

REFRIGERATION, FREEZING AND THAWING

THE EFFECTS OF WASHING LAMB CARCASSES

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Lamb washing trials have been carried out using a fan-type spray operated at 50 psi while temperature (37°C, 50°C, 65°C, 80°C), chlorine concentration (30 ppm, 95 ppm, 450 ppm) and time (30 secs, 120 secs) were varied. The lower temperatures (37°C, 50°C) did not give significant reductions in bacterial numbers unless chlorine was present. Both 65°C and 80°C gave similar significant reductions of \log_{10} 0.8. The addition of chlorine at any temperature significantly enhanced reductions, 30 and 95 ppm by \log_{10} 0.5 and 450 ppm by \log_{10} 1.0. Increased time was only beneficial in the presence of chlorine. All washed carcasses were visually cleaner than unwashed controls without any loss of 'bloom' being evident.

DIE EFFEKTE VON WASHUNG VON LAMM KADAVERN

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Lamm-Waschungsversuche sind mit einer fächerartigen Dusche bei 50 psi ausgeführt worden, während die Temperatur (37°C, 50°C, 65°C, 80°C), Chlor Konzentrat (30 ppm, 95 ppm, 450 ppm) und Zeit (30 Sek., 120 Sek) verschieden waren. Die niedrigeren Temperaturen erzeugten keine wesentlichen Verringerungen in Bakterienzahl, wenn kein Chlor vorhanden war. 65°C und 80°C ergaben ähnliche wesentliche Reduzierungen von \log_{10} 0.8. Der Zusatz von Chlor bei jeder Temperatur erhöhte wesentlich die Reduzierung, 30 und 95 ppm von \log_{10} 0.5 und 450 ppm von \log_{10} 1.0. Zunehmende Zeit war nur bei vorhandenem Chlor vorteilhaft. Alle gewaschenen Kadaver waren sichtlich sauberer als ungewaschene Kontrollen ohne augenscheinlichen Verlust von Flaum.

LES EFFETS DE LAVAGE SUR LES CARCASSES D'AGNEAUX

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Les essais de lavage sur les carcasses d'agneaux ont été effectués en se servant d'un embrun formé d'un éventail mis en marche à cinquante (livres le pouce carré), pendant que les températures (37°C, 50°C, 65°C, 80°C), les concentrations de chlore (30 parties par million), 95 ppm, 450 ppm) et la durée de cette besogne (30 seconds, 120 seconds) étaient variées. Le lavage en contre bas (37°C, 50°C) sans chlore ne fournissaient pas des réductions de grande portée dans la population bactériologique. Dans le cas de (65°C, 80°C) on y pourrait apercevoir des réductions significatives semblablement de \log_{10} 0.8. L'addition de chlore à toutes les températures mettait en valeur les réductions d'importances, 30 et 95 ppm par \log_{10} 0.5, et 450 ppm par \log_{10} 1.0. Une augmentation dans le temps était profitable seulement en présence de chlore. Tous les carcasses lavés étaient visuellement plus propres que ceux-là des surveillance pas lavés, sans aucune perte de "velouté".

ЭФФЕКТЫ ПРОМЫВКИ ТУЛОВИЩ ЯГНЯТ

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Испытались системы промывки ягнят с помощью веерообразного распылителя при давлении в 50psi при разных температурах (37°C, 50°C, 65°C, 80°C); концентрации хлора (30ppm, 95ppm, 450ppm) и временах (30 сек., 120сек.). Более низкие температуры (37°C, 50°C) не дали значительных уменьшений количеств бактерий, только при присутствии хлора. И при 65°C и 80°C появились подобные, значительные уменьшения на \log_{10} 0.8. Добавление хлора при всякой температуре значительно увеличило редукции 30 и 95 ppm на \log_{10} 0.5; 450ppm на \log_{10} 1.0. Дополнительное время оказало положительное влияние только при присутствии хлора. Все промывные туловища представили собой более чистые по сравнению с контролями, и без всякой явной потери "цвели".

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MATERIALS AND METHODS

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INTRODUCTION

The growing importance of their lamb carcass export trade has caused Irish meat factories to seek out production methods which will yield a carcass capable of maintaining high quality during transportation and ensure complete customer satisfaction. The banning of wiping cloths used for cleaning and removing excess water from carcasses has meant that a carcass washing treatment must be found which will remove visible dirt and stains and not damage the "bloom", a term as yet not clearly defined, but taken to include such carcass characteristics as colour, appearance and texture of the outer tissue layers.

Traditionally it has been felt that washing resulted in a loss of "bloom", and although reports by Bryce-Jones (1969), Bailey (1972) and Patterson (1971) have indicated that this does not occur, many Irish factories have received unfavourable comments on their washed lamb carcasses from export markets.

