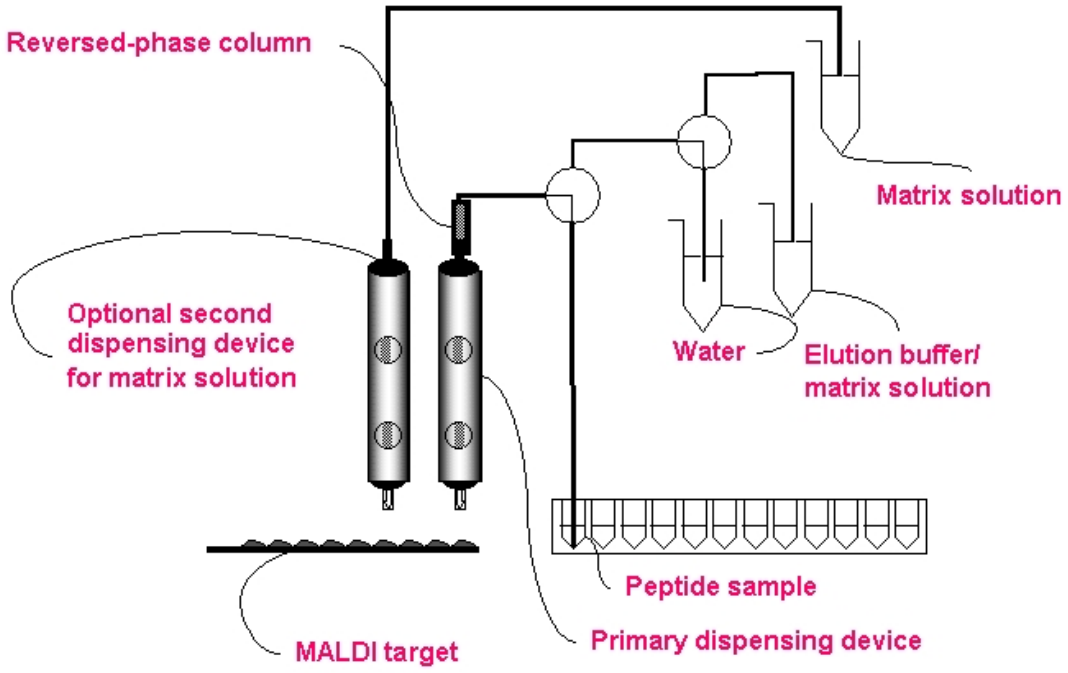
Proteomics involves the systematic separation, identification and characterization of the proteins present in a tissue or other biological sample. By comparing the proteins in samples from individuals affected by a particular disease with those present in samples from healthy individuals, it is possible to identify directly those proteins that are potentially related to that disease. These proteins may have commercial potential as targets for the development of drugs or as a basis for the development of diagnostics.

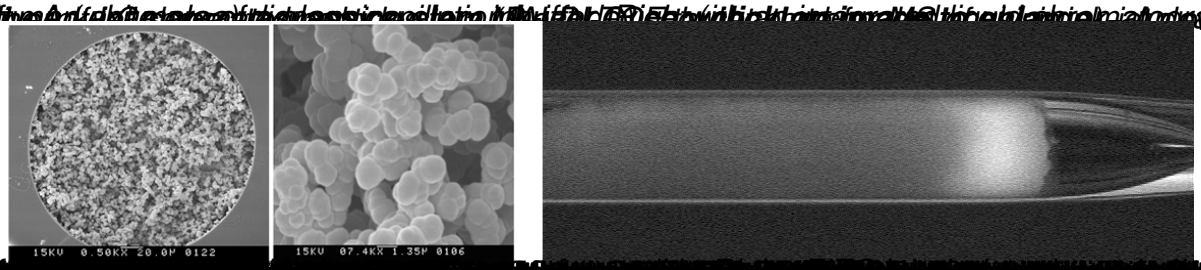
Although, the pattern of gene activity can be abnormal when a tissue is diseased, there is often a poor correlation between the level of activity of different genes and the relative abundance within the tissue of the corresponding proteins. Consequently, the information about a disease process that can be derived from analysis at the level of gene activity is limited. Moreover, since post-translational modifications are not directly encoded, knowing a gene sequence does not determine the complete structure of individual proteins encoded by that gene.

