# COLD WATER, ULTRA-HIGH PRESSURE CLEANING OF ABATTOIRS

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Cold water (10°C) at ultra-high pressure (38.5 - 49 kg/cm$^2$) was compared with (a) hot water (65.6 - 82.2°C) at low pressure (4.2 - 5.6 kg/cm$^2$) and (b) hot water containing a detergent (2% w/v sodium silicate). Seven sites were examined in a beef abattoir and six in a bacon factory.

Three surfaces in the beef abattoir had lower residual colony counts (higher reductions) after hot water/low pressure than after cold water/high pressure. However, the differences were not significant ($P > 0.05$). The range of the mean $\log_{10}$ count/cm$^2$ before cleaning was 4.02 - 5.15, and after cleaning, 1.73 - 2.32 (hot water) and 1.9 - 2.85 (cold water).

On three of the remaining sites, the three methods were compared. The overall differences between treatments were not significant ($P > 0.05$), although there was an effect of surface and an interaction between surface and treatment.

The cold water produced lower residual counts on three sites in the bacon factory than the hot water (45° - 54°C) However, the differences were not significant on the remaining surfaces.

## Nettoyage des Abattoirs, à l'eau froide à très haute pression.

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On a comparé l'eau froide (10°C) à très haute pression,(38,5 - 49 kg/cm$^2$) avec (a) l'eau chaude, (65,6 - 82,2°C) à basse pression,(4,2 - 5,6 kg/cm$^2$), et (b) l'eau chaude,contenant un détergent, (2% w/v silicate de sodium). On a examiné sept endroits dans un abattoir de boeufs et six endroits dans une usine de jambon.

Trois des surfaces de l'abattoir de boeufs avaient un compte de colonies résiduelles plus bas, (diminution plus élevée), après passage à l'eau chaude/basse pression qu'après passage à l'eau froide/haute pression. Cependant, les différences n'étaient pas significatives,($P > 0,05$). L'étendue du compte de logarithme$_{10}$ moyen/cm$^2$ était de 4,02 - 5,15 avant nettoyage et de 1,73 - 2,32(eau chaude) et 1,9 - 2,85(eau froide) après nettoyage.

On a comparé les trois méthodes à trois autres endroits. En général, les différences entre les traitements n'étaient pas significatives,($P > 0,05$). Il y avait, cependant, un effet de surface et une action réciproque entre surface et traitement.

L'eau froide a donné des comptes résiduels moins élevés à trois endroits de l'usine de jambon que ceux de l'eau chaude,(45°-54°C). Cependant, les différences n'étaient pas significatives sur les autres surfaces.

# C7:2

## KALTWASSER, ULTRA-HOCHDRUCK-REINIGUNG DES SCHLACHTHAUSES

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Kaltwasser bei Ultra-Hochdruck (38.5 -49 kg/cm$^2$) wurde verglichen mit Heisswasser (65.6 - 82.2°C) bei Tiefdruck (4.2 - 5.6 kg/cm$^2$) und (b) heissem Wasser ein Reinigungsmittel enthaltend (2% w/v sodium silicate). In einem Rinderschlachthaus wurden sieben Plätze und sechs in einer Schinkenfabrik.

Drei Oberflächen in dem Rinderschlachthaus hatten eine niedrigere Rückstands-Mengenzahl (höhere Reduktion) nach Heisswasser/Tiefdruck als nach Kaltwasser/Hochdruck. Trotzdem waren die Unterschiede nicht beträchtlich (P>0.05). Der Umfang der durchschnittlichen Eintragungen vor der Reinigung war 4.02 - 5.15 und nach der Reinigung 1.73 - 2.32 (Heisswasser) und 1.9 - 2.85 (Kaltwasser).

Bei drei der übrigen Plätze wurden die drei Methoden verglichen. Die Gesamtergebnisse zwischen den einzelnen Behandlungen waren nicht bedeutend, obgleich eine Wirkung an der Oberfläche und eine Wechselwirkung zwischen Oberfläche und Behandlung festzustellen war. (P>0.05)

Die Kaltwassermethode ergab niedrigere Rückstandsmengen bei drei Plätzen in der Schinkenfabrik als die Heisswassermethode (45°-54°C). In jedem Fall waren die Unterschiede bei den übrigen Plätzen von keiner Bedeutung.

