



Report

Cleaning with Less Water

Test of Combined Cleaning & Disinfection Products

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Introduction

Purpose

The meat industry wishes to reduce the water consumption associated with daily cleaning. The purpose of these tests is to investigate if the water consumption can be reduced by using combined cleaning & disinfection (C&D) products in low soil areas instead of the traditional 2-step procedure. This without impairing the level of hygiene and disinfection efficiency.

Background

The traditional cleaning procedure in the meat industry involves large volumes of water and liquid chemicals. The current cleaning programme can be divided into the following subroutines: 1) Prerinsing with water to remove solid waste, 2) Application of cleaning detergent, 3) Rinsing, 4) Disinfection, 5) Rinsing.

Cleaning and disinfection can be combined into one operation using a product containing both cleaning detergents and a disinfectant (C&D product). These products can in some cases replace the traditional 2-step procedure leading to both time and water savings. However, a lower disinfection efficiency is obtained with combined C&D products if the soil level is high (Wiberg et al., 2019).

The purpose of these tests is to investigate if the combined C&D products can be used in low soil areas in a food production without impairing the disinfection efficiency. Low soil areas could be the packaging zone and storage rooms.

The effects of the different disinfectants are evaluated against general recommendations for microbiological level after disinfection of food contact surfaces for raw meat (Table 1) (Danish Standard, 2006). These recommendations can, however, vary between different food production sites. At some sites, a level of 5 cfu/cm² is set as the upper limit of acceptance for food contact surfaces (corresponds to 45 cfu per cm² when contact plates such as Hygicult are used).

Table 1. Quality levels for aerobic plate count of swab samples from food contact surfaces.

Quality of environmental samples	Description	Colony count on 1 plate*	cfu/cm ²
Grade 1	Very good	<1	<1
Grade 2	Good	26-50	1.0-1.9
Grade 3	Acceptable	51-100	2.0-3.8
Grade 4	Improvement is needed	101-200	3.9-7.7
Grade 5	Unacceptable	201- <300	7.8 - <11.5

* Area of plate = 26 cm²

Conclusion

The cleaning and disinfection effect of the two combined C&D products (Topaz CL1 and Foam 2000 CL) was compared with the traditional 2-step procedure with separate products for cleaning and disinfection.

The water consumption was reduced by approx. 100 L when the combined C&D products were used, which in these tests corresponds to a water saving of 30-45% when comparing to the consumption for the 2-step procedure.

All surfaces were visually clean after the use of different cleaning products/programs.

The effect of the different disinfectants was evaluated against a Danish standard for microbiological levels after disinfection. In general, it is recommended that the levels do not exceed 3.8 cfu/cm².

The bacterial levels on all surfaces after the use of the conventional 2-step procedure were acceptable, and most of the swab samples contained <1 cfu/cm² (the initial levels on the surfaces before cleaning varied between 2.7-5.3 log).

A more variable disinfection effect was obtained when the combined C&D products were used; especially for the modular conveyor belt, which is more difficult to clean/disinfect than the steel surfaces. The bacterial levels on the belt after the final rinsing were acceptable on some test days, while the counts varied between 1.2-390 cfu/cm² on other days.

An acceptable disinfection effect was obtained with Topaz CL1 when the product was used on the two different steel surfaces. The bacterial level on these surfaces was reduced from an initial count of 3.8-5.0 log cfu/cm² before cleaning to <1 cfu/cm². The disinfection effect of Foam 2000 CL was more variable on the steel surfaces. The effect was acceptable on the first test day, and on the following two days the bacterial counts in 6 out of the 20 swab samples were above the recommended level.

Based on these results, it is not recommended to replace the daily 2-step procedure with the use of C&D products, as the disinfection effect in some of the tests were too variable/low when a contact time of 15 min was used.

The next step in this project:

- Test if a more stable disinfection effect is obtained if the contact time is increased with 5 min (to 20 min.).
- Test if bacteria are accumulated on the surfaces when combined C&D products are used for a longer period.

Overview of experiments

The tests were performed in DMRI's pilot plant using the same cleaning equipment and settings as used in the industry. This included water pressure, water temperature, and types of nozzles. The tests were conducted using the following procedure:

1. Surfaces were soiled with pork breasts ribs inoculated with bacteria.
2. The meat was removed after 18 hours of soiling to simulate a common production day in the meat industry.
3. After 2 hours of drying, the surfaces were cleaned and disinfected using a procedure with combined C&D products or the traditional 2-step process with separate products for cleaning and disinfection and intermediate rinsing.

