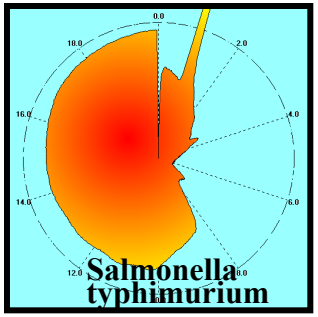
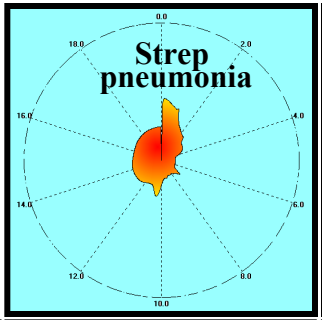
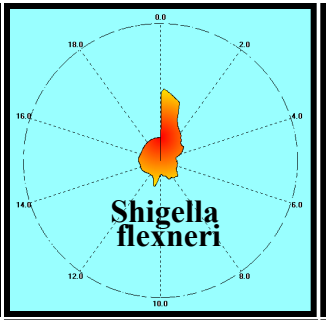
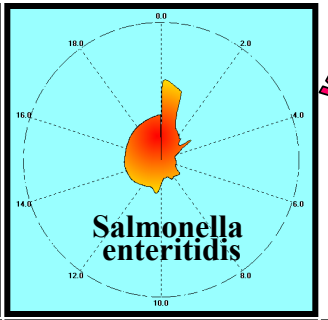
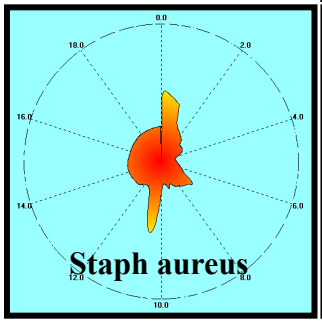
VaporPrint™ of Infectious Bacteria Cultures

