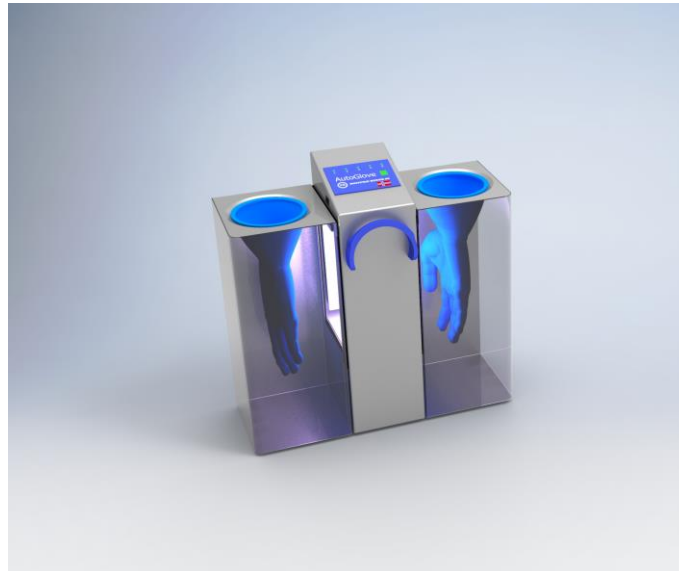

Report

**Simulated in-use test of AutoGlove
- apparatus with UV light allowing for reuse of disposable gloves**



Methodology for laboratory tests; simulated in-use test of AutoGlove apparatus with UV light allowing for reuse of disposable gloves

1. Description of the apparatus and the effect:



AutoGlove is an apparatus allowing donning and doffing of disposable gloves in a matter of seconds. The device facilitates for users to easily switch between hygienic and unhygienic zones at different workplaces. Such as at various fast food chains where there is a rapid switching between preparing food and receiving money from customers. The gloves are exposed to UV-C radiation every time they are put to rest in the machine. Thus, the gloves can be used repeatedly as long as users follow the guidelines of the Norwegian Food Safety Authority*.

This goal of this study was to investigate the effect of the UV-C lamp used in the device on certain bacteria and certain types of gloves with different exposure times.

Technical specifications:

The lamp is of the type TUV PL-S 9W / 2P1CT / 6X10BOX. The distance from the glove lamp and the glove is 14 cm, and the glove compartments in the device are manufactured in stainless steel (Aisi 304).

2. Test Strains

- a) *Staphylococcus aureus*, Gram positive cocci - CCUG621
- b) *Escherichia coli*, Gram negative rods - CCUG24

Strains were prepared in separate suspensions by incubation overnight in BHI broth. Density: About 10⁶ cfu / ml.

The gloves were dipped into the two bacterial suspensions.

The tests were conducted at room temperature.

2. Pre-values

10 sets (5x2) with pre-values of Staph.aureus and 10 sets (5x2) with pre-values of E. coli were performed with two different types of glove materials; latex and nitrile.

Fingertips with gloves on the right and left hand rubbed for 1 minute in each petri dish with broth. 1ml from each dish was diluted, plated out and incubated (37° C) and counted. These results are hereafter referred to as values before exposure (lg).

Setup pre-values:

5 glove sets (10 samples) Pre-values Staph.aur, glove type Latex

5 glove sets (10 samples) Pre-values Staph.aur, glove type Nitrile

5 glove sets (10 pcs samples) Pre-values E.coli, glove type Latex

5 glove sets (10 pieces of samples) Pre-values E.coli, glove type Nitrile

3. Exposure - UV light - post treatment values

10 sets (5x2) of each bacteria type; Staph.aureus and E.coli, repeated with two different glove types - latex and nitrile i.e. 10 sets of data for each type of glove.

Gloves were dipped in the two suspensions and then the gloves were put into the apparatus after the suspension had dripped off / dried somewhat.

After exposure, fingertips with gloves on the right and left hand were rubbed for 1 minute in each petri dish with broth. 1ml from each dish was diluted, plated out and incubated (37 ° C) and counted. These results are hereafter referred to as post-exposure values (lg).

On glove sets that were treated for 10 sec and 30 sec, it was plated out from -1 and -2 dilution.

Glove set treated for 1 min was plated out directly and from -1 dilution.