Two combined C&D products were selected for the tests. The products were selected in cooperation with Novadan and Ecolab:

- Week 47-48, 2021 (test 1): Foam 2000 CL (Novadan)
- Week 9-10, 2022 (test 2): Topaz CL1 (Ecolab)

Both products were compared to the traditional 2-step procedure using the alkaline foam cleaning agent Topaz MD4 followed by disinfection with sodium-hypochlorite.

Each product was tested three times on separate days.

Surface soiling

The effect of the two programs was tested on two steel tables (7000 cm² and 5676 cm²) and one modular conveyor belt (4800 cm²).

Each surface was soiled with pork breasts inoculated with a bacteria cocktail containing the following species:

- *Brochotrix thermosphacta* (DMRICC 4613)
- *Pseudomonas fluorescens* (DMRICC 4760)

The pure cultures were cultivated in BHI bouillon at 25°C/3 days after which the cultures were mixed 1:1 and diluted to 10⁶ cfu/ml in test 1 and 10⁷ cfu/ml in test 2. Each pork breast (1250 cm²) was inoculated with 25 ml cocktail corresponding to ~ 4.5-5.5 log cfu/cm².

The surfaces were soiled with meat/bacteria in the afternoon (Figure 1). The conveyor belt ran for 1 hour in test 1 and 30 min in test 2 to soil the entire belt. After soiling, the belt with meat was covered in plastic to avoid drying of the surface. The tables were not covered in plastic.

The average room temperature and relative humidity during overnight soiling of the surfaces were 11°C and 58%.



Figure 1. Soiling of surfaces with meat inoculated with $\sim 4.5-5.5 \log \text{cfu}/\text{cm}^2$. The surfaces were soiled for approx. 18 hours to simulate a normal production day in the meat industry.

The meat was removed from the surfaces in the following morning, and the surfaces were cleaned after 2 hours. The surfaces after soiling are shown in Figure 2.

One of the steel tables was raised in an angle of approx. 45° before cleaning, making it more difficult to clean, as some soap and disinfectant will slip off during the contact time of the products.

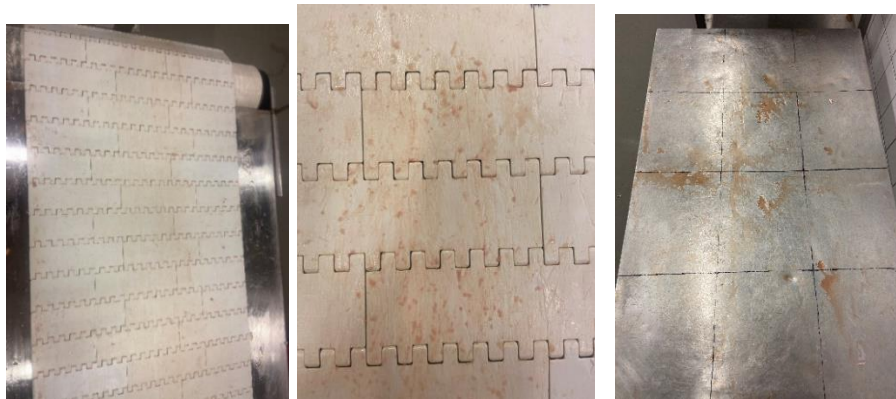


Figure 2. Soiled surfaces.

Products for tests Two combined C&D products were tested and compared with the traditional 2-step procedure (Table 2).

Table 2. Products for tests including contact time used in the tests (recommended interval) and used dosage (recommended dosage).

Product	Product type	Contact time
Foam 2000 CL (Novadan)	Alkaline foam cleaning agent with chlorine	15 min (5-20 min)
Topaz CL1 (Ecolab)	Alkaline foam cleaning agent with chlorine	15 min (10-20 min)
Topaz MD4 (Ecolab)	Alkaline cleaning product without chlorine	15 min (10-20 min)
Sodium hypochlorite (Novadan)	Disinfectant chlorine	10 min (5-10 min)

Cleaning program The two test programs are shown in Table 3.