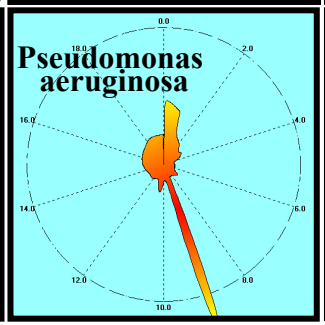


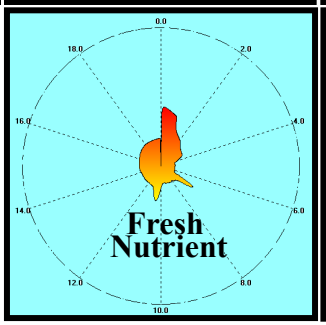


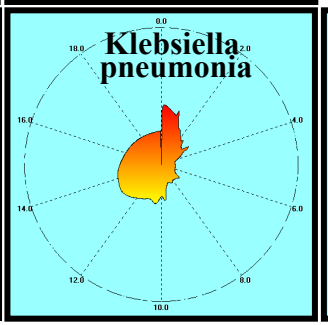


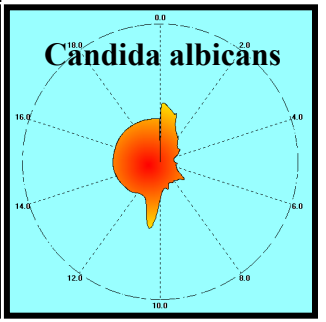


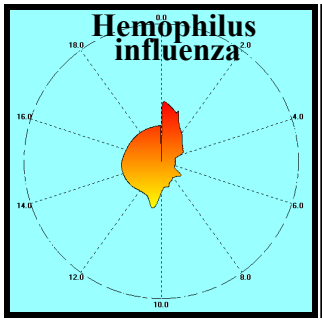


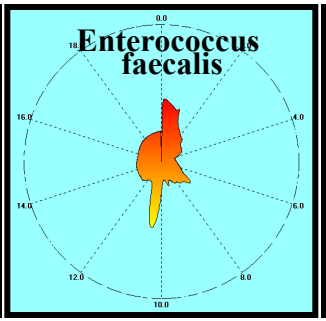


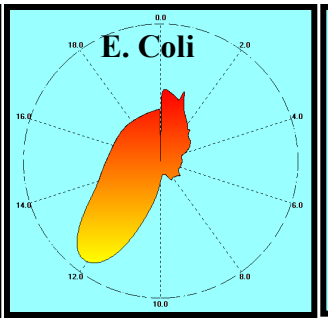


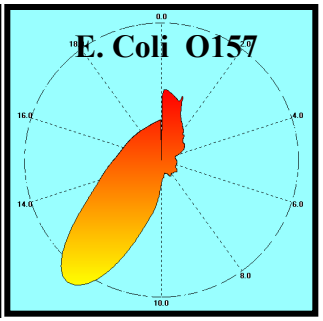












Electronic Sensor Technology

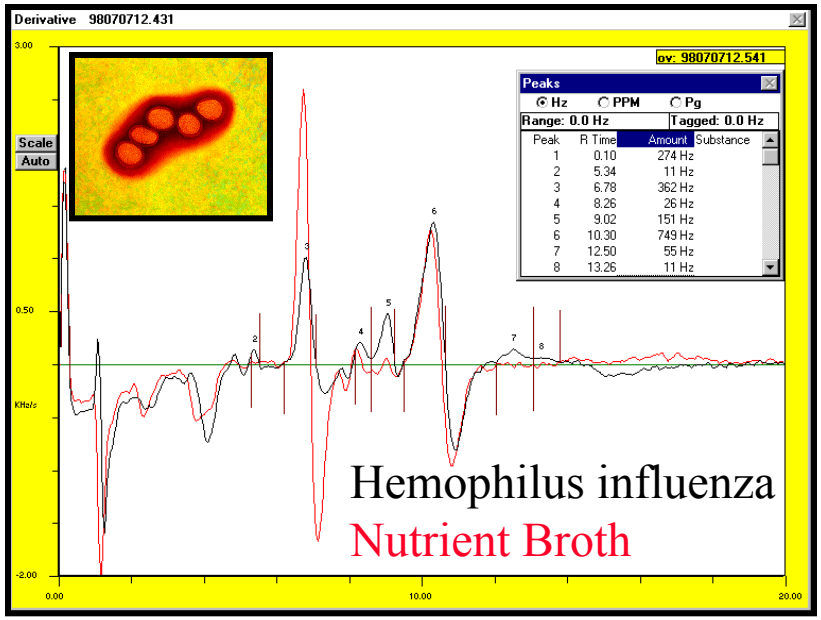
Cultures Prepared by: Department of Pathology and Laboratory Medicine, State Public Health Laboratory of Nevada

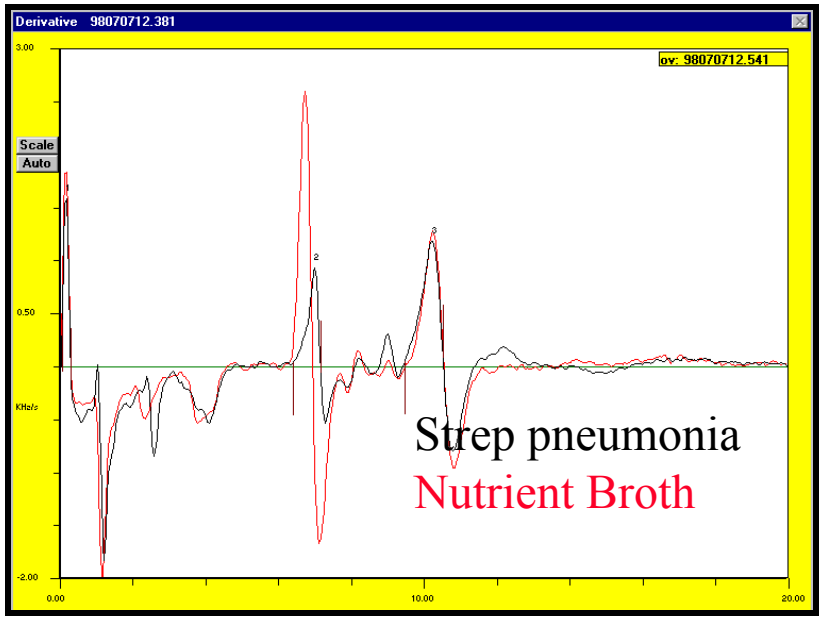
An Investigation of Infectious Bacteria With a GC/SAW Electronic Nose

- Water based cultures were inoculated with 12 infectious bacteria and allowed to incubate at 37°C for 24 hours before analyzing headspace vapors with GC/SAW Electronic nose. Two of the twelve cultures did not develop and contained no bacteria.
- Headspace vapor of cultures without bacteria displayed two primary nutrient analyte peaks and three small analyte peaks located midway between the two nutrient peaks.
- Bacteria growth dynamically interacted with nutrient compounds as well as created new analyte vapors specific to the bacteria itself. The concentrations of new analytes together with modified nutrient vapors created VaporPrints™ images specific to bacteria type.
- E.Coli and E.Coli)157 produced nearly identical VaporPrintsTM, however, one analyte was found to be specific to only O157.
- In general each bacteria type could be recognized by its unique VaporPrint™ image.

Bacteria Tested	*Ease of Identification*	*Summary of Results*
1. Strep pneumonia	0	Negative Culture Growth
2. Hemophilus influenza	0	Negative Culture Growth
3. Candida albicans	4	Doubled 2nd nutrient peak and 2 persursors
4. Shegella flexneri	5	Nutrients diminished, percursor and precursor ripple
5. Staphylococcus aureus	3	Increased nutrients, doubled 2nd
6. Pseudomonas aeruginosa	10	Reduced 1st nutrient, 10X new ripple peak
7. Salmonella enteritidis	7	Reduced 1st nutrient, Large percursor peak
8. Enterococcus faecalis	5	Reduced 1st nutrient, Large increase in 2nd
9. Klebsiella pneumonia	10	Reduced nutrients, large new ripple and percursors
10 Escherichia coli O157	10	Reduced 1st, increased 2nd, large post, added ripple
11 Escherichia coli (benign)	10	Same as O157 except 4th ripple peak not present
12 Salmonella typhimurium	10	Reduced nuturients, large new ripple, precursors