Thus investigations were commenced to establish what effects if any washing had on lamb carcasses in terms of bacteriological quality and "bloom".

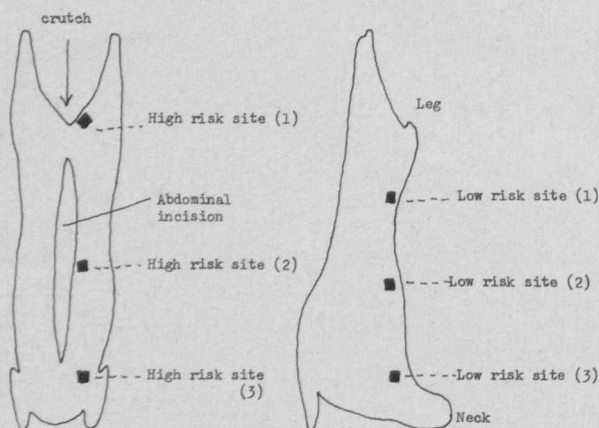


Diagram of sites swabbed on the carcass

The desired temperature (ex hose) was obtained using steam injection. NaOCl (in the form "Chlorox" I.C.I.) was added to give the required Chlorine concentration. This was checked by the iodometric method of Vogel (1948).

Prior to washing, one side of the carcass was swabbed at the six sites as shown in the diagram. Each site (of 25 sq cms) was swabbed using a cotton tipped applicator stick. The corresponding sites on the other side of the carcass were swabbed 30 minutes after treatment. The three sites on the back of the carcass were considered to be "low risk contamination areas" and were pooled in 75 mls $\frac{1}{4}$ strength Ringers Thiosulphate diluent (+ 0.1% peptone). The other three sites were considered to be "high risk contamination" areas and were similarly pooled. Total viable counts of these pooled swab samples were carried out using the pour-plate technique (Trial One) or the drop technique of Davis & Bell (1959) (Trial Two) on Plate Count Agar (Oxoid) and incubated at 25°C for 3 days. After washing the carcasses were hung in a well ventilated chill (1°C). Bloom was evaluated by a panel of 7 judges which included members of the staff of the factory experienced in carcass judging, a member of the veterinary profession, and a member of the meat research department. At 1 and 3 days post-mortem the

(1) Trials One and Two

All trials were carried out in one export factory. The carcasses used in Trial One weighed 50-60 lbs, those in Trial Two under 45 lbs. Carcasses were obtained at the end of the slaughter line after they had undergone the normal factory dressing procedure which included a quick spraying of the neck and shoulder region with cold water (10°C).

Half of the carcasses selected in each trial did not receive any further treatment and were retained as controls for evaluation of "bloom". The other carcasses were washed using a Mono pump (Type SH ZZA5) delivering water at 50 p.s.i. through a fan-type spray jet held six inches from the carcasses. The different washing treatments used are listed in Table One; 8 carcasses were washed by each treatment in Trial One, and 3 by each treatment in Trial Two.

TABLE ONE: Washing Treatments used in Trials One and Two.

Trial One			Trial Two	
Temperature (°C)	Chlorine (ppm)	Time (secs)	Temperature (°C)	Chlorine (ppm)
80	450	30	80	-
80	450	120	80	30
80	-	30	80	95
80	-	120	65	-
37	450	30	65	30
37	450	120	65	95
37	-	30	50	-
37	-	120	50	30
			50	95

Pressure: constant 50 psi

Pressure: constant 50 psi

Time : constant 120 secs

panel examined 8 pairs of carcasses, each pair consisting of a carcass treated by us and one which had received only the factory dressing. They first examined each pair in turn and selected the carcass, if any, they considered had a better bloom. After this, they again examined each pair in turn and assigned each carcass a grade for bloom based on a five point scale from "poor" to "excellent".

The evaluation of cleanliness was made by a separate panel of 3 judges who normally inspect and clean carcasses in the factory.

(2) Trial Three

No bacteriological samples were taken in this trial. Carcasses were obtained from the slaughter line before the routine neck washing. In order to eliminate animal to animal variation in bloom it was decided to wash only one side of each carcass, and use the unwashed side as a within animal bloom control. The unwashed side was protected by plastic sheeting.

The side was washed with the fan jet as previously at 50 p.s.i. for a period of 1 minute with unchlorinated water at three temperatures

1) Cold (10°C) 2) 37°C 3) 65°C

Eight carcasses were washed at each temperature. A panel of 3 judges assessed bloom after one and seven days hanging in a well ventilated storage chill room (1°C). As well as overall evaluation of the washed against the unwashed side, they were asked if they could see anything abnormal in the following parts of the carcass:

- 1) back; colour and appearance of fat
- 2) legs; colour
- 3) crutch fat; appearance
- 4) abdominal region; dampness, rubberiness (an apparent lack of rigor mortis) colour.