Table 3. Left: Test procedure for combined C&D products (Foam 2000 CL and Topaz CL1). Right: Test procedure using the traditional 2-step procedure.

Combined C&D products		Tradition 2-step procedure	
Step 1	Pre-rinsing with water (50°C) *	Step 1	Pre-rinsing with water (50°C) *
Step 2	Cleaning and disinfection: Test 1: Foam 2000 CL Test 2: Topaz CL1	Step 2	Cleaning: Topaz MD4
Step 3	Rinsing with water	Step 3	Rinsing with water
		Step 4	Disinfection: Sodium-hypochlorite
		Step 5	Rinsing with water

* Only the conveyor belt was pre-rinsed. Decided after discussion with ISS as low soiled areas are not pre-rinsed.

Each program/product was tested 3 times and on individual test days, e.g.

- Day 1: Test with Foam 2000 CL/Topaz CL1
- Day 2: Test with the 2-step procedure
- Day 3: Test with Foam 2000 CL/Topaz CL1
- Day 4: Test with the 2-step procedure
- Day 5: Test with Foam 2000 CL/Topaz CL1

Two different cleaning operators were used for the tests. The cleaning procedure regarding the distance from water to the surfaces and the cleaning cycle was decided with the individual operators before each test week, and the operators were instructed to use the same procedure every day.

The surfaces were cleaned using standard nozzles used daily in DMRI's pilot plant.

Only the conveyor belt was pre-rinsed with water until approx. 95% of the soil was removed to ensure optimal effect of the cleaning products, while the two steel tables were not pre-rinsed (recommend by ISS).

After the use of cleaning and disinfection agents, the surfaces were rinsed with water until chlorine strips were colourless after surface testing (only used in test weeks 9-10), (Hydrion, Chlorine test strips).

The water usage and time was noted between the individual steps in both procedures.

Pictures before and after cleaning and disinfection are shown in Figure 3.



Figure 3. Pictures of surfaces with soap (10 min after application) and the belt after cleaning and disinfection.

Visual/tactile inspection

The surfaces were inspected (visually/tactile) before and after cleaning and disinfection to document potential day-to-day variations in soil and cleaning levels.

Bacterial analysis

The bacterial level on all surfaces were analysed before and after cleaning and disinfection using sterile gauze swabs. Five swab samples were taken at each sampling time.

After sampling, 50 ml FKP water was added to each gaze cloth, and the sample was stomached for 1 min.

Each sample was analysed for total aerobic plate count at 20°C/5 days on PCA according to SM 108-09.

Results & Discussion

The effect of Foam 2000 CL was evaluated against the conventional 2-step procedure, both by measuring the water consumption and by visual assessment and microbiological analysis of the surfaces after cleaning and disinfection.

The water consumption for the two test programs is shown in Table 4. The water consumption was reduced with approx. 100 L with Foam 2000 CL, which corresponds to a water reduction of 30% compared to when the 2-step procedure was used. The average water consumption for the three test days with Foam 2000 CL was 217 ± 10 L, while the average consumption for the 2-step procedure was 308 ± 15 L.

The microbiological results of the environmental swab samples for the different surfaces are shown Tables 5-7. The results from the tests with foam are shown on the left side in each table, and the results from the 2-step procedure are shown on the right side. Bacterial counts above the recommended level of 3.8 cfu/cm² are marked in red in each table.

All surfaces were visually clean after use of the two different procedures. The most stable disinfection effect was obtained with the conventional 2-step procedure. The inoculation level of the different surfaces varied from 2.7-5.3 log cfu/cm² and after use of the 2-step procedure, all swab samples contained <1 cfu/cm².

The disinfection effect of Foam 2000 CL was more variable, and the bacterial counts in some of the swab samples after the final rinsing were above the recommended levels for food contact surfaces (see Table 1). The disinfection effect was acceptable on the first test day (Tables 5-7, day 1), while a lower effect was obtained on the next two days (Tables 5-7, day 3 and 5). 6 out of 20 swab samples taken from the steel tables were too high on the last two days, and the levels varied from <1-20 cfu/cm².

The disinfection effect on the conveyor belt was very limited on the last test day although the belt was visually clean. The bacteria levels exceeded the requirements in all swab samples taken after the final rinsing, and the highest count was 390 cfu/cm².