No Growth Confirmed
for Hemophilus influenza and Strep pneumonia Culture Bottles



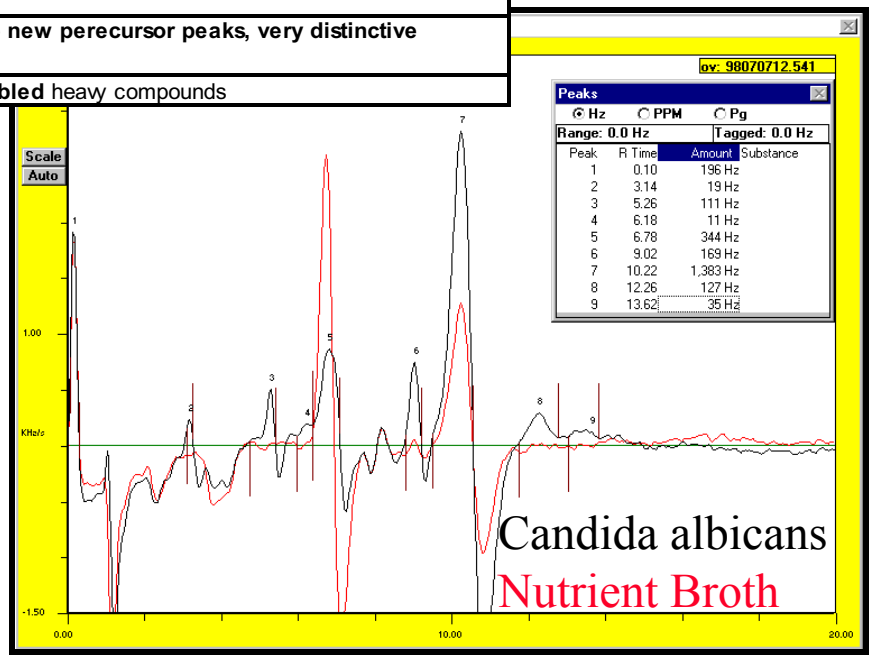


Analytes Present in Nutrient Broth

	Retention Time	Amount after 24 hr @ 37° C	
Primary Nutrient Peaks (2)	6.8	362	Quantitative results based upon no-growth chromatograms of H. influenza and S. pneumonia
	10.3	749	
Ripple Peaks (3)	7.8	10	Small set of 3 peaks prominent and generally always present but much smaller than primary nutrient peaks
	8.2	26	
	9	151	
Post Peaks (1)	12.5	55	Broad low vapor pressure compounds generally present

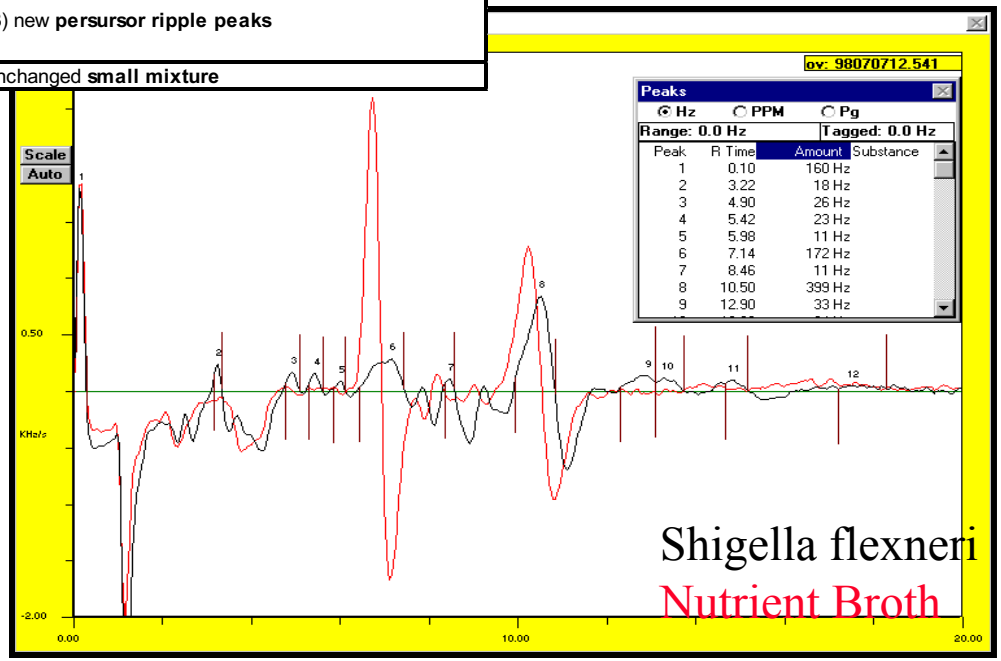
Candida albicans

Analytes Present in Candida albicans			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.8**	**344**	First peak unchanged but **second doubled**
	10.2	**1383**	
Ripple Peaks (3)	**7.8**	**10**	ripple peaks **unchanged**
	8.2	**26**	
	9.0	**169**	
New Peaks (2)	**3.14**	**40**	**Two new perecursor peaks, very distinctive**
	5.26	**111**	
Post Peaks (1)	**12.26**	**127**	**Doubled** heavy compounds