The analysis of proteins in tissues can be a laborious exercise in marked contrast with the sequence analysis of genes, which for several years has been a rapid automated process. For many years this meant that proteins were studied indirectly through their gene sequences. Proteomics has emerged as a field in which technology is being developed to enable proteins to be analyzed in a high throughput, automated way similar to how genes are being studied. This advance will have major implications for the understanding, diagnosis and treatment of disease and cancer including pharmaceutical research and development.

Ink-jet Chromatography

MicroFab Technologies has been awarded a NIH Phase II Small Business Innovative Research grant award for the development of a system to deliver microvolumes (0.1 to 100nL) of proteolysed peptides separated by liquid chromatography onto MALDI-TOF MS targets for mass spec analysis. Under this grant Microfab has developed an ink-jet microdispensing printhead having integrated liquid chromatographic capability. The piezoelectric liquid microdispenser having an integrated liquid chromatography (LC) column is for the purpose of separating and dispensing proteolysed peptides onto MALDI-TOF MS target plates for subsequent mass spec analysis. The figure below displays a magnified view of an ink-jet microdispensing with an integrated column producing drops of the eluted solution.

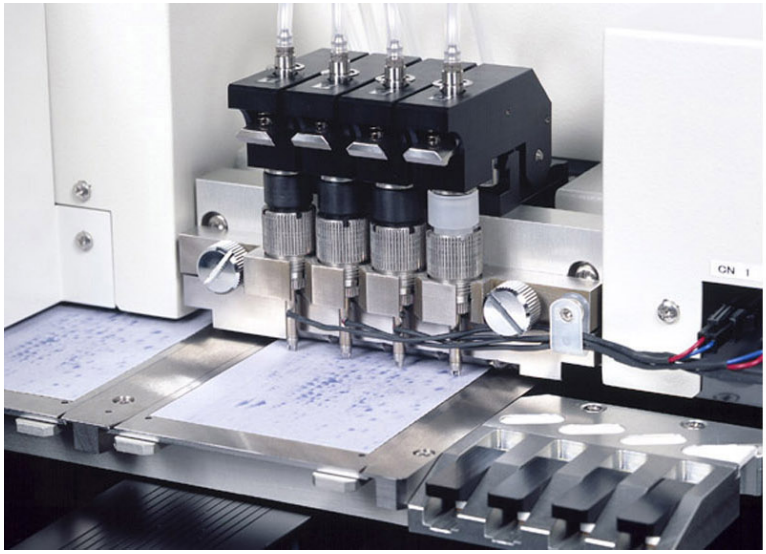




click here for spectra

Protein Analysis using the Chemical Ink-Jet Printer

The Chemical Ink-Jet Printer (ChIP) is the result of collaborative efforts between Proteome Systems, Ltd., (http://www.proteomesystems.com), MicroFab Technologies, Inc., and Shimadzu Biotech (http://www.shimadzu-biotech.net). These efforts have lead to the development of an instrument that delivers picoliter to nanoliter volumes of reagents or biochemicals to 2D-Page protein arrays that have been transferred to a PVDF membrane (see figure below). In essence this technology is a combination of a protein chip with 2 dimensional electrophoresis. The Chemical Ink-Jet printer utilizes piezoelectric drop-on-demand ink jet technology to deliver the small volumes of reagents and/or biofluids. It is possible to use this technology to perform *in situ* proteinase digests of selected membrane bound proteins with subsequent MALDI-TOF MS analysis directly from the membrane surface. Thus, the liquid handling steps associated with in gel digestion procedures are avoided. Additionally, it is possible to archive the sample retained on the protein blot for future interrogation.



Left - Close-up of the 4 ink jet device printhead positioned over a PVDF membrane during printing. Right - The Chemical Ink-jet Printer instrument [Images courtesy of Proteome Systems Ltd. and Shimadzu Biotech].

Additional Information (PDF)

Shimadzu Biotech brochure describing the Chemical Ink-Jet Printer.