Glove set treated for 2 minutes was plated out 1 ml directly from suspension. The samples were incubated for 18-24 hours at 37 ° C

4. Exposure time

Four different exposure times were chosen; 10 sec, 30 sec, 1 min and 2 min

This gave the following Setup:

5 glove sets (10 samples) with Staph.aur, glove type Latex, 10 sec

5 glove sets (10 samples) with Staph.aur, glove type Latex, 30 sec

5 glove sets (10 samples) with Staph.aur, glove type Latex, 1 min

5 glove sets (10 samples) with Staph.aur, glove type Latex, 2 min

5 glove sets (10 samples) with Staph.aur, glove type Nitrile, 10 sec

5 glove sets (10 samples) with Staph.aur, glove type Nitrile, 30 sec

5 glove sets (10 samples) with Staph.aur, glove type Nitrile, 1 min

5 glove sets (10 samples) with Staph.aur, glove type Nitrile, 2 min

5 glove sets (10 samples) with E. coli, glove type Latex, 10 sec
5 glove sets (10 samples) with E. coli, glove type Latex, 30 sec
5 glove sets (10 samples) with E. coli, glove type Latex, 1 min
5 glove sets (10 samples) with E. coli, glove type Latex, 2 min

5 glove sets (10 samples) with E. coli, glove type Nitrile, 10 sec
5 glove sets (10 samples) with E. coli, glove type Nitrile, 30 sec
5 glove sets (10 samples) with E. coli, glove type Nitrile, 1 min
5 glove sets (10 samples) with E. coli, glove type Nitrile, 2 min

5. Data processing

The differences in lg pre-values and post-values of the same hand and the same type of glove material (right / left) and exposure time are calculated = reduction factor.

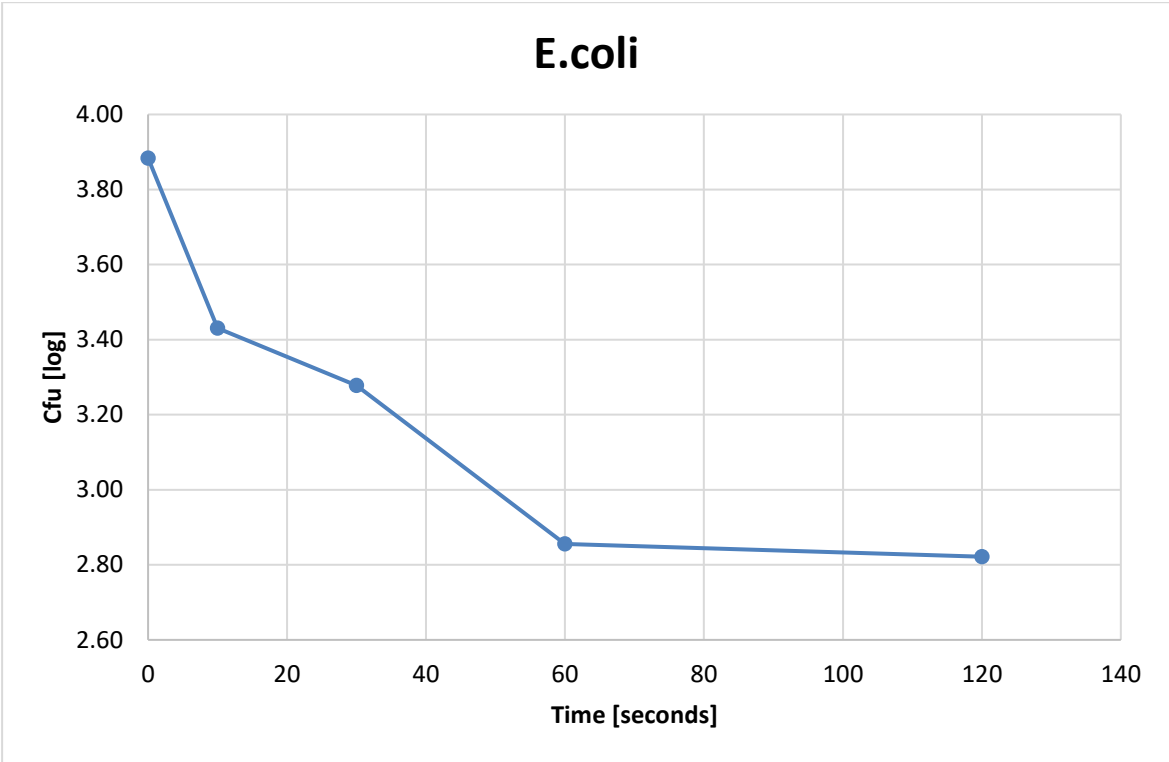
6. Results

E.coli Nitril

Preverdier				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	7800	7700	3,89	3,89
2	7900	8100	3,90	3,91
3	7400	7800	3,87	3,89
4	6800	7400	3,83	3,87
5	7900	7800	3,90	3,89
Eksonering 10 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	2800	2200	3,45	3,34
2	3400	2100	3,53	3,32
3	2700	3100	3,43	3,49
4	2500	3500	3,40	3,54
5	2300	2700	3,36	3,43