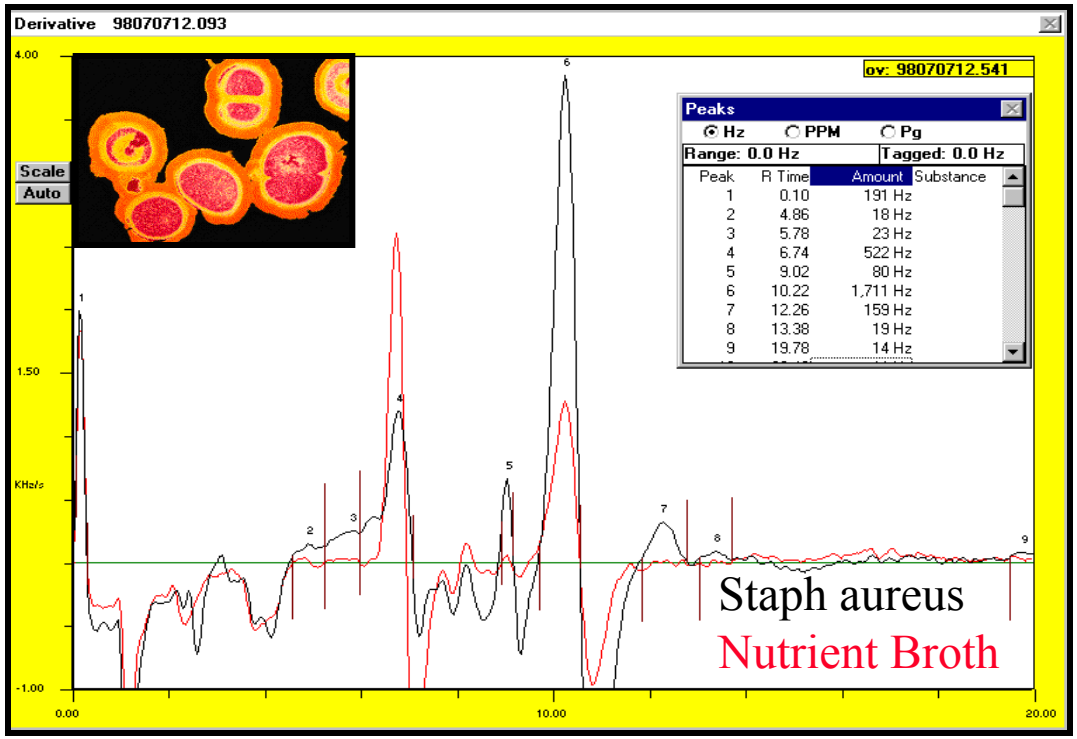
Shigella flexneri

Analytes Present in Shegella flexneri			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**7.1**	**172**	First peak **almost gone** and second **greatly reduced**
	10.5	**399**	
Ripple Peaks (3)	**7.8**	**10**	ripple peaks **unchanged**
	8.2	**26**	
	9.0	**155**	
Precursor Peaks (4)	**3.22**	**30**	**(1) percursor peak**
	4.9	**26**	(3) new **persursor ripple peaks**
	5.42	**23**	
	5.98	**11**	
Post Peaks (1)	**12.26**	**32**	unchanged **small mixture**



