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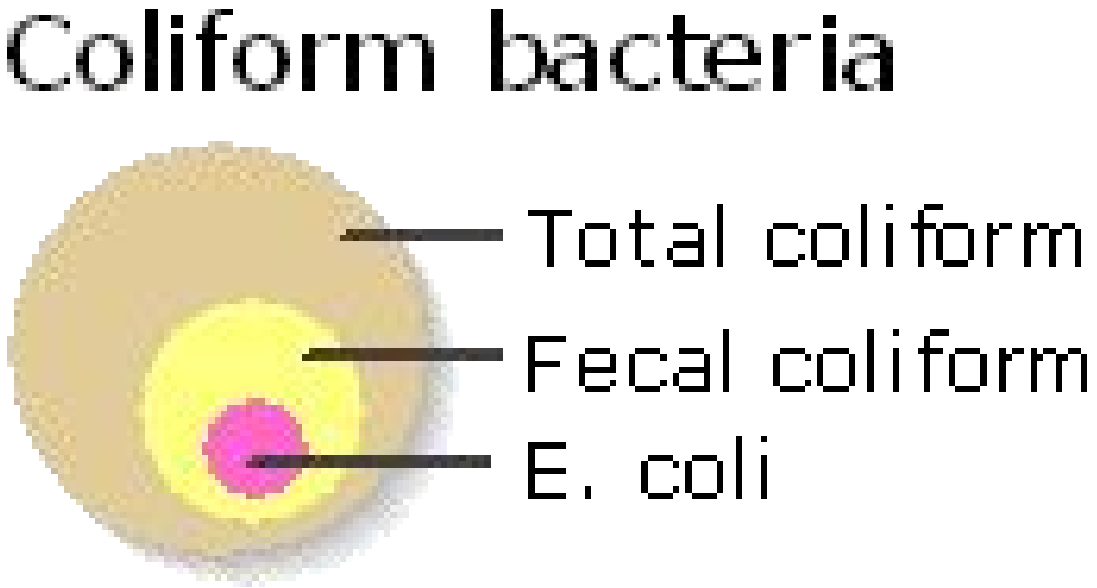
Microbiological Water Safety Detection

The purpose of this presentation is to convey the work done by the MSWM subteam this semester. More information can be found on our team page on the AguaClara wiki page

Problems

Causes of E.Coli and coliform growth:

- Leaks in pipes and tanks
- Improper cleaning of backwashing filters
- Increased precipitation



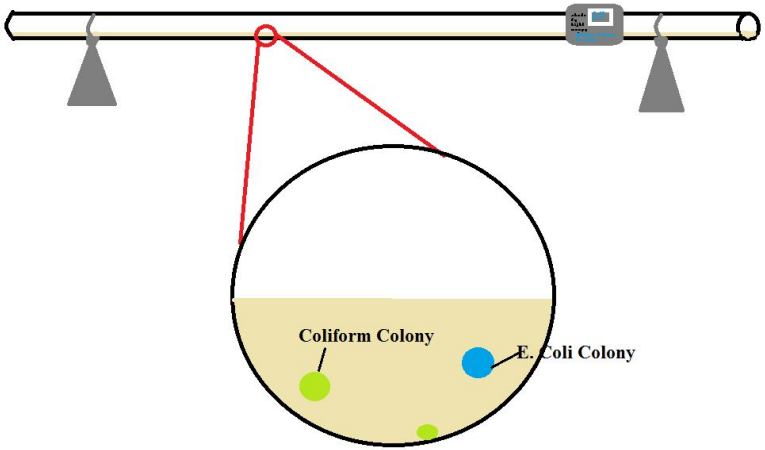
Unexpected events can take place during lifetime of plant operation

Goals

- Testing AguaClara water post-plant-treatment
- Creating a low cost test
- Creating a reliable test
- Creating a fast test
- Enumeration vs Presence/Absence

There are a plethora of pathogen detection methods, but few that can be used in low resource areas.