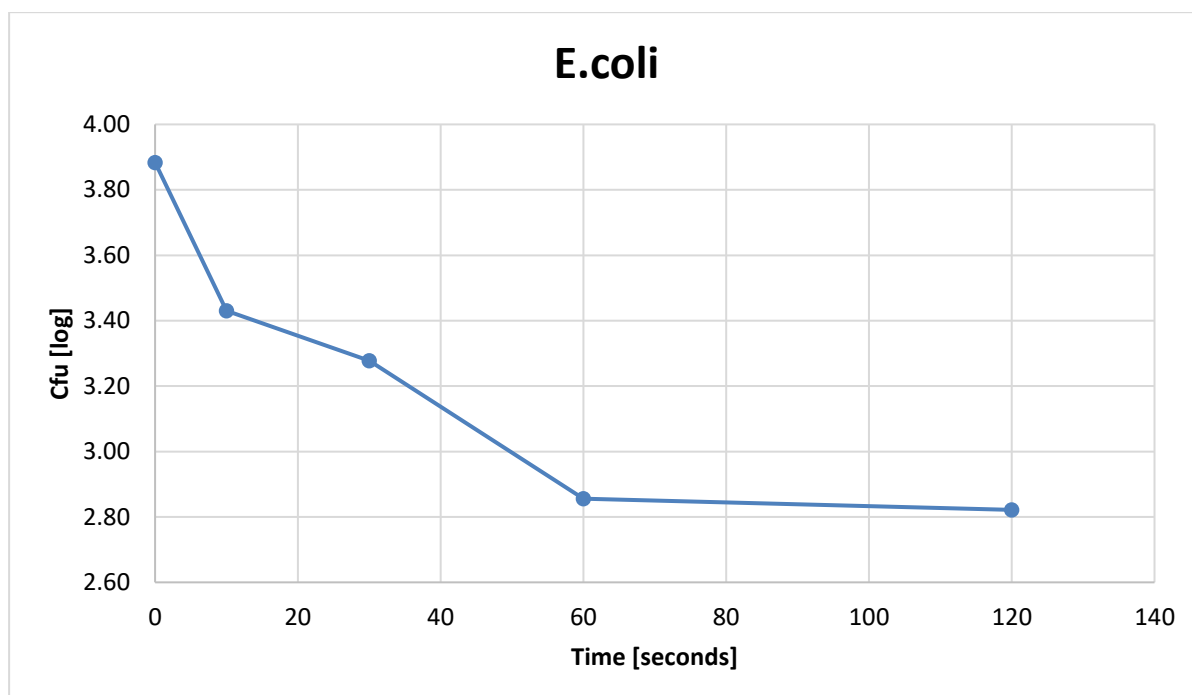
Eksonering 30 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	1900	1700	3,28	3,23
2	2300	2400	3,36	3,38
3	2000	2000	3,30	3,30
4	1500	1800	3,18	3,26
5	1200	2600	3,08	3,41
1 min				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	920	770	2,96	2,89
2	970	950	2,99	2,98
3	450	330	2,65	2,52
4	870	910	2,94	2,96
5	870	540	2,94	2,73
2 min				
Sett	Venstre	Høyre	Log venstre	Log høyre
1	720	710	2,86	2,85
2	700	650	2,85	2,81
3	710	700	2,85	2,85
4	620	560	2,79	2,75
5	660	621	2,82	2,79

Log diagram	Snitt venstre	Snitt høyre	Snitt
0	3,88	3,89	3,88
10	3,43	3,43	3,43
30	3,24	3,32	3,28
60	2,90	2,81	2,86
120	2,83	2,81	2,82