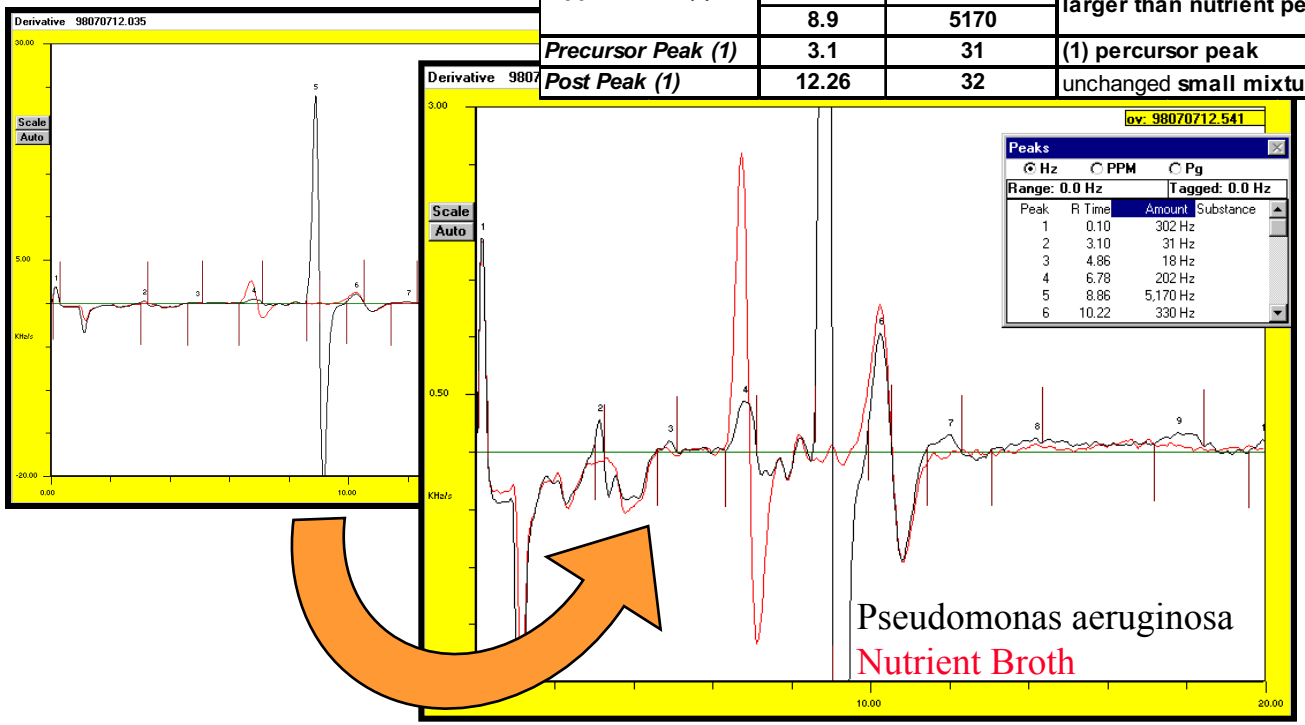
Staphylococcus aureus

Analytes Present in Staphylococcus aureus			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.74**	**522**	First peak **slight increase** and second **doubled++**
	10.22	**1711**	
Ripple Peaks (3)	**7.8**	**10**	ripple peaks **unchanged**
	8.2	**26**	
	9.0	**155**	
Post Peaks (1)	**12.26**	**159**	well defined **unchanged**



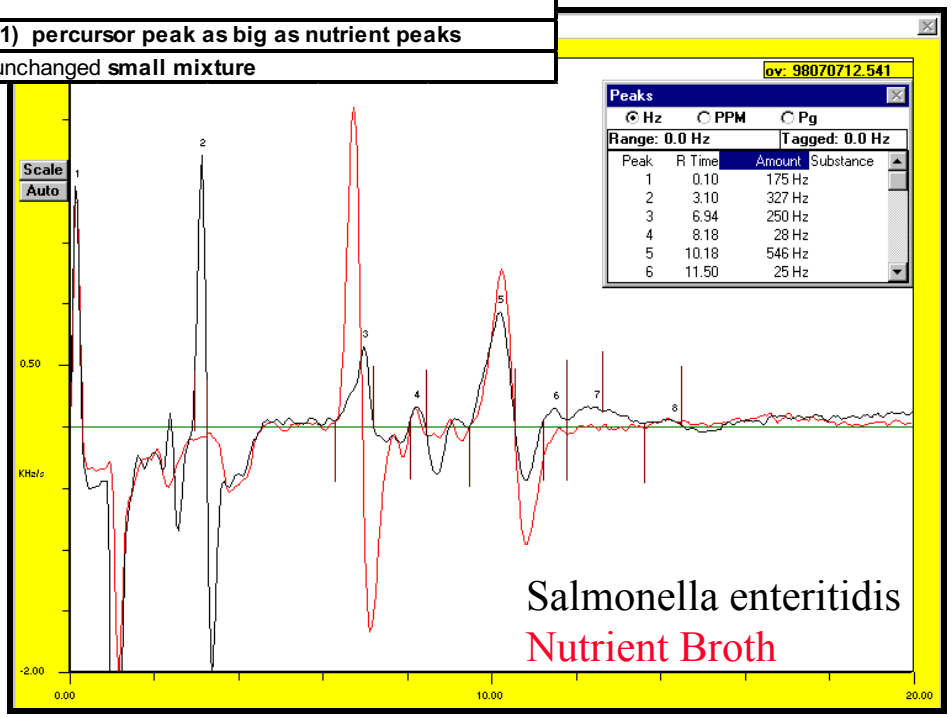
Pseudomonas aeruginosa

Analytes Present in Pseudomonas aeruginosa			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.78**	**202**	First peak **almost gone** and second **slightly reduced**
	10.22	**330**	
Ripple Peaks (3)	**7.8**	**10**	first two ripple peaks **unchanged** but **third is 10 times larger than nutrient peaks**
	8.2	**26**	
	8.9	**5170**	
Precursor Peak (1)	**3.1**	**31**	**(1) percursor peak**
Post Peak (1)	**12.26**	**32**	unchanged **small mixture**