Sliding Colony Counter

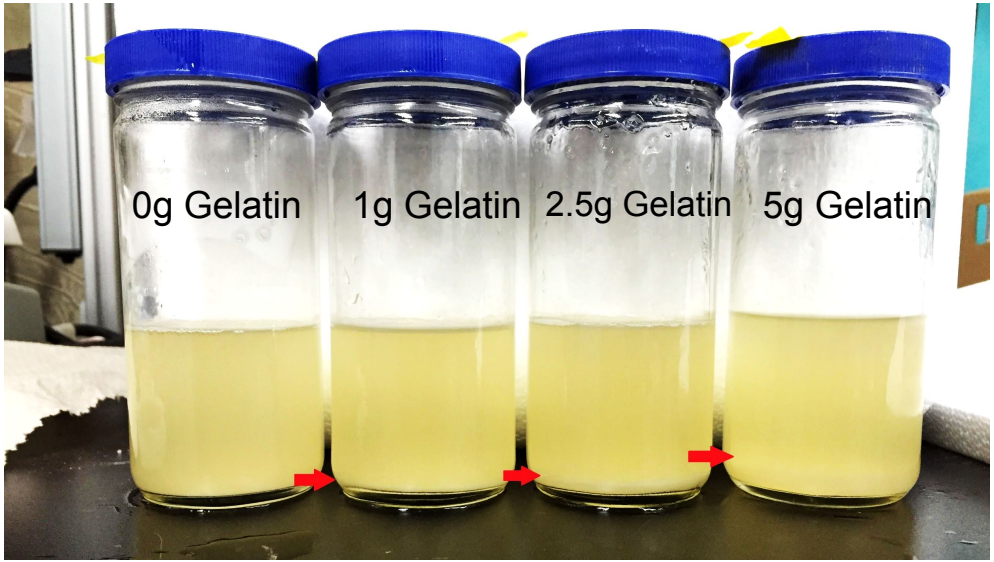


Design Goal: tube incubator with sliding colony counting device.

Methods

- Used water sample from creek
- Created LB Broth
- Heated up samples
- Mixed with gelatin
- Incubated

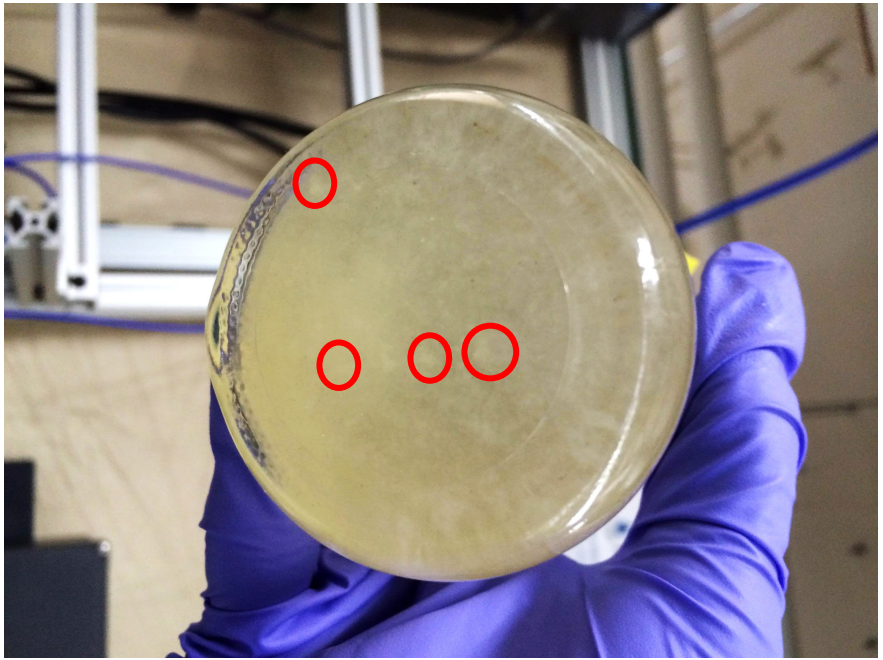
Difference in gelatin concentration correlated to difference in bacterial retention



