

# Rapid and Efficient Biological Sample Preparation and Concentration for use with Small Volume Liquid Analytical Systems

## InnovaPrep: The Macro-to-Micro Interface



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# InnovaPrep

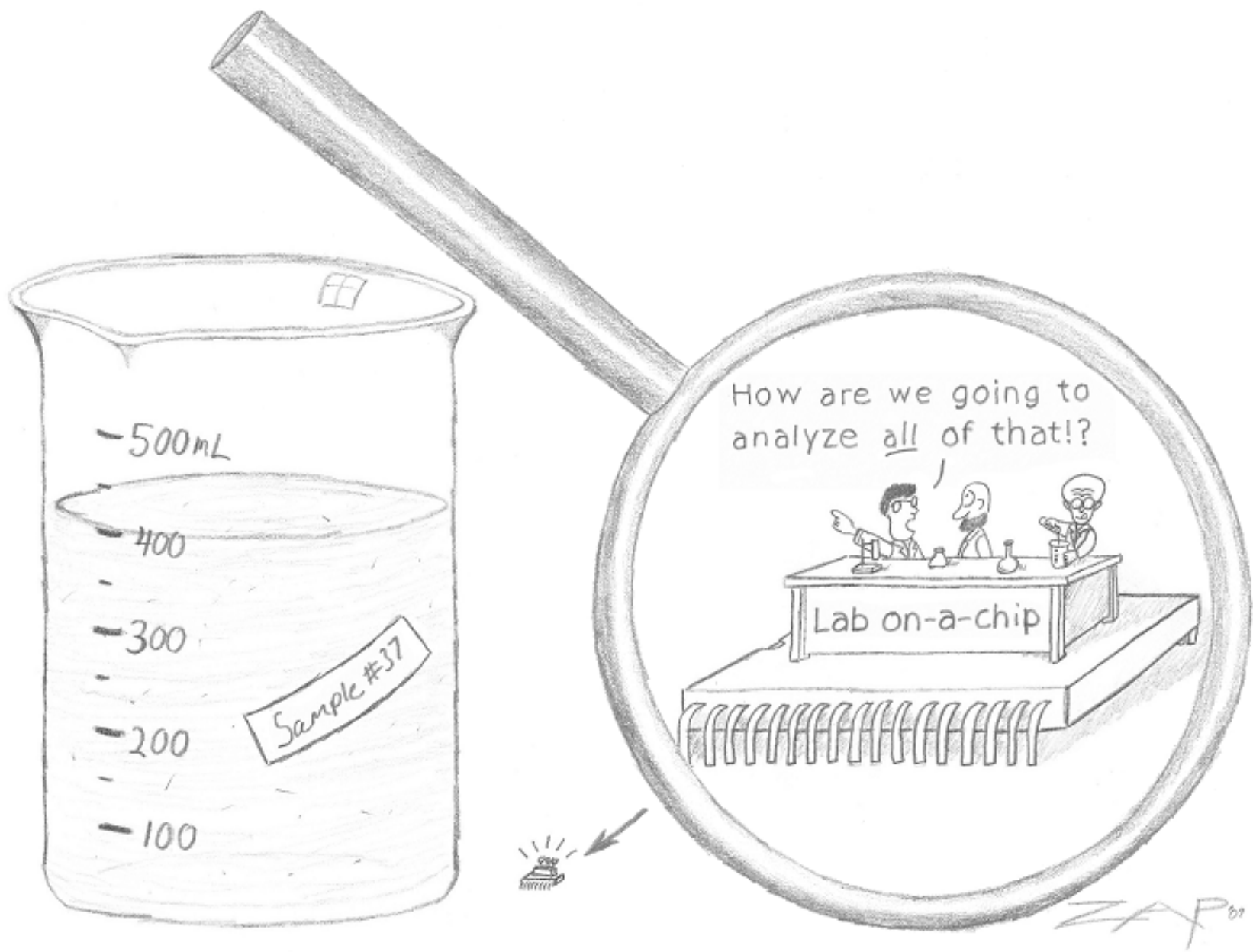
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- Not a Detector, but can make them better
- The problem – real world sized samples
- The solution – make the sample smaller
- Applications and advantages to this
- Concentrating Bg samples collected from surfaces into a liquid
- Concentrating Ba samples collected from surfaces into a liquid
- Differences and opportunities

# Situation

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**The best detectors are automated, fast, and sensitive, but they analyze extremely small volumes.**



# Problem



# Solution



# Problem



Detecting a small number of particles in a liquid is very difficult.