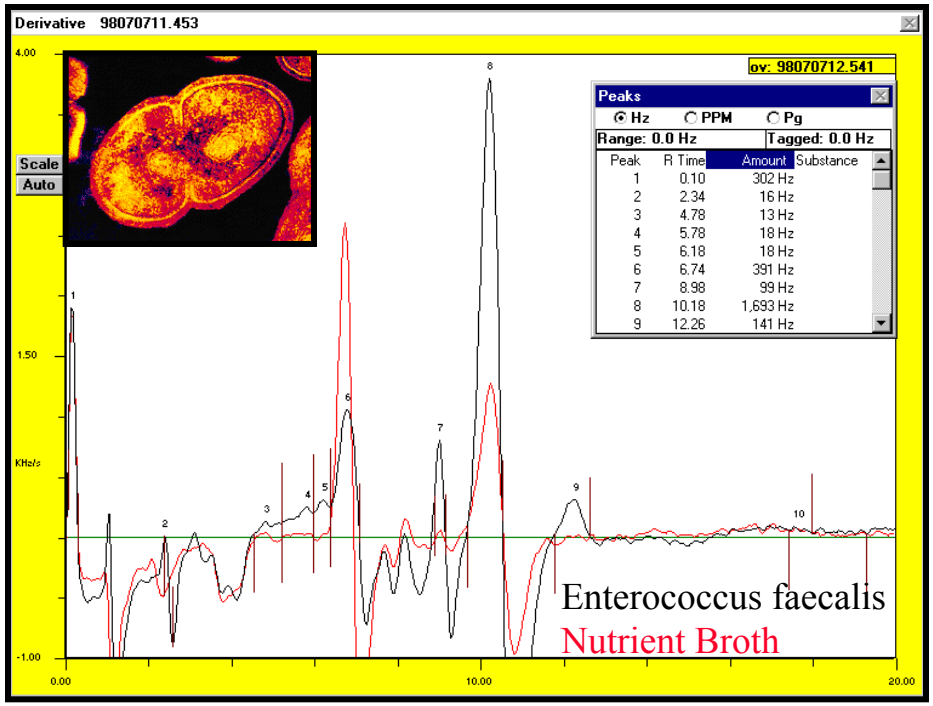
Salmonella enteritidis

Analytes Present in Salmonella enteritidis			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.94**	**250**	First peak **almost gone** and second **unchanged**
	10.18	**546**	
Ripple Peaks (3)	**7.8**	**10**	ripple peaks **unchanged**
	8.2	**28**	
	9.0	**155**	
Precursor Peak (1)	**3.1**	**327**	**(1) percursor peak as big as nutrient peaks**
Post Peaks (1)	**11.5**	**25**	unchanged **small mixture**



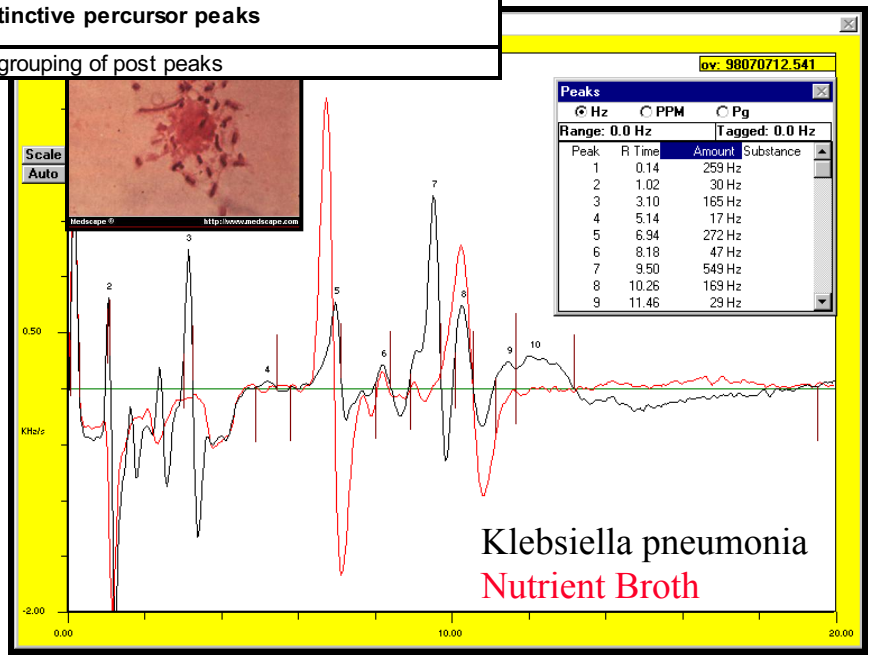
Enterococcus faecalis

Analytes Present in Enterococcus faecalis			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.74**	**391**	First peak **slight decrease** and second **greatly increased**
	10.18	**1693**	
Ripple Peaks (3)	**7.8**	**10**	ripple peaks **unchanged**
	8.2	**26**	
	9.0	**155**	
Precursor Peak (1)	**2.34**	**16**	**(1) small percursor peak**
Post Peaks (1)	**12.26**	**141**	**distinctive small peak**