## ОЧИСТКА СКОТОБОЙНИ ХОЛОДНОЙ ВОДОЙ ПОД УЛЬТРАВЫСОКИМ ДАВЛЕНИЕМ

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Сравнивалась холодная вода (10°C) под ультравысоким давлением (38,5 - 49 кг/см$^2$) с а) горячей водой (65,6 - 82,2°C) под низким давлением (4,2 - 5,6 кг/см$^2$) и с б) горячей водой, содержащей дезинфицирующее средство ( 2% w/v $Na_4SiO_4$). Исследовалось семь мест в скотобойне и шесть мест на заводе для производства бекона.

Три поверхности в скотобойне показали низшее количество колоний (высшую редукцию) после горячей воды под низким давлением чем после холодной воды под высоким давлением. Однако эти различия не являются значительными (P > 0,05)

Пределы, высчитанные для колонии в среднем в см$^2$ были перед очисткой 4,02-5,15 и после очистки 1,73-2,32 (горячая вода) и 1,9-2,85 (холодная вода).

На трех остальных местах сравнивались эти три метода. В общем различия между ними не были значительными (P > 0,05), но наблюдалось влияние поверхности и взаимодействие между поверхностью и видом очистки.

На трех местах на заводе для производства бекона было установлено низшее количество колоний после очистки холодной водой чем после очистки горячей водой (45°-54°C), но остальные поверхности не показали значительного различия.

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## INTRODUCTION

A re-evaluation has had to be made of the cost of raising steam for abattoir cleaning since the oil crisis of October 1973. The cost of detergents and detergents/sterilizers has also increased by as much as 40% since that time (Campbell, pers. comm.). This situation has necessitated investigating other means of cleaning of which one is cold water (C. 10°C) at ultra-high pressures (38.5 - 49.0 Kg/cm$^2$)*. The present investigation was undertaken to compare the efficiency of the method with others commonly used.

## EXPERIMENTAL

### Experiment 1.

The work was carried out in a beef abattoir (200 - 220 cattle per day) during a six month period (April - Oct. 1975) by comparing the following methods;

1. Cold water (C. 10°C) at 49Kg/cm$^2$ using a 'Psimat' high pressure pump, model No. 800E (Psimat Ltd., Henley-on-Thames, England) for 60 - 90 sec. and delivering 14 l/min.
2. Steam hose (65.6° - 82.2°C) at 4.2 - 5.6 Kg/cm$^2$ delivering 45 - 70 l/min. These methods were compared in five trials.
3. On three of these occasions it was noted that a brown-green scum developed on certain areas, e.g. the tiled walls of the carcase washing bay after both cold and hot water treatments. Method 3 was then introduced and consisted of brushing the surface with a 2% ($^w/_v$) solution of sodium silicate at 68°C and rinsing with cold water (Dempster, 1971).

The sites chosen were: (1) tiled wall of carcase washing bay, (2) tiled wall of 'deheading' area, (3) stainless steel inedible fat chute, (4) metal guard at backbone saw, (5) evisceration table, (6) and (7) stainless steel boning tables.

Bacteriological counts were carried out on each surface by swabbing an area on four sites each of 100 cm$^2$ using a sterile metal template and four cotton-gauze swabs. The swabs were rubbed over the surface five times in each direction using moderate pressure (Patterson, 1971). They were pooled by transferring to 80 ml quarter strength ringer's diluent + 0.1% peptone (Straka and Stokes, 1957) in a screw-capped bottle. Serial decimal dilutions were made in the same diluent, using a 1 ml 'Oxford' sampler pipette with a disposable tip (Oxford Laboratories, Athy, Ireland). Dried plates of 'Uxoid' plate Count Agar were divided into quadrants and the surface inoculated with replicate 0.025 ml amounts of sample using a 25 µl Oxford sampler. The plates were counted after 3 days at 25°C. A visual appraisal was made of surfaces before and after cleaning by members of the factory staff, veterinary officers and staff of this Institute.

* 1 Kg/cm$^2$ = 14.29 p.s.i.

### Experiment 2.

This experiment was conducted in a bacon factory (350 pigs/day) on six occasions (Nov. - Dec., 1975). Only two treatments were compared:

1. Cold water (C. 10°C) at 38 Kg/cm$^2$ using a 'Jet-n-spray' (700) pump (W.D.M. Plant Hire Ltd. Exeter, England) for 60 sec. and delivering 54 l/min. and,
2. hot water (45° - 54°C) from a steam hose at 3.5 - 4.2 Kg/cm$^2$ for 60 sec. and delivering 36 l/min.