Ubehandlet				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	8300	8000	3,92	3,90
2	6200	6800	3,79	3,83
3	5000	7400	3,70	3,87
4	6300	8800	3,80	3,94
5	7600	6200	3,88	3,79
10 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	2700	2500	3,43	3,40
2	2100	2000	3,32	3,30
3	2600	3600	3,41	3,56
4	3000	2600	3,48	3,41
5	3800	2900	3,58	3,46
30 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	2900	1800	3,46	3,26
2	1900	1700	3,28	3,23
3	1700	1800	3,23	3,26
4	2700	1900	3,43	3,28
5	1700	2000	3,23	3,30
1 min				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	760	730	2,88	2,86
2	900	980	2,95	2,99
3	740	680	2,87	2,83
4	1300	740	3,11	2,87
5	740	700	2,87	2,85
2 min				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	520	690	2,72	2,84
2	540	430	2,73	2,63
3	430	290	2,63	2,46
4	720	490	2,86	2,69
5	460	670	2,66	2,83

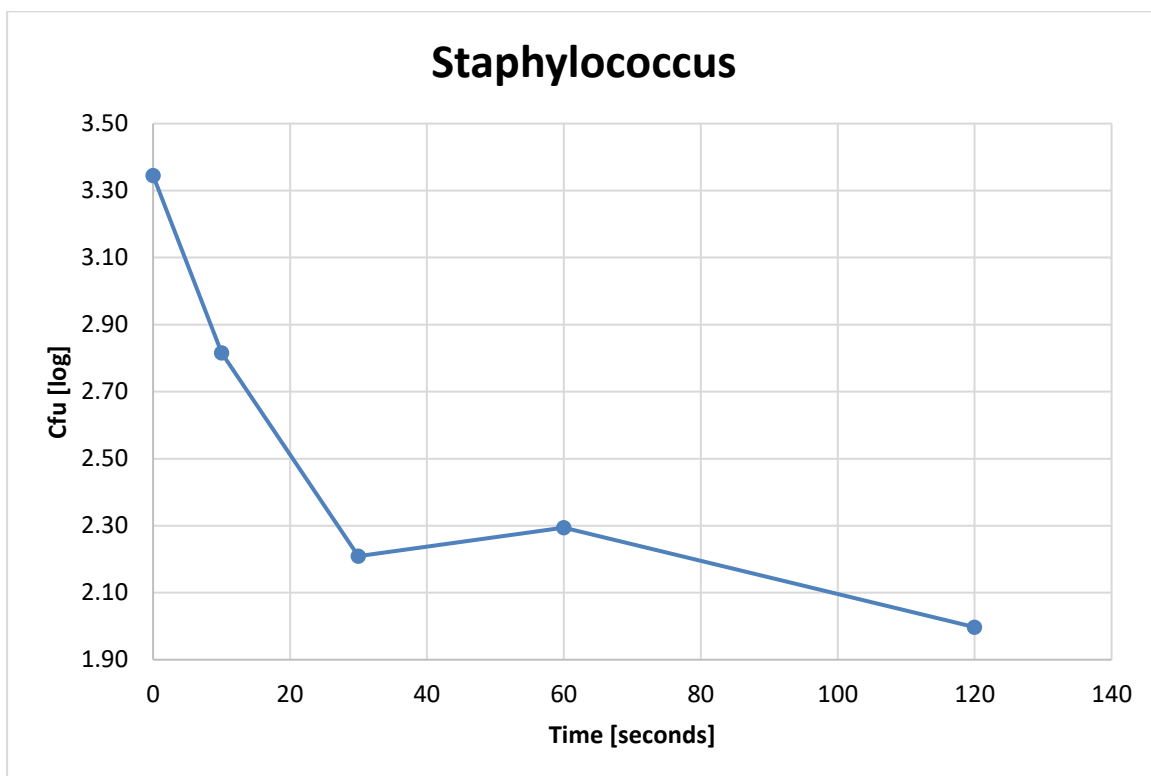
Log diagram	Snitt venstre	Snitt høyre	Snitt
0	3,82	3,87	3,84
10	3,45	3,43	3,44
30	3,33	3,26	3,30
60	2,94	2,88	2,91
120	2,72	2,69	2,71



Staph.aureus Nitril

Ubehandlet				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	2000	1400	3,30	3,15
2	2600	2800	3,41	3,45
3	2400	2700	3,38	3,43
4	2600	3100	3,41	3,49
5	1900	1400	3,28	3,15
10 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	600	480	2,8	2,7
2	990	1230	3,0	3,1
3	710	740	2,9	2,9
4	400	260	2,6	2,4
5	850	880	2,9	2,9
30 sek				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	180	320	2,26	2,51
2	170	200	2,23	2,30
3	600	70	2,78	1,85
4	190	110	2,28	2,04
5	120	60	2,08	1,78
1 min				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	300	230	2,48	2,36
2	240	80	2,38	1,90
3	140	200	2,15	2,30
4	210	490	2,32	2,69
5	100	230	2,00	2,36
2 min				
Sett	Cfu Venstre	Cfu Høyre	Log venstre	Log høyre
1	300	70	2,48	1,85
2	110	70	2,04	1,85
3	50	90	1,70	1,95
4	130	100	2,11	2,00
5	110	90	2,04	1,95

