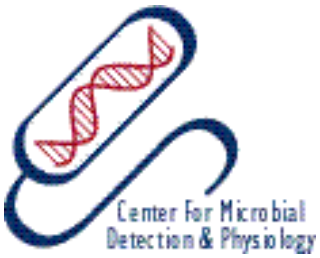
TECHNOLOGY FOR RAPID MICROBE DETECTION



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The Center for Microbe Detection & Physiology at Utah State University develops and commercializes rapid detection methods for microbes. The primary focus of the group is bacterial detection, but other targets are also investigated. To date, four technologies are under development: ImmunoFlow, ImmunoDNA, GlycoBind, and TissueTag.

Each technology has a unique use and application, but are not limited to a single type of use. For example, ImmunoFlow has many fields of use ranging from water to air, and has the potential to detect many types of bacteria. Initial prototypes are available for BG spores and *E. coli* O157 cells.

Each type of assay has a maximum detection time of 30 minutes with a sensitivity of < 10 cells. A unique feature of each technology is that it is volume independent, because they were developed with large samples in mind. Hence, both large (tens of liters) and small (1 to 100 milliliters) samples are commonly used. Each technology is at a different stage of development with ImmunoFlow being the most developed and TissueTag being the least.

Comparison of technology available from CMDP.

Technique	Use	Target	Speed	Sensitivity
ImmunoFlow	· Fluids, solids, air	· Organism specific	≤30 minutes	≤10 cells
ImmunoDNA	· Fluids, solids, air	· Organism specific	≤30 minutes	≤10 cells
GlycoBind	· Fluids, solids, air · Rapid detection of a pathogenic organism	· General for organism · specific for infected tissue	≤30 minutes	≤10 cells
TissueTag	· Fluids and Air · Rapid detection of a infectious organisms	· General for organism · Specific for infected tissue · Specific for invasive organisms or toxins	≤30 minutes	To be determined
Conventional	Fluids and solids	General	hours to days	Variable

Contact CMDP for more information

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ImmunoFlow

Two prototypes of this technology are available – large scale that will handle many liters of sample and small scale that will use a few milliliters. This technology is a patented use of fluidized beds to exploit high flow rate capture of targets from fluids, and soon air. An automated version of this technology is in development with a joint venture between CMDP and a commercial partner. Detection of specific organisms, such as *E. coli* O157 or *Bacillus anthracis* spores are good examples for use of this technology.

Advantages

Large or small samples –
Use of the fluid bed format allows capture and concentration of targets from large or small samples.

No clogging –
This allows use of dirty samples that contain large particulates that clog conventional filter techniques.

Specific –
The test can be made to be very specific for detection target organisms

Fast –
The total time from loading the sample to signal detection is ≤ 30 minutes.

Sensitive –
Detection limits are <10 cells or spores for each organism. This is volume independent because the sample size is variable. Use of 50 mL or 50 L is of equal difficulty.

Portable –
A portable test is available for use in the field.

Automated –
An automated version of this technology is under development. The field user will be able to use this test with little to no scientific training.

Disadvantages

The user must know the target before use of this test. Modifications can be made to group specific microbes if needed.

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ImmunoDNA

Development of ImmunoDNA capture and detection was aimed at reducing background and improving the flexibility of target specific detection. This format is available for use with PCR or chip–type technologies for detection of protein–type targets that do not contain DNA. In addition to detection of specific organisms, forensics is an excellent example of a use for this technology.

This technique is a unique combination of DNA fragments and antibodies that allow a two–step binding event to occur that holds the target in place with higher affinity that either binding event alone. With this approach, the target is labeled in the liquid phase and captured onto a solid phase for subsequent detection.

Advantages

Specific –
The test is very specific for detection target organisms

Fast –
The total time from loading the sample to signal detection is ≤ 30 minutes.

Sensitive –
Detection limits are <10 cells or spores for each organism.

Capture DNA –
Use of this technique allows capture and detection of specific DNA fragments from a complex sample matrix.

Solution phase recognition –
By "labeling" the target in solution the unusual chemistry due to surface interactions are avoided with the antibody.

Disadvantages

The user must know the target before use of this test. Modifications can be made to group specific microbes if needed.

GlycoBind

While detection of specific targets is useful, there are uses that are better served by a test that detects pathogenic or disease–causing organisms irrespective of their identity. Subsequent testing for identification and verification will determine this information. The intent of this technology is to give field people a fast method to determine if immediate action is needed to prevent or contain subsequent spread of pathogenic organisms. Determination of pathogen content of unknown powders or liquids is a good example of this technology.

The aim of this technology is to use host receptors that mimic pathogen attachment on to the cell. With these molecules attached to solid surfaces the target is captured onto a solid phase and subsequently detected in a variety of different formats depending on the amount of information needed on location. The specificity is adjusted by use of a secondary reagent.

Advantages

Large or small samples –
Use of the fluid bed format allows capture and concentration of targets from large or small samples.

No clogging –
This allows use of dirty samples that contain large particulates that clog conventional filter techniques.

Specific –
The test can be made to be very specific for detection target organisms or very general for classes of organisms. It also has the ability to be refined to determine which tissue the suspect target will infect. As need arises this attribute will be expanded and exploited for a commercial instrument.

Fast –
The total time from loading the sample to signal detection is ≤ 30 minutes.

Sensitive –
Detection limits are <10 cells or spores for each organism. This is volume independent because the sample size is variable. Use of 50 mL or 50 L is of equal difficulty.

Portable –
A portable test is available for use in the field.

Automated –
An automated version of this technology is under development. The field user will be able to use this test with little to no scientific training.

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TissueTag

This technology is the most complex biologically and has the potential to be the most useful. The aim of this technology is determine the amount and content of viable invasive agents the sample in question. Covalent attachment of units containing membrane associated infection mimetic molecules allows detection of targets only if they are invasive and subsequent disease results. Detection of bioengineered bacteria is an excellent example of this technology as well as detection of a small number of viable targets in a mixture of largely dead targets. The sensor generates a signal only if the target is infectious.

Advantages

Specific –
The detection is specific for viable infectious agents.

Fast –
The total time from loading the sample to signal detection is ≤ 30 minutes.

Sensitive –
Detection limit for each organism needs to be determined.

Bioengineered organism detection –
All organisms must "communicate" with the host cell to cause disease, indicating a sensor that exploits this interaction will allow detection of bioengineered organisms. Even bioengineering of benign organisms must use these communication mechanisms to cause disease.