Six sites were chosen: (1) 'terrazzo' wall of bleeding passage, (2) stainless steel dehairer platform, (3) blades of black scraper, (4) cutting table, (5) 'terrazzo' wall of boning hall and (6) stainless steel table. Bacterial counts and visual appraisal of surfaces were made as described above.

An analysis of variance was performed on the log transformed colony counts in both experiments. The data was analysed as a split plot design with surface (site) as the main plot factor and treatment as sub plot factor. The 't' test was used for tests between individual means for a given surface.

## RESULTS AND DISCUSSION

In Table 1 is shown the reductions in count for four surfaces in a beef abattoir when cleaned by hot water/low pressure and cold water /high pressure. Surfaces 3,4 and 7 had lower residual counts (higher reductions) after hot water cleaning. However, in no instance was there a significant difference between the two methods of cleaning, or a significant difference between surfaces and there was no interaction between them ($P > 0.05$). The mean colony count/cm$^2$ before cleaning ranged from log 4.02 to 5.15 and after cleaning, from log 1.73 to 2.32 (hot water) and log 1.9 to 2.85 (cold water). These results therefore suggest that cold water/high pressure is as efficient as hot water /low pressure in removing bacterial contamination.

The reductions in count on three other surfaces after cleaning by the three methods are presented in Table 2. The overall differences between treatments were not significant ($P > 0.05$) although there was an effect of

surface and interaction between surface and treatment ($P < 0.05$). The mean initial and residual counts ($log_{10}/cm^2$) for these surfaces are shown in Table 3. Brushing with a hot detergent solution produced a higher reduction (lower residual count) on the wall of the carcase washing bay than the other methods. This treatment also removed the staining on tiled walls. However, there was a nett increase in bacterial numbers on the walls of the washing bay after hot water/low pressure washing. It is presumed this was due to a combination of factors, namely, water temperature, low line pressure and recontamination. The mean water temperature was 66°C which is short of sterilizing temperature (82°C) (McLaughlin, 1969). The recontamination was due to what is described as 'gravity soiling'. This term was coined to describe contamination which drains by gravity down a surface and applies particularly to vertical or inclined areas such as walls. The low line pressure was not sufficient to dislodge foci of contamination. However, recontamination did not occur on the wall of the 'deheading' area. A possible explaination is that the mean initial count (log 5.05/$cm^2$) may have been greater than that of surrounding areas and therefore any combination of cleaning techniques would result in a decrease in numbers.

The composite results of six trials in a local bacon factory are presented in Table 4. On sites 1, 2 and 3, the cold water treatment produced higher reductions than the hot water treatment ($P < 0.05$). However, on sites 4, 5 and 6 the differences were not significant ($P > 0.05$) although on sites 4 and 6, hot water/low pressure resulted in greater reductions. On average, the cold water/high pressure was more efficient than the hot water/low pressure ($P < 0.01$) producing a log 0.39 better reduction than the hot. There were also significant differences between sites ($P < 0.05$) and a significant interaction between treatments and sites ($P < 0.01$).

The mean initial and residual colony counts and percentage survival for these surfaces are shown in Table 5. As before, recontamination occurred on one surface (site 2) which was an inclined platform attached to the dehairer machine. The residual counts were still high ranging from 219 - 6,761,000/$cm^2$ (hot water) and 468 - 871,000/$cm^2$ (cold water), although the results were satisfactory in terms of percentage organisms surviving with the exception of site 1 (70.81%). Similar results were obtained with meat mincing machines and recommendations were made to ensure that only small numbers of microorganisms survive, e.g., 100/ml or 100/$cm^2$ at 22° - 25°C. (Dempster 1973). The extremely high counts on the Black scraper reflect the conditions which can exist when equipment of this type is not regularly cleaned. Earlier observations (Dempster 1971) had shown that the undersides of the scraping blades were heavily contaminated with slime and time-consuming methods were required to remove this.

One recurring comment of the judges (bacon factory) was the unattractive 'greasy' film which persisted on surfaces after both methods of cleaning but especially when cold water was used. However, with few exceptions, the present results have indicated that both cold water and hot water produced a low percentage survival of organisms. At present, the relationship between residual 'greasiness' and bacterial contamination is being further examined.

## Recommendations

Cold water at ultra-high pressure can be used in abattoir cleaning if the following conditions exist;

1. The soiling is of recent origin, i.e., <24 hours old.
2. Other methods are used, e.g., brushing with hot detergent solution when a surface becomes visually stained.
3. Cleaning is regularly carried out (hourly or daily). Cold water or even hot water (50° - 55°C) will not remove faecal staining, congealed blood or other types of 'hard soil' if allowed to dry on a surface.
4. All surfaces are examined weekly to determine which system of cleaning is to be used.