# Solution



Concentrate the particles into a small volume.

# Concentration Technologies

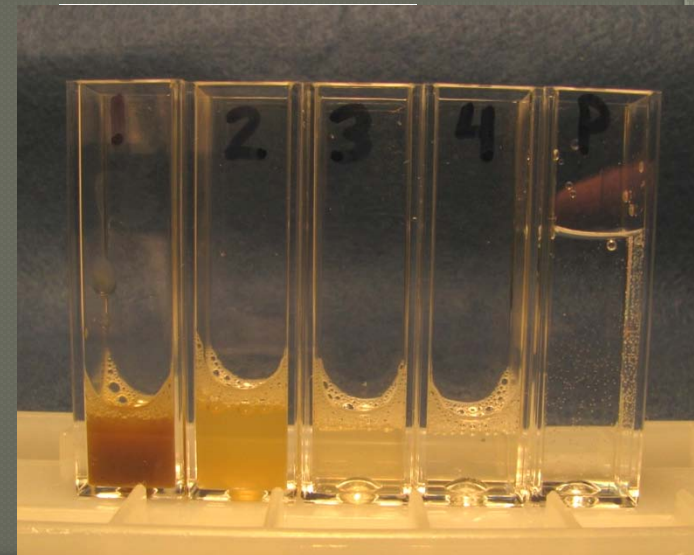
## Long Standing Technologies

- Growth (enrichment)
- Growth (filter/plate)
- Centrifugation



## Newer Technologies

- Microfluidic concentrators
- Flat membrane concentrators
- Hollow fiber concentrators



# INNOVAPREP

- Liquid-to-liquid hydrosol concentrator

- Fast
- Automated & easily integrated
- Smallest elution volumes
- Highest efficiencies
- Smallest particle sizes
- Separation & concentration



Pat. Pend.



# Application

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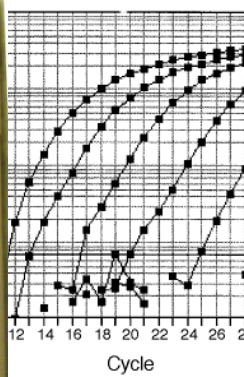
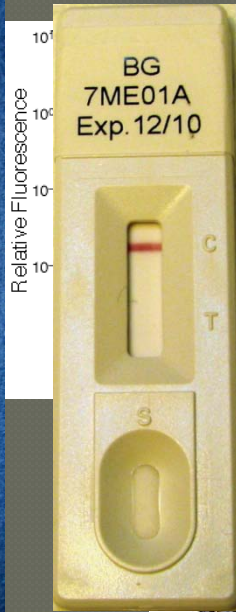
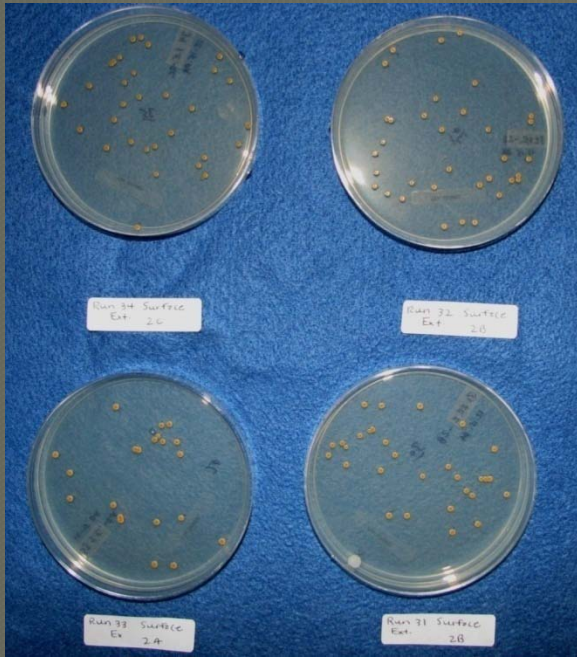
- Concentrate biological particles present in liquids
  - “Particles” are from 10 nm to several microns in physical diameter
  - Proteins, DNA, viruses, bacteria
  - Present in aqueous solutions
- Soluble materials are removed from the sample
  - Salts, metal ions, organic chemicals, excess surfactants or inappropriate buffers

# Fields of Use

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- Aerosol collector concentrator samples
- Field samples
- Process samples
- Diagnostics
- Bio Forensics
- Anywhere that biological detection can be enhanced by concentrating samples to match the volume needed for analysis