It is difficult to find a direct reason for the variations between the results from the different test days. The soil/bacteria levels were similar from day to day, and the belt was pre-rinsed with most water on the test day that showed the lowest effect (day 5). The variations could, however, be associated with the two different operators. Operator 2 was cleaning and disinfecting the surfaces on the first 2 test days (day 1 and 3), while operator 1 was used on the last day (day 5). However, similar variations in the test results were not seen for the 2-step procedure when the two operators were shifted.

Table 4. Water consumption (Litres ± std.dev., n=3) using Foam 2000 CL (left) and a traditional 2-step procedure with separate products for cleaning and disinfection (right).

Foam 2000 CL	Day 1*	Day 3	Day 5
Pre-rinsing - only the belt	-	45 L	69 L
Cleaning	-	20 L	14 L
Rinsing	-	155 L	122 L
Disinfection			
Rinsing			
Total	225 L	220 L	205 L

2-step procedure	Day 2	Day 4	Day 6
Pre-rinsing - only the belt	60 L	55 L	68 L
Cleaning	15 L	12 L	13 L
Rinsing	102 L	115 L	151 L
Disinfection	15 L	20 L	17 L
Rinsing	119 L	89 L	72 L
Total	311 L	291 L	321 L

*The water consumption in the individual steps was not noted.

Table 5. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Foam 2000 CL (left) or 2-step procedure (right). Bacterial levels above the recommended levels are marked in red.

Steel surface				
	Samples	Unit	Foam 2000 CL	
Day 1 Operator 2	Before C&D	log cfu/cm ²	3.4 ± 0.4	
	After – S1	cfu/cm ²	2.3	
	After – S2	cfu/cm ²	<1	
	After – S3	cfu/cm ²	<1	
	After – S4	cfu/cm ²	<1	
	After – S5	cfu/cm ²	<1	
Day 3 Operator 2	Before C&D	log cfu/cm ²	4.7 ± 0.8	
	After – S1	cfu/cm ²	1.3	
	After – S2	cfu/cm ²	3.3	
	After – S3	cfu/cm ²	4.2	
	After – S4	cfu/cm ²	<1	
	After – S5	cfu/cm ²	<1	
Day 5 Operator 1	Before C&D	log cfu/cm ²	3.1 ± 0.4	
	After – S1	cfu/cm ²	3.0	
	After – S2	cfu/cm ²	20.0	
	After – S3	cfu/cm ²	1.9	
	After – S4	cfu/cm ²	2.3	
	After – S5	cfu/cm ²	<1	
Average bacterial count after C&D				2.7 ± 5.0 cfu/cm ²

	Samples	Unit	2-step procedure (reference)
Day 2 Operator 2	Before C&D	log cfu/cm ²	4.4 ± 0.6
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Day 4 Operator 1	Before C&D	log cfu/cm ²	3.2 ± 0.2
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Day 6 Operator 1	Before C&D	log cfu/cm ²	3.4 ± 0.3
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Average bacterial count after C&D			<1 cfu/cm ²

Table 6. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Foam 2000 CL (left) or 2-step procedure (right). Bacterial levels above the recommended levels are marked in red.

Tilted steel surface								
	Samples	Unit	Foam 2000 CL		Samples	Unit	2-step procedure (reference)	
Day 1 Operator 2	Before C&D	log cfu/cm ²	2.9 ± 0.4		Day 2 Operator 2	Before C&D	log cfu/cm ²	3.8 ± 0.4
	After – S1	cfu/cm ²	<1			After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1			After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1			After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1			After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1			After – S5	cfu/cm ²	<1
Day 3 Operator 2	Before C&D	log cfu/cm ²	3.4 ± 0.9		Day 4 Operator 1	Before C&D	log cfu/cm ²	2.7 ± 0.3
	After – S1	cfu/cm ²	9.2			After – S1	cfu/cm ²	1.7
	After – S2	cfu/cm ²	3.9			After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	6.2			After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	2.0			After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1			After – S5	cfu/cm ²	<1
Day 5 Operator 1	Before C&D	log cfu/cm ²	3.4 ± 0.9		Day 6 Operator 1	Before C&D	log cfu/cm ²	3.4 ± 0.5
	After – S1	cfu/cm ²	1,1			After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	10.0			After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1			After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	86			After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	3.2			After – S5	cfu/cm ²	<1

Average bacterial count after C&D	8.3 ± 21.8 cfu/cm ²
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Average bacterial count after C&D	<1 ± 0.4 cfu/cm ²
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Table 7. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Foam 2000 CL (left) or 2-step procedure (right). Bacterial levels above the recommended levels are marked in red.