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Table 1

MEAN $LOG_{10}$ REDUCTIONS IN COUNT/$CM^2$ ON 4 SURFACES BY 2 TREATMENTS (BEEF ABATTOIR)

| No. | Site | Treatment: Hot Water (65.6°-82.2°C) at low pressure | Treatment: Cold Water (10°C) at high pressure |
|---|---|---|---|
| 3 | Stainless Steel fat chute | 2.73 | 2.70 |
| 4 | Metal guard | 2.29 | 1.62 |
| 5 | Evisceration table | 1.80 | 1.89 |
| 7 | Stainless Steel boning table | 2.83 | 2.30 |

S.E. of difference between treatments,

(Same Surface = 0.412 df = 16
(Different Surface = 0.619 df = 12.7

Table 2

MEAN $LOG_{10}$ REDUCTIONS IN COUNT/$CM^2$ ON 3 SURFACES BY 3 TREATMENTS (BEEF ABATTOIR)

| No. | Site | Treatment: Hot Water (65.6°-82.2°C) | Treatment: Cold Water (10°C) at high pressure | Treatment: Hot (68°C) Detergent Solution (2% w/v) |
|---|---|---|---|---|
| 1 | Tiled wall of washing bay | -0.58 | 0.50 | 1.31 |
| 2 | Tiled wall of deheading area | 1.21 | 2.72 | 2.79 |
| 6 | Stainless Steel boning table | 2.94 | 1.20 | 1.72 |

S.E. of difference between treatments,

(Same Surface = 0.726 df = 12
(Different Surface = 0.693 df = 7.8

Table 3

MEAN INITIAL AND RESIDUAL COUNTS ($LOG_{10}$/$CM^2$) OF SURFACES CLEANED BY DIFFERENT METHODS (BEEF ABATTOIR)

| No. | Site | Initial Count | Hot Water (65.6°-82.2°C) at low pressure | Cold Water (10°C) at high pressure | Hot (68°C) Detergent Solution (2% w/v) |
|---|---|---|---|---|---|
| 1 | Tiled wall of washing bay | 2.43 | 3.09 | 2.17 | 1.80 |
| 2 | Tiled wall of deheading area | 5.05 | 3.23 | 2.45 | 2.75 |
| 6 | Stainless steel boning table | 4.19 | 1.90 | 2.64 | 2.15 |

Table 4

MEAN $LOG_{10}$ REDUCTIONS IN COUNT/$CM^2$ ON 6 SURFACES BY 2 TREATMENTS (BACON FACTORY)

| No. | Site | Treatment: Hot Water (45°-54°C) at low pressure | Treatment: Cold Water (10°C) at high pressure |
|---|---|---|---|
| 1 | Terrazzo wall of bleeding passage | 0.15 | 1.41 |
| 2 | Stainless steel dehairer platform | -0.42 | 0.98 |
| 3 | Blades of Black scraper | 1.07 | 1.96 |
| 4 | Stainless steel cutting table | 2.23 | 1.90 |
| 5 | Terrazzo wall of boning hall | 1.07 | 1.11 |
| 6 | Stainless steel table | 2.05 | 1.58 |

S.E. of difference between treatments (Same Surface = 0.353 df = 30
(Different Surface = 0.602 df = 25.7

Table 5

MEAN INITIAL AND RESIDUAL COUNTS/$CM^2$ OF SURFACES CLEANED BY DIFFERENT METHODS (BACON FACTORY)

| No. | Site | Initial Count | Residual count after cleaning by: Hot Water (45°-54°C) at low pressure | Residual count after cleaning by: Cold Water (10°C) at high pressure |
|---|---|---|---|---|
| 1 | Terrazzo wall of bleeding passage | 138,000 | 97,720 (70.81)* | 5,370 (3.89)* |
| 2 | Stainless steel dehairer platform | 6,457 | 16,980 (inc)** | 661 (10.24) |
| 3 | Blades of Black scraper | 79,430,000 | 6,761,000 (8.51) | 871,000 (1.10) |
| 4 | Stainless steel cutting table | 37,150 | 219 (0.59) | 468 (1.26) |
| 5 | Terrazzo wall of boning hall | 8,511,000 | 724,400 (8.51) | 676,100 (7.94) |
| 6 | Stainless steel table | 134,900 | 1,202 (0.89) | 3,548 (2.63) |

*, Survival (%)

**, Increase