# Lab R & D





# Application to CRP LFIs



JPEO-CBD Critical Reagents Program  
Aberdeen Proving Ground, MD  
410.436.8713

- Concentration factors of Two to Three orders of magnitude were demonstrated for Bg spores in liquid
- Samples concentrated to 100 microliters for LFIs

Sponsor: U.S. Army Research Laboratory

# Simulant Testing

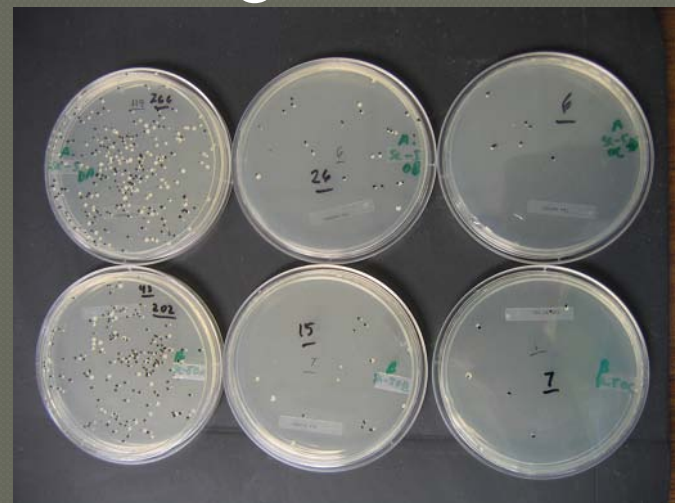
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- ◉ Bg directly spiked into a liquid
- ◉ Bg aerosols collected and transferred into a liquid
- ◉ Bg spiked onto a flat surface and extracted into liquid
- ◉ In each case above, the resulting liquid samples (hydrosols) were:
  - Concentrated by InnovaPrep
  - Analyzed by plating, LFIs, and qPCR

# Surface to Liquid to Liquid Bg



- Surface recovery efficiency 88-119%, average 99.6%
- Sample concentration efficiency 88-105%, average 97.8%



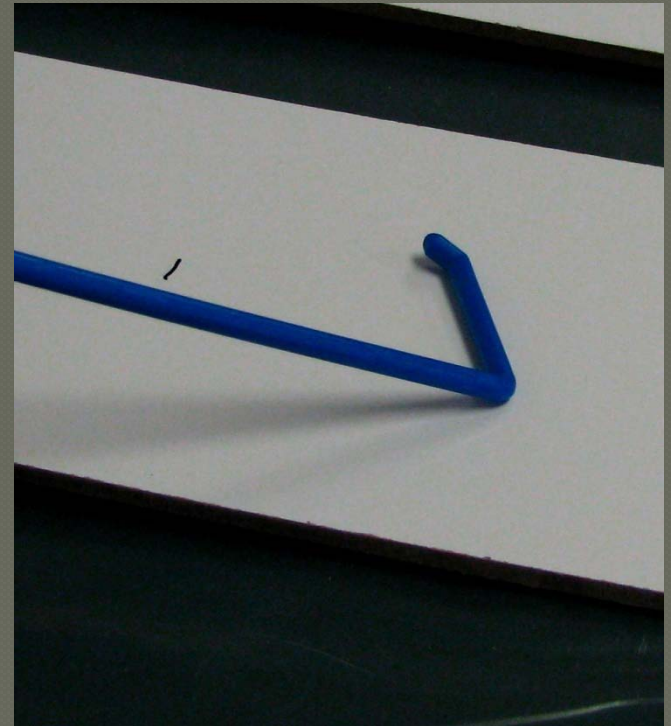
# Simulants vs. the “real thing”