RESULTS

(1) Bacteriological

The effect of the washing treatments on bacterial numbers at the "high risk sites" is shown in Tables Two and Three, in terms of the actual residual count and the reductions obtained.

In Trial One the effect of raising the temperature from 37°C to 80°C on the effect of raising the chlorine level from zero to 450 ppm were both statistically significant ($p < 0.001$). The effect of using both the higher temperature and the high chlorine level were additive, (i.e. almost a double reduction was obtained. Increasing the duration of washing was only beneficial if chlorine was used. (The chlorine by time interaction was significant ($p < 0.05$). Thus the longer time was adopted for Trial Two.

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TABLE TWO: Effect of washing on bacterial numbers in Trial One.

Time	No Chlorine		450 ppm Chlorine	
	30 secs	120 secs	30 secs	120 secs
Temp 37°C	0.20	0.40	1.11	1.66
80°C	1.33	1.41	1.63	2.70
S.E.	0.212	Df 52		

(2) Residual count (\log_{10}) / sq cm

Time	No Chlorine		450 ppm Chlorine	
	30 secs	120 secs	30 secs	120 secs
Temp 37°C	3.73	3.62	2.88	2.41
80°C	2.57	2.49	2.18	1.22
Average count before washing (\log_{10}) = 3.94				
S.E.	0.194	Df 52		

In Trial Two any reduction greater than \log_{10} 1.10 or any residual contamination level of \log_{10} 3.0 was significantly different ($p < 0.05$) than the initial levels and 80°C at the 30 ppm level gave reductions significantly lower ($p < 0.01$) than the initial contamination, while 50°C (with 95 ppm), and 80°C (unchlorinated and with 95 ppm) also gave reductions significantly lower ($p < 0.05$) than the initial contamination.

The effect of the different temperatures averaged over all the chlorine concentrations, and the effect of the different chlorine levels averaged over all temperatures is shown in Tables Four and Five. 30 and 95 ppm chlorine have similar effects which are significantly different ($p < 0.05$) from no chlorine, 65°C and 80°C also have similar effects which are significantly different ($p < 0.05$) from 50°C.

TABLE FOUR: Average effect of chlorine in Trial Two.

Chlorine conc.		0	30 ppm	95 ppm	S.E.
		Average of all temperatures	(Reduction) 0.71	1.45	
	(Residual)	3.42	2.89	2.73	0.24

TABLE FIVE: Average effect of temperature in Trial Two.

Temperature		50°C	65°C	80°C	S.E.
		Average of all chlorine concentrations	(Reduction) 0.80	1.45	
	(Residual)	3.48	2.79	2.77	0.24

(2) Carcass appearance

(A) Cleanliness. All treatments used gave a visually cleaner carcass than the control which had only received factory preparation.

(B) "Bloom". In Trial One the carcasses treated were all 50 - 60 lbs in weight and had a good fat covering. When the results of the judgments on the paired comparisons (control v treatment) were statistically examined it was found that (a) the judges did not agree with each other as to which of the carcasses within pairs was best and (b) they were unable to consistently differentiate between carcasses within pairs when asked to repeat their judgment. It was felt that this was because the carcasses were similar in "bloom" whether treated or not.

The carcasses used in Trial Two were under 45 lbs weight and had much less fat covering than those in Trial One. The judges were found to be far more consistent than in Trial One. However, no statistically significant differences were evident between washed and unwashed carcasses. It appeared that animal to animal variation in bloom was far greater than the effect of washing (if any) on bloom. In this trial the judges complained that it was very difficult to describe bloom in a single score, and suggested that the scoring system should allow evaluation of different parts of the carcass to be made separately.

TABLE THREE: Effect of washing on bacterial numbers in Trial Two.

Temp	No Chlorine		30 ppm	95 ppm
	50°C	0.29	0.87	1.23
65°C	0.81	1.72	1.81	
80°C	1.11	1.77	1.41	
Df 15	S.E.	0.36		

(2) Residual count (\log_{10}) / sq cm

Temp	No Chlorine		30 ppm	95 ppm
	50°C	3.66	3.45	3.32
65°C	3.54	2.58	2.27	
80°C	3.05	2.66	2.61	
Df 15	S.E.	0.42		

Average count before washing (\log_{10}) = 4.22

The initial mean contamination levels at the low risk sites differed from the high risk sites by \log_{10} 0.8/sq cm in both trials:

	High Risk	Low Risk
Trial One	3.94 / sq cm	3.18 / sq cm
Two	4.22 / sq cm	3.40 / sq cm

The reductions brought about by the treatments at the low risk sites were similar to those at the high risk