Conveyor belt			
	Samples	Unit	Foam 2000 CL
Day 1 Operator 2	Before C&D	log cfu/cm ²	2.8 ± 0.1
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	1.9
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Day 3 Operator 2	Before C&D	log cfu/cm ²	-
	After – S1	cfu/cm ²	-*
	After – S2	cfu/cm ²	-*
	After – S3	cfu/cm ²	-*
	After – S4	cfu/cm ²	-*
	After – S5	cfu/cm ²	-*
Day 5 Operator 1	Before C&D	log cfu/cm ²	2.9 ± 0.4
	After – S1	cfu/cm ²	180
	After – S2	cfu/cm ²	120
	After – S3	cfu/cm ²	160
	After – S4	cfu/cm ²	6.9
	After – S5	cfu/cm ²	390

	Samples	Unit	2-step procedure (reference)
Day 2 Operator 2	Before C&D	log cfu/cm ²	2.8 ± 0.0
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Day 4 Operator 1	Before C&D	log cfu/cm ²	2.5 ± 0.2
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	1.9
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1
Day 6 Operator 1	Before C&D	log cfu/cm ²	2.6 ± 0.6
	After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1

Average bacterial count after C&D	86 ± 129.3 cfu/cm ²
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Average bacterial count after C&D	<1 ± 0.4 cfu/cm ²
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* The wrong nozzle was used when the cleaning detergent was applied on the belt, and the data can therefore not be used.

Evaluation of Topaz CL1 The water consumption was reduced with approx. 100 L with Topaz CL1, which corresponds to a water reduction of 45% compared to when the 2-step procedure was used. Approx. 121 L were used for cleaning and disinfection of two steel tables (7000 cm² and 5676 cm²) and one conveyor belt (4800 cm²), while the water consumption was increased to 220 L when the 2-step procedure was applied.

All surfaces were visually clean after use of the two different procedures on all test days, and the disinfection effect of Topaz CL1 was in most cases comparable with the effect of the 2-step procedure. After the final rinsing, the average bacterial counts on the two steel tables were <1 cfu/cm². Bacteria were only found in a few swab samples after cleaning/disinfection, but the counts of these samples were still acceptable. The initial bacterial levels on the steel surfaces before the cleaning/disinfection varied from 3.8-5 log cfu/cm² (Tables 9-10).

A more variable disinfection effect was obtained when Topaz CL1 was used on the conveyor belt (Table 11). Acceptable levels after cleaning/disinfection were obtained on the first two days, and the counts varied from <1-3.1 cfu/cm² (Table 11, day 2 and 4). On the last test day, the bacterial level in 4 out of 5 swab samples were unacceptable with the highest count of 125 cfu/cm². The reason for the variable effect has not been identified. The soil/bacteria level was consistent throughout the different tests, and the water consumption in the individual steps in the tests did not vary from day-to-day when the combined C&D product was used.

When comparing the results of the two combined C&D products, the highest disinfection effect with the lowest water consumption was obtained with Topaz CL1.

Table 8. Water consumption (Litres ± std.dev., n=3) using Topaz CL1 (left) and a traditional 2-step procedure with separate products for cleaning and disinfection (right).

Topaz CL1	Day 1	Day 3	Day 5
Pre-rinsing - only the belt	25 L	35 L	29 L
Cleaning	10 L	8 L	11 L
Rinsing	82 L	80 L	83 L
Disinfection			
Rinsing			
Total	117	123	123

2-step procedure	Day 2	Day 4	Day 6
Pre-rinsing - only the belt	30 L	35 L	34 L
Cleaning	5 L	10 L	10 L
Rinsing	86 L	70 L	70 L
Disinfection	9 L	9 L	10 L
Rinsing	75 L	108 L	97 L
Total	205	232	221

Table 9. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Topaz CL1 (left) or 2-step procedure (right).

Bacterial levels are below the recommended level.