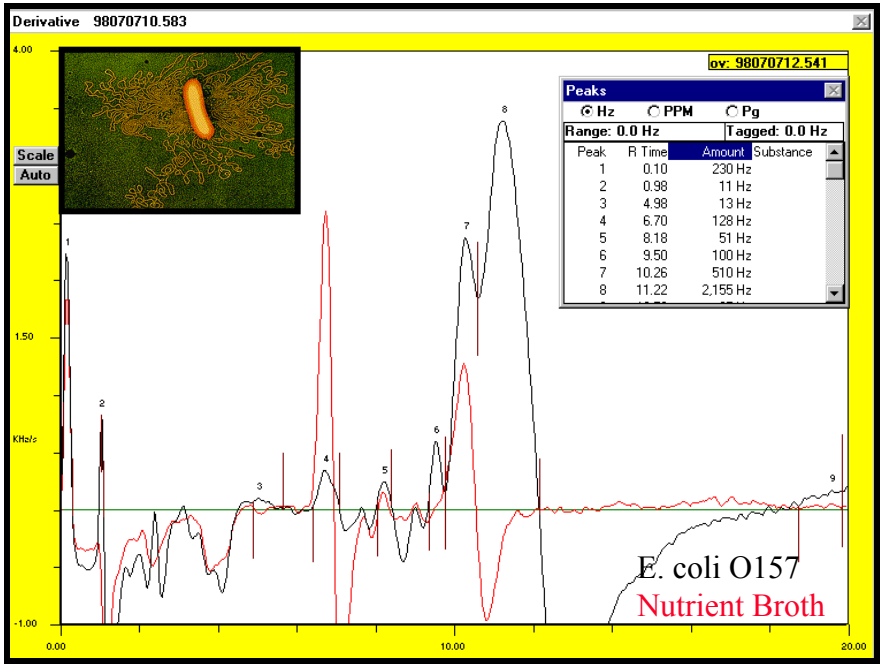
Klebsiella pneumonia

Analytes Present in Klebsiella pneumonia			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.94**	**272**	**Both** nutrient peaks **reduced**
	10.26	**169**	
Ripple Peaks (4)	**7.8**	**10**	original (3) ripple peaks **unchanged** but with **a fourth large new peak**
	8.2	**26**	
	9.0	**155**	
	9.5	**549**	
Precursor Peaks (2)	**1.02**	**30**	**(2) distinctive percursor peaks**
	3.1	**165**	
Post Peaks (1)	**11.46**	**169**	**large** grouping of post peaks

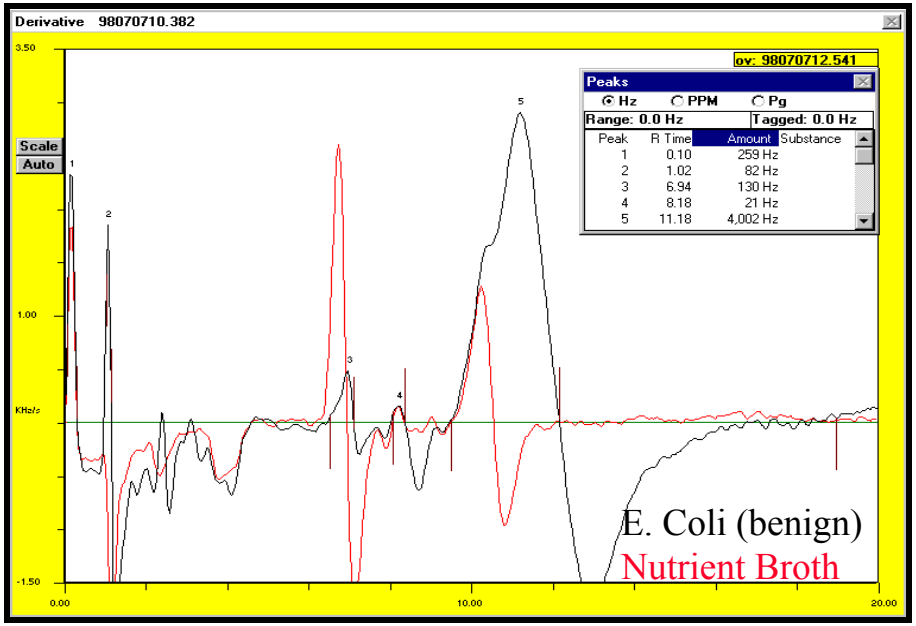


Escherichia coli O157

Analytes Present in Escherichia coli O157			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.7**	**129**	**early peak reduced** and **second peak increased**
	10.26	**510**	
Ripple Peaks (4)	**7.8**	**10**	original (3) ripple peaks **unchanged** but with **a fourth new peak**
	8.2	**26**	
	9.0	**155**	
	9.5	**100**	
Post Peaks (1)	**11.22**	**2135**	**large** new post peak