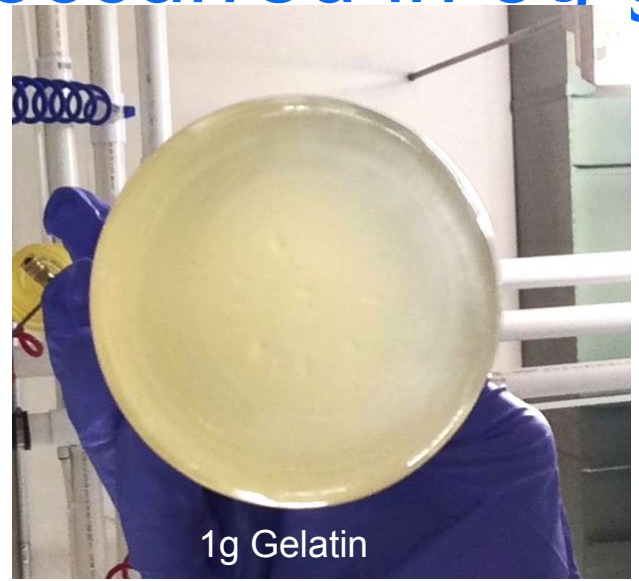
Greater gelatin concentrations tended to yield thicker layers on the bottom of the jars.

Isolation of colony forming units only occurred in 5g gelatin

- Control and 1g Gelatin were similar
- 2.5g gelatin: thicker layer but no isolation
- CFUs-colony forming units



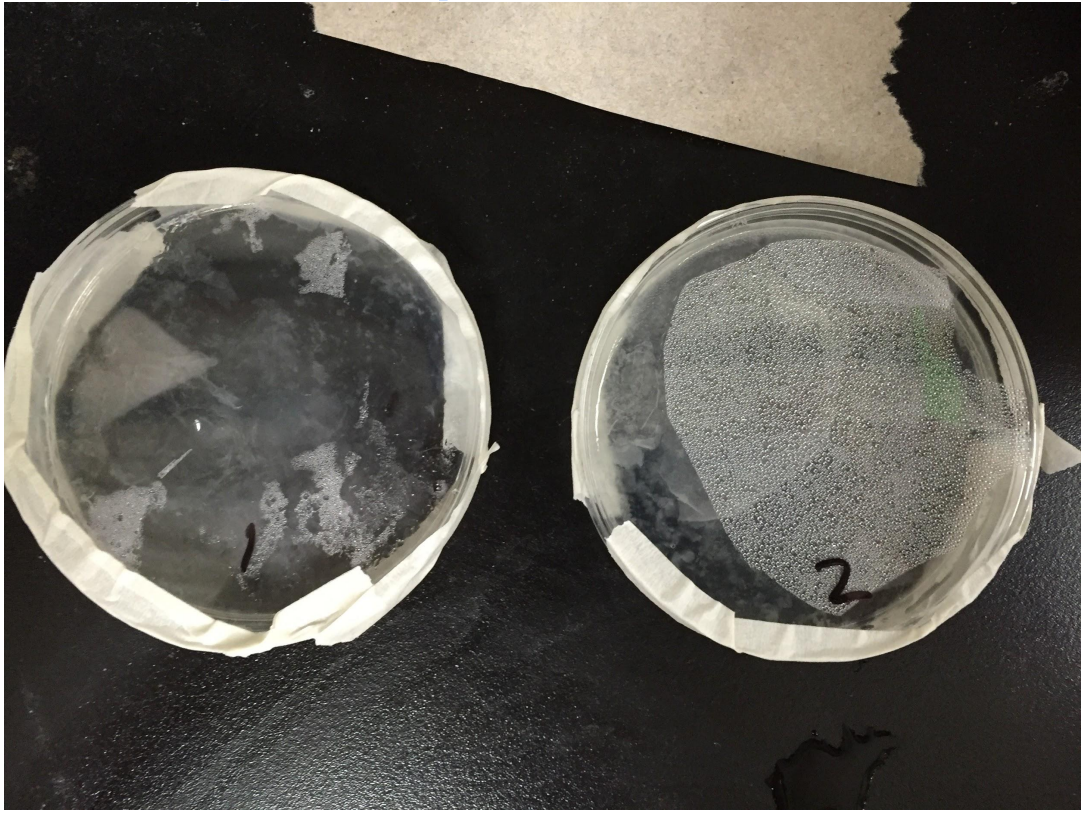
Isolation of colony forming units only occurred in 5g gelatin