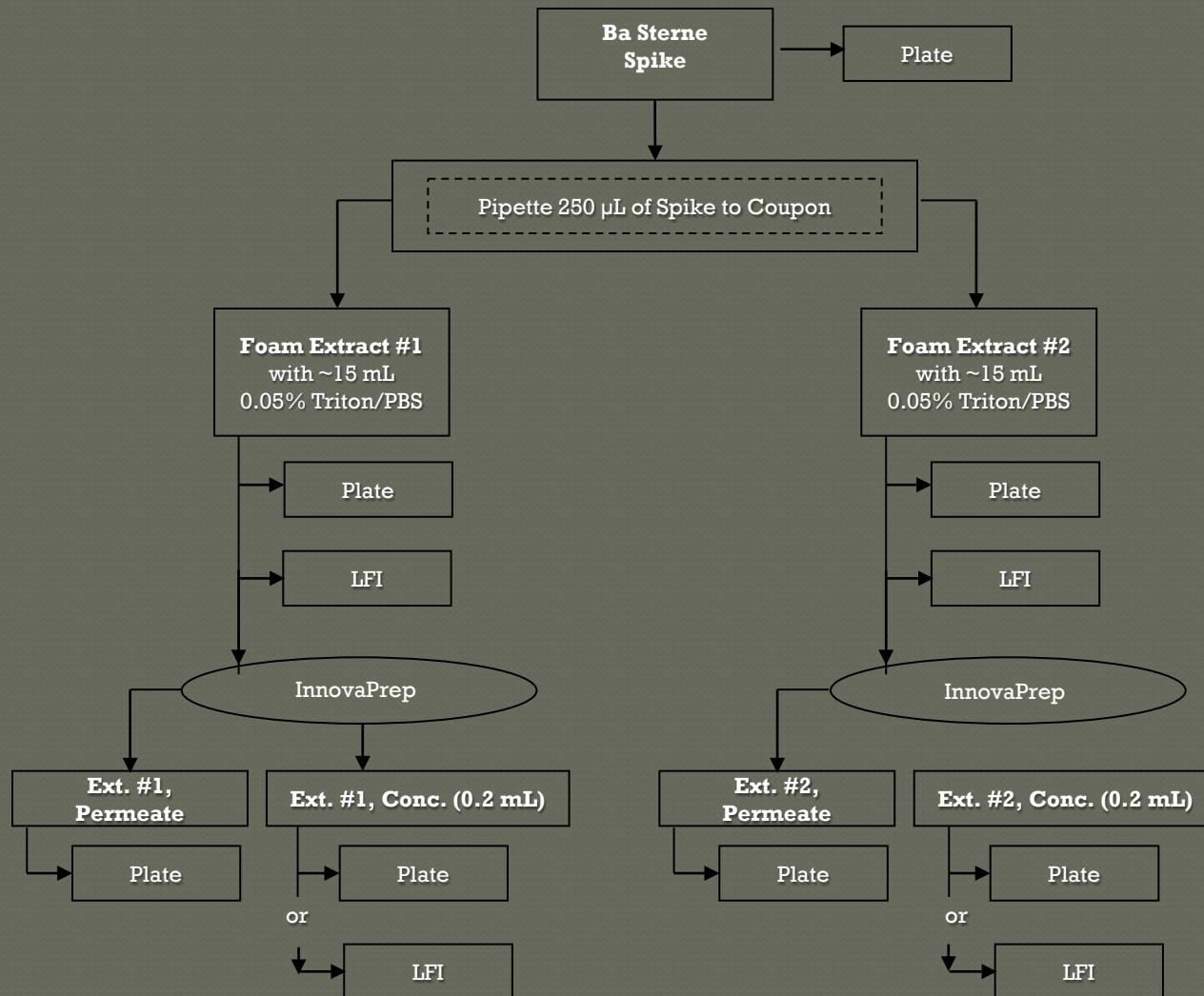
- There can be significant differences in the behavior and attributes of simulant organisms
  - Madhusudhan, Baron, Lindquist, Stuebing, Camp, Hawley...
  - These differences present challenges as well as opportunities for differential sample processing and target sorting



# Ba Sterne Surface to Liquid to Liquid Sampling and Concentration



# Testing Scenario



# Surface Extracts vs. Concentrates



BioThreat Alert  
Tetracore, Rockville, MD  
240.268.5400

- Surface extracts were 64-83% efficient, avg. 79%
- Concentrates were viable
- Sample concentration factors 64x to 100x
- Conc. Efficiency 39-68%, avg. 47%

# Ba Sterne Liquid to Liquid

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- Concentration from a liquid by the InnovaPrep process was from 250 mL to 300 microliters
- Liquid was PBS + 0.05% Triton X-100
  - Processing time ~10 min (could be faster)
  - Concentration factors were 520x to 894x
  - Concentration efficiencies were 72-141%, average 126%

# Discussion and Conclusions

- Ba and Bg react differently in controlled surface sampling, recovery, analysis
  - Free DNA, Antigens
- Ba exosporium and adhesion
- Drying onto surfaces
- Stronger surfactant is needed to recover dried on samples, 0.1% or more
- InnovaPrep provides the ability to exchange from a strong surfactant solution to a solution with 0.01% or less if needed for the analytical method



# Contact Information

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