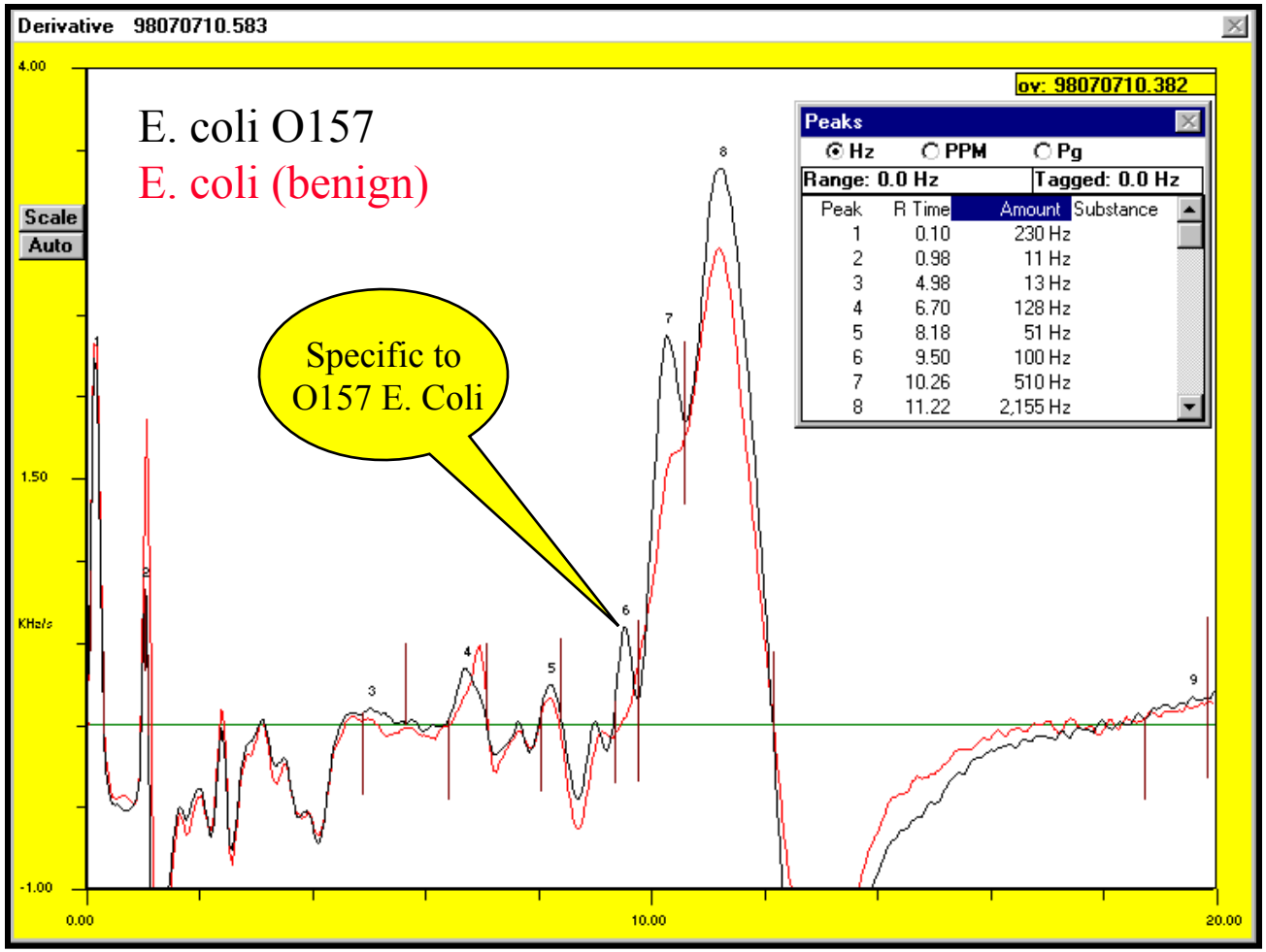


E. coli (benign)

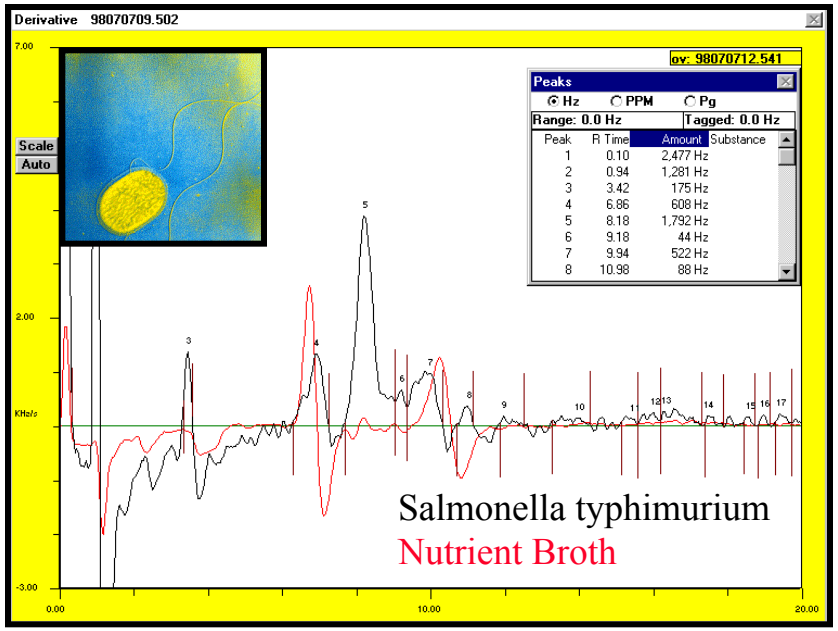


Analytes Present in Escherichia coli (benign)			
	Retention Time	***Amount after 24 hr @ 37° C***	
Primary Nutrient Peaks (2)	**6.7**	**129**	**early peak reduced** and **second peak increased**
	10.26	**510**	
Ripple Peaks (3)	**7.8**	**10**	original (3) ripple peaks **unchanged**
	8.2	**26**	
	9.0	**155**	
Post Peaks (1)	**11.22**	**4002**	**large** new post peak

Comparison of E. coli



Salmonella typhimurium



Analytes Present in Salmonella typhimurium

	Retention Time	*Amount after 24 hr @ 37° C*	
Primary Nutrient Peaks (2)	**6.86**	**608**	First peak **reduced** and second **almost gone**
	9.94	**522**	
Ripple Peaks (3)	**7.8**	**10**	**large new ripple peak**
	8.18	**1792**	
	9.0	**155**	
Precursor Peak (2)	**0.94**	**1281**	**(2) distinctive percursor peaks**
	3.42	**175**	
Post Peaks (1)	**10.9**	**25**	**many** low volaltility analytes present