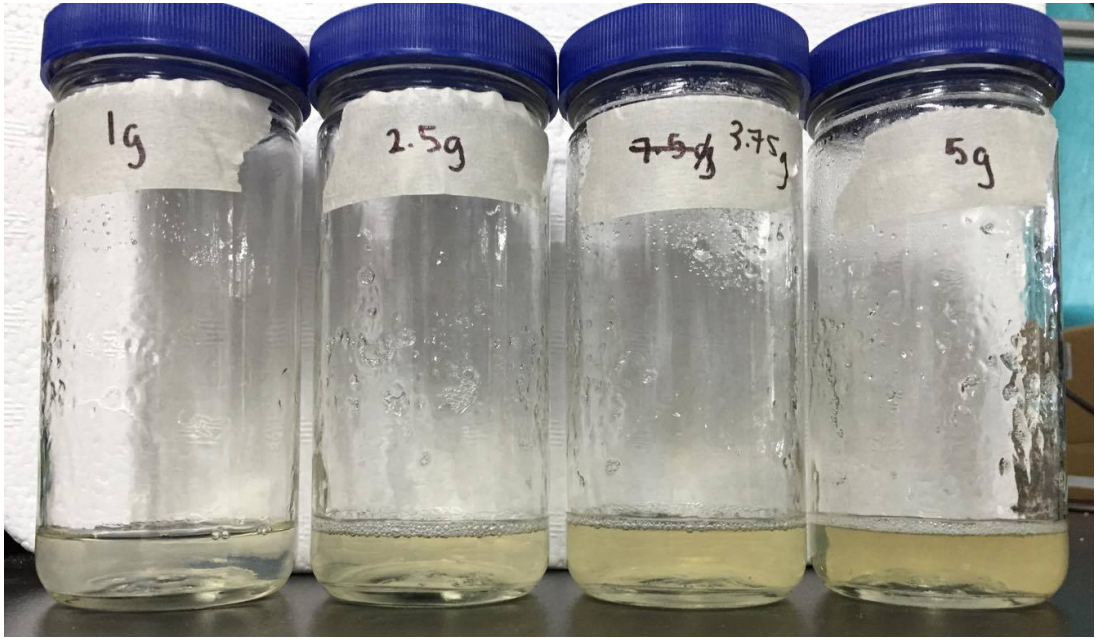
Compared to the 5g gelatin jars, the 1g and 2.5g gelatin samples only formed layers of bacteria rather than colonies.

Implementation of the pour plate method

- Thinner spread, more area
- Less sample water
- Greater ratio of gelatin to sample
- Bacterial films formed