Steel surface								
	Samples	Unit	Topaz CL1		Samples	Unit	2-step procedure (reference)	
Day 2 Operator 1	Before C&D	log cfu/cm ²	4.5 ± 0.3		Day 1 Operator 1	Before C&D	log cfu/cm ²	4.9 ± 0.3
	After - S1	cfu/cm ²	<1			After - S1	cfu/cm ²	<1
	After - S2	cfu/cm ²	<1			After - S2	cfu/cm ²	<1
	After - S3	cfu/cm ²	<1			After - S3	cfu/cm ²	<1
	After - S4	cfu/cm ²	<1			After - S4	cfu/cm ²	<1
	After - S5	cfu/cm ²	<1			After - S5	cfu/cm ²	<1
Day 4 Operator 1	Before C&D	log cfu/cm ²	4.9 ± 0.4		Day 3 Operator 1	Before C&D	log cfu/cm ²	4.3 ± 0.4
	After - S1	cfu/cm ²	<1			After - S1	cfu/cm ²	<1
	After - S2	cfu/cm ²	<1			After - S2	cfu/cm ²	<1
	After - S3	cfu/cm ²	<1			After - S3	cfu/cm ²	<1
	After - S4	cfu/cm ²	<1			After - S4	cfu/cm ²	<1
	After - S5	cfu/cm ²	<1			After - S5	cfu/cm ²	<1
Day 6 Operator 1	Before C&D	log cfu/cm ²	5.0 ± 0.8		Day 5 Operator 1	Before C&D	log cfu/cm ²	5.3 ± 0.6
	After - S1	cfu/cm ²	<1			After - S1	cfu/cm ²	<1
	After - S2	cfu/cm ²	<1			After - S2	cfu/cm ²	<1
	After - S3	cfu/cm ²	<1			After - S3	cfu/cm ²	<1
	After - S4	cfu/cm ²	<1			After - S4	cfu/cm ²	<1
	After - S5	cfu/cm ²	<1			After - S5	cfu/cm ²	<1
Average bacterial count after C&D			<1 ± 0 cfu/cm ²	Average bacterial count after C&D			<1 ± 0 cfu/cm ²	

Table 10. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Topaz CL1 (left) or 2-step procedure (right). Bacterial levels are below the recommended level.

Tilted steel surface							
	Samples	Unit	Topaz CL1		Samples	Unit	2-step procedure (reference)
Day 2 Operator 1	Before C&D	log cfu/cm ²	4.0 ± 0.2	Day 1 Operator 1	Before C&D	log cfu/cm ²	3.8 ± 0.4
	After – S1	cfu/cm ²	<1		After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	2.5		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1		After – S5	cfu/cm ²	<1
Day 4 Operator 1	Before C&D	log cfu/cm ²	3.8 ± 0.3	Day 3 Operator 1	Before C&D	log cfu/cm ²	3.8 ± 0.2
	After – S1	cfu/cm ²	<1		After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1		After – S5	cfu/cm ²	<1
Day 6 Operator 1	Before C&D	log cfu/cm ²	4.4 ± 0.5	Day 5 Operator 1	Before C&D	log cfu/cm ²	4.1 ± 0.4
	After – S1	cfu/cm ²	1.8		After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	<1		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	3.8		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	<1		After – S5	cfu/cm ²	<1
Average bacterial count after C&D			<1 ± 1.3 cfu/cm ²	Average bacterial count after C&D			<1 ± 0 cfu/cm ²

Table 11. Bacterial counts before (log cfu/cm²) and after (cfu/cm²) cleaning and disinfection with Topaz CL1 (left) or 2-step procedure (right). Bacterial levels above the recommended are marked in red.

Conveyor belt				Conveyor belt			
	Samples	Unit	Topaz CL1		Samples	Unit	2-step procedure (reference)
Day 2 Operator 1	Before C&D	log cfu/cm ²	3.5 ± 0.8	Day 1 Operator 1	Before C&D	log cfu/cm ²	3.3 ± 0.4
	After – S1	cfu/cm ²	<1		After – S1	cfu/cm ²	3.3
	After – S2	cfu/cm ²	<1		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	<1		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	2.5		After – S5	cfu/cm ²	<1
Day 4 Operator 1	Before C&D	log cfu/cm ²	4.5 ± 0.7	Day 3 Operator 1	Before C&D	log cfu/cm ²	3.5 ± 0.4
	After – S1	cfu/cm ²	1.2		After – S1	cfu/cm ²	<1
	After – S2	cfu/cm ²	1		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	1.2		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	<1		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	3.1		After – S5	cfu/cm ²	<1
Day 6 Operator 1	Before C&D	log cfu/cm ²	4.8 ± 0.7	Day 5 Operator 1	Before C&D	log cfu/cm ²	5.0 ± 0.4
	After – S1	cfu/cm ²	125		After – S1	cfu/cm ²	2.5
	After – S2	cfu/cm ²	113		After – S2	cfu/cm ²	<1
	After – S3	cfu/cm ²	31		After – S3	cfu/cm ²	<1
	After – S4	cfu/cm ²	1.2		After – S4	cfu/cm ²	<1
	After – S5	cfu/cm ²	6,3		After – S5	cfu/cm ²	<1
Average bacterial count after C&D			19.2 ± 41.4 cfu/cm ²	Average bacterial count after C&D			<1 ± 1.0 cfu/cm ²