Log diagram	Snitt venstre	Snitt høyre	Snitt
0	3,36	3,33	3,35
10	2,83	2,80	2,82
30	2,32	2,09	2,21
60	2,27	2,32	2,29
120	2,07	1,92	2,00



Preverdier				
Sett	Venstre	Høyre	Log venstre	Log høyre
Sett 1	1600	1700	3,20	3,23
Sett 2	1400	1700	3,15	3,23
Sett 3	1100	2400	3,04	3,38
Sett 4	1900	1900	3,28	3,28
Sett 5	1400	1900	3,15	3,28

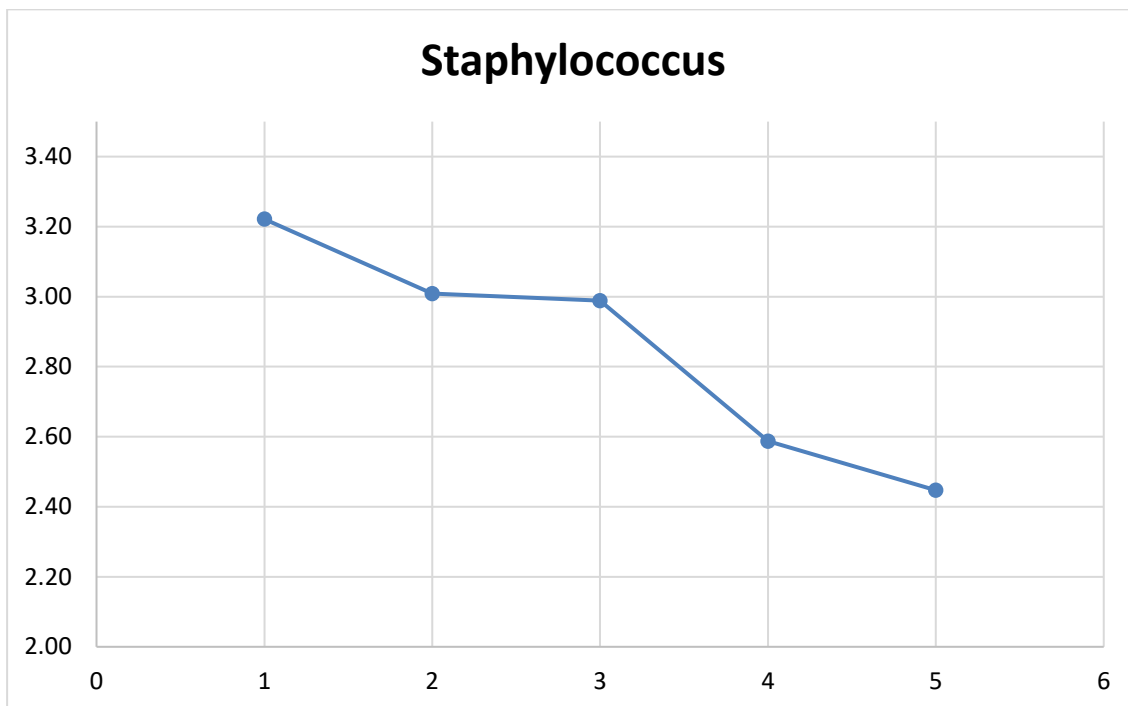
10 sek				
Sett	Venstre	Høyre	Log venstre	Log høyre
Sett 1	1000	770	3,00	2,89
Sett 2	830	930	2,92	2,97
Sett 3	1200	1200	3,08	3,08
Sett 4	990	1600	3,00	3,20
Sett 5	900	1000	2,95	3,00

30 sek				
Sett	Venstre	Høyre	Log venstre	Log høyre
Sett 1	900	970	2,95	2,99
Sett 2	900	980	2,95	2,99
Sett 3	950	910	2,98	2,96
Sett 4	940	940	2,97	2,97
Sett 5	1000	1300	3,00	3,11

1 min				
Sett	Venstre	Høyre	Log venstre	Log høyre
Sett 1	290	500	2,46	2,70
Sett 2	550	260	2,74	2,41
Sett 3	470	280	2,67	2,45
Sett 4	240	560	2,38	2,75
Sett 5	550	370	2,74	2,57