Exclusively gelatin experimentation



More gelatin→ Darker media

Combination of gelatin and media in both jars and plates

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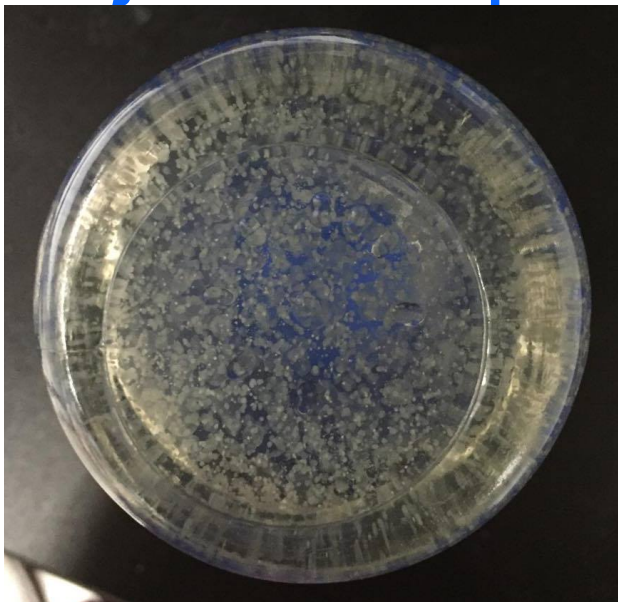
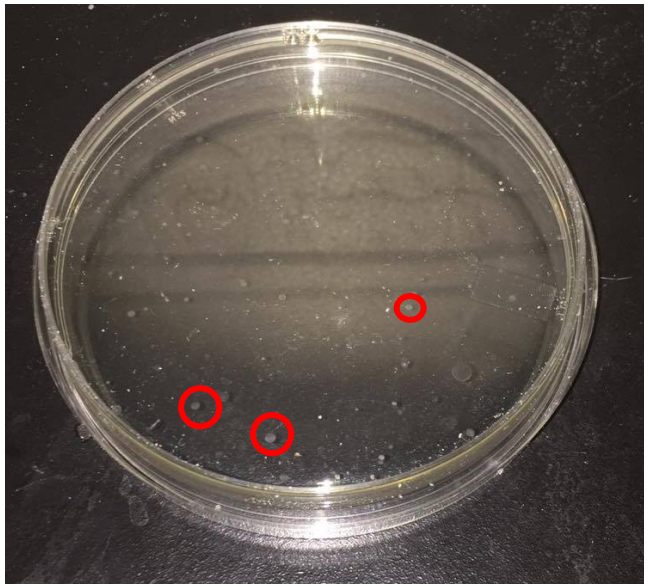
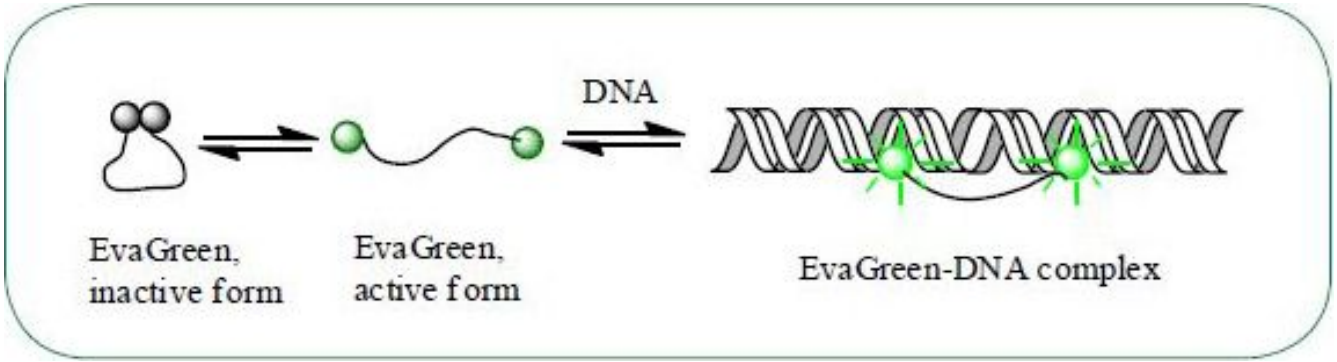




Used minimum required gelatin concentration found from previous experimentation with LB media instead of water

Future Work

- Color indication integration
- Investigate contamination
- Differing container shapes



An indicator will aid in identifying colony forming units

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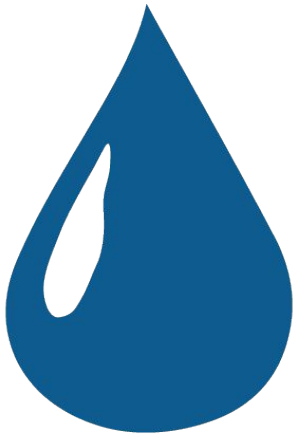
Questions and Recommendations