Conclusion

The cleaning and disinfection effect of the two combined C&D products (Topaz CL1 and Foam 2000 CL) was compared with the traditional 2-step procedure with separate products for cleaning and disinfection.

The water consumption was reduced by approx. 100 L when the combined C&D products were used, which in these tests corresponds to a water saving of 30-45% when comparing to the consumption for the 2-step procedure.

All surfaces were visually clean after the use of different cleaning products/programs.

The effect of the different disinfectants was evaluated against a Danish standard for microbiological levels after disinfection. In general, it is recommended that the levels do not exceed 3.8 cfu/cm².

The bacterial levels on all surfaces after the use of the conventional 2-step procedure were acceptable, and most of the swab samples contained <1 cfu/cm² (the initial levels on the surfaces before cleaning varied between 2.7-5.3 log).

A more variable disinfection effect was obtained when the combined C&D products were used; especially for the modular conveyor belt, which is more difficult to clean/disinfect than the steel surfaces. The bacterial levels on the belt after the final rinsing were acceptable on some test days, while the counts varied between 1.2-390 cfu/cm² on other days.

An acceptable disinfection effect was obtained with Topaz CL1 when the product was used on the two different steel surfaces. The bacterial level on these surfaces was reduced from an initial count of 3.8-5.0 log cfu/cm² before cleaning to <1 cfu/cm². The disinfection effect of Foam 2000 CL was more variable on the steel surfaces. The effect was acceptable on the first test day, and on the following two days the bacterial counts in 6 out of the 20 swab samples were above the recommended level.

Based on these results, it is not recommended to replace the daily 2-step procedure with the use of C&D products, as the disinfection effect in some of the tests were too variable/low when a contact time of 15 min was used.

The next step in this project:

- Test if a more stable disinfection effect is obtained if the contact time is increased with 5 min (to 20 min.).
- Test if bacteria are accumulated on the surfaces when combined C&D products are used for a longer period.

References

Danish Standard (2006), Cleaning Quality – Systems for Establishing and Assessing Cleaning Quality. DS Projekt: M252393 ICS: 03.080.10.

Wiberg, S., Hindborg Kristensen, C., Bjarnov Kaas-Larsen, Kjartan (2019), Optimeret rengøring og desinfektion i kødindustrien – Test af alternative kemiprodukter og kemiprogrammer. Projektnr. 2007045. Rapport af 14/11 2019.

*Time schedule
for tests*

Test 1 – Foam 2000 CL (week 47-48)	Date	Product	Operators
Day 1	23.11 21	Foam 2000 CL	DME
Day 2	24.11.21	Topaz MD4 and Sodium-hypochlorite	DME
Day 3	25.11 21	Foam 2000 CL	DME
Day 4	30.11 21	Topaz MD4 and Sodium-hypochlorite	DME
Day 5	01.12 21	Foam 2000 CL	JPT
Day 6	02.12 21	Topaz MD4 and Sodium-hypochlorite	JPT

Test 1 – Topaz CL1 (week 9-10)	Date	Product	Operators
Day 1	01.03 22	Topaz CL1	JPT
Day 2	02.03 22	Topaz MD4 and Sodium-hypochlorite	JPT
Day 3	03.03 22	Topaz CL1	JPT
Day 4	08.03 22	Topaz MD4 and Sodium-hypochlorite	JPT
Day 5	09.03 22	Topaz CL1	JPT
Day 6	10.03 22	Topaz MD4 and Sodium-hypochlorite	JPT