2 min				
Sett	Venstre	Høyre	Log venstre	Log høyre
Sett 1	280	180	2,45	2,26
Sett 2	380	300	2,58	2,48
Sett 3	260	220	2,41	2,34
Sett 4	160	340	2,20	2,53
Sett 5	460	360	2,66	2,56

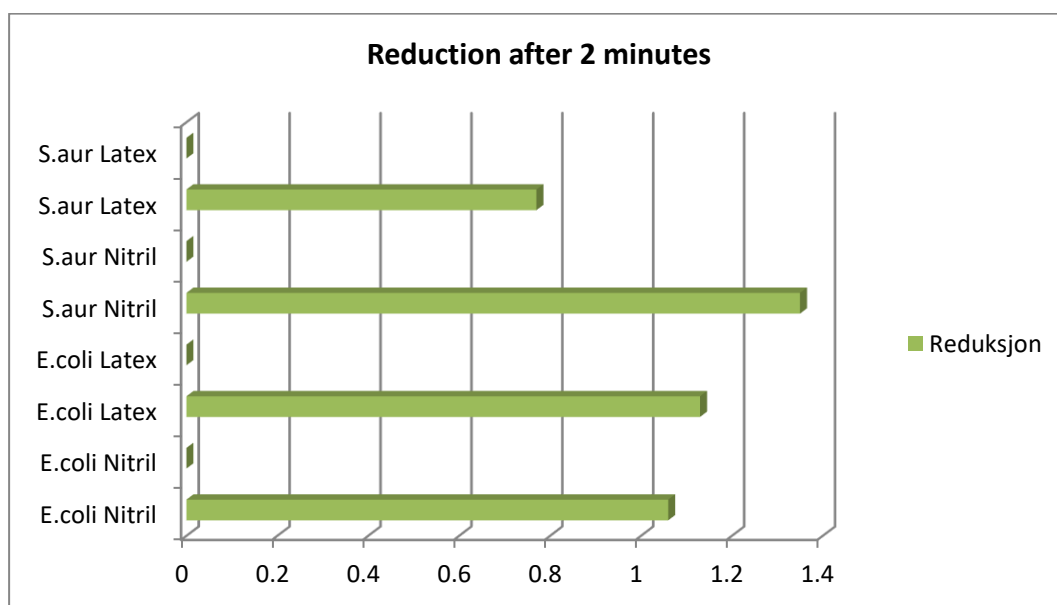
Log Diagram	Snitt venstre	Snitt høyre	Snitt
Preverdier	3,16	3,28	3,22
Etter 10 sek	2,99	3,03	3,01
Etter 30 sek	2,97	3,00	2,99
Etter 1 min	2,60	2,58	2,59
Etter 2 min	2,46	2,43	2,45



7. Conclusion

Table strain, glove type and reduction after 2 minutes in AutoGlove

Stamme+type	Eksp tid, sek	log Høyre	Log venstre	Log snitt	Reduksjon
E.coli Nitril	120	2,83	2,81	2,82	1,06
	0	3,88	3,89	3,88	
E.coli Latex	120	2,72	2,69	2,71	1,13
	0	3,82	3,87	3,84	
S.aur Nitril	120	2,07	1,92	2,00	1,35
	0	3,36	3,33	3,35	
S.aur Latex	120	2,46	2,43	2,45	0,77
	0	3,16	3,28	3,22	



In this study, treatment of disposable gloves with AutoGlove resulted in a reduction in the number of E.coli and S.aureus upon exposure for 10 sec, 30 sec, 1 minute and 2 minutes.

In order to achieve a further reduction, the exposure time can be increased beyond 2 minutes.

Treatment with UV light thus reduces the presence of these bacteria for each treatment cycle. Even at exposure times down to just 10 seconds, the amounts of E.coli and S.aureus bacteria on the gloves are reduced.

It is important that gloves are replaced or cleaned as soon as there are visible dirt and food residue on them as dirt and food residues will reduce the effect of UV treatment.

The device facilitates the hygienic reuse of disposable gloves as long as users follow the guidelines of the Food Safety Authority*

*Source:https://www.mattilsynet.no/om_mattilsynet/gjeldende_regelverk/veiledere/veileder_til_smilefjesordningen_fra_mattilsynet.21114/binary/Veileder%20til%20smilefjesordningen%20fra%20Mattilsynet

Heidi Stenbråten
Consultant Microbiology/KAM

Eurofins Food & Feed Testing Norway AS