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Appendix Slides

Literature Review

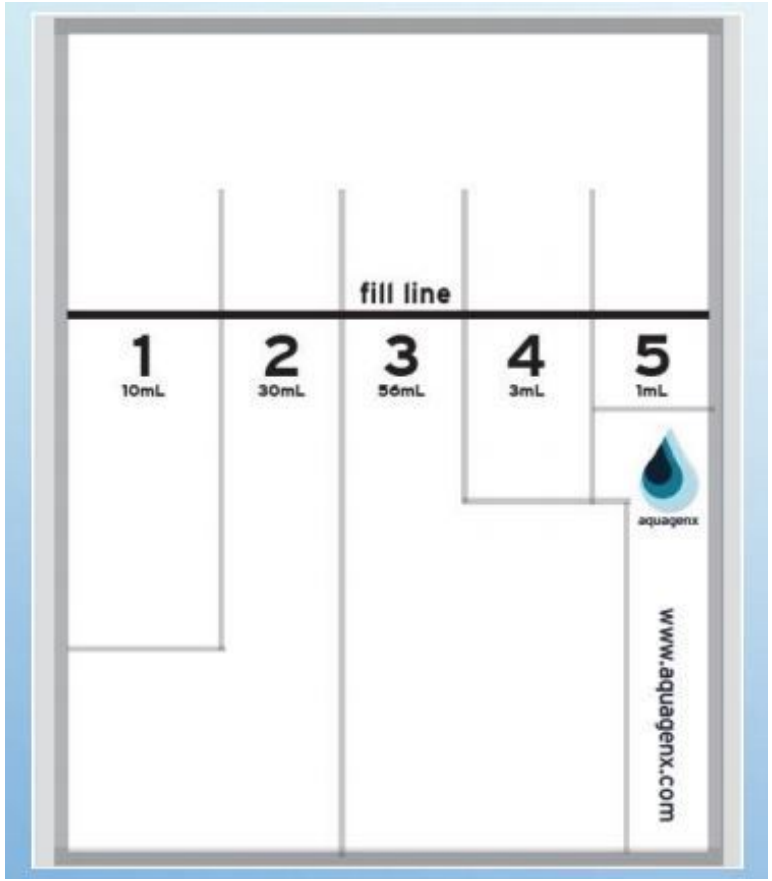
A chart of all of the different types of detection.

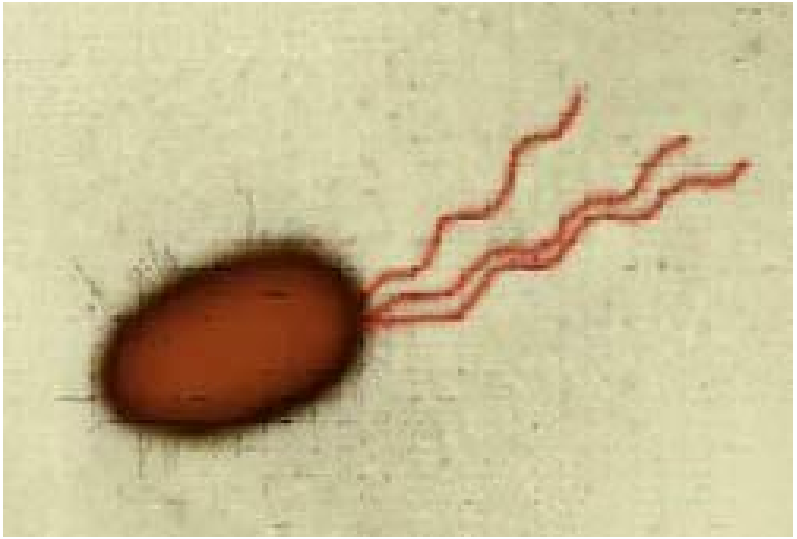
Table 4. Catalogue of microbial drinking water tests.

Type		Product	Resources required: Cost per test [1]	Cost of specialist equipment [2]	Analysis time (min)	Trained technician	Controlled incubation	Ultraviolet light	Sterilisation/disinfection	Deionised water	Cold storage	Transport	Disposal	Other: Time to result (hrs)	Shelf-life (mths)	Temperature (°C)	Settings: Low resource	Medium resource	High resource
Presence Absence	Hydrogen sulphide	PathoScreen™	$0.60	$0	<5				x				$	24–72	12	RT			
		LTEK H_2S 20 mL	$0.80	$0	<5				x				$	24–72	24	RT			
		HiWater™	$2.40	$100	<5				x				M	24–72	24	RT			
		LTEK H_2S 100 mL	$1.80	$0	<5				x				M	24–72	12	RT			
		Local manufacture	Δ	$0	<5				x				$	24–72	Δ	RT			
	Total Coliform	Lamotte® Coliform	$1.20	$0	<5				x				$	44–48	24	RT			
		Rapid HiColiform™	$0.80	$100	<5		x		x			x	M	24	36	2–8			
	E. coli and Total coliform	Colilert® 10 mL	$1.80	$100	<5		x	x	x			x	$	24	12	4–30			
		Colilert® 100 mL	$8.00	$100	<5		x	x	x			x	M	24	12	4–30			
		Colisure®	$6.00	$100	<5		x	x	x			x	M	24	12	2–25			
		Colilert® 18	$6.00	$100	<5		x	x	x			x	M	18	18	2–25			
		Modified Colitag™	$4.80	$100	<5		x	x	x			x	M	16	22	4–30			
		Waterchek™ [BWB] [3]	$6.00	$2,700	<5		x	x	x			x	M	24	36	2–30			
		Readycult®	$3.00	$100	<5		x	x	x			x	M	24	36	15–25			
		E*Colite	$3.00	$100	<5		x	x				x	M	28	12	RT			
		EC Blue 100P	$3.70	$100	<5		x	x	x			x	M	24	12	RT			
		AquaCHROM™	$2.60	$0	<5		x		x			x	M	18	24	15–30			
		HiSelective™ E. coli	$2.20	$0	<5		x		x			x	M	24–48	12	2–8			
Most Probable Number	Most Probable Number	Compartmentalised bag test	$1.00	$0	<5								$	24–72	6–9	RT			
			$1.00	$0	<5								$	24–72	6–9	RT			
		Aquatest™	$4.00	$100	5		x	x					M	24	24	RT			
		Coliplate™	$7.50	$200	10	x	x	x	x			x	L	24	36	2–30			
		EC BlueQuant	$5.80	$100	5	x	x	x	x			x	L	24	12	RT			
		Multiple tube (LTB/EC-MUG)	$3.80	$200	30	x	x	x	x	x		x	$	48	36	RT			
		Multiple tube (LTB/BGLB)	$2.10	$200	30	x	x		x	x		x	$	36	36	RT			
		Colitag/iMFN1600	$5.77	$0	10	x	x	x	x			x	L	16	22	4–30			
		Colilert/Quanti-Tray®	$8.50	$4,100	10	x	x	x	x			x	L	18/24	12	2–25			
		Colilert-Quanti-Tray® 2000	$6.00	$4,100	10	x	x	x	x			x	L	18/24	12	2–25			
Colony Count	Plate Methods	Petrifilm™ E.coli/coliform	$1.30	$100	<5		x		x			x	$	24	18	≤8			
		Petrifilm™ Aqua Coliform	$0.70	$100	<5		x		x			x	$	24	18	≤8			
		CHROMagar™ ECC	$0.80	$100	15	x	x		x			x	$	24	36	15–30			
		Compact Dry EC™	$1.50	$0	<5		x		x			x	$	24	24	1–30			
	Gel based	Colisan Easygel	$2.20	$0	5	x	x		x			x	M	24	12	<0			
		ColiGel/PathoGel [4]	$3.80	$100	5		x	x				x	M	28	12	RT			
Colony Count	Membrane Filtration [4]	Portable kit/LSB [5]	$0.80	$2,700	20	x	x		x	x		x	$	24	48	RT			
		Portable kit/m-coliblue 24™	$2.50	$4,000	15	x	x		x	x	x	x	M	24	12	2–8			
		m-Coliblue 24™	$2.50	$2,500	15	x	x		x	x	x	x	M	24	12	2–8			
		Colisan MF™	$2.20	$2,500	15	x	x		x	x	x	x	M	24	12	<0			
		m-Endo	$1.80	$2,500	15	x	x		x	x		x	M	24	48	RT			
		m-FC	$1.80	$2,500	15	x	x		x	x		x	M	24	48	RT			
		CHROMagar™ Liquid ECC	$1.10	$2,500	15	x	x		x	x		x	M	24	36	15–30			
		CHROMagar™ ECC	$1.30	$2,500	15	x	x		x	x		x	M	24	36	15–30			
		MI Agar	$1.70	$2,500	15	x	x		x	x		x	M	24	36	RT			
		Chromocult	$1.20	$2,500	15	x	x		x	x		x	M	24	60	RT			
		Rapid E.coli	?	$2,500	15	x	x		x	x		x	M	24	?	?			

The compartmentalized bag test.

Literature Review





First Iteration

1g Gelatin

Sixth Iteration

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2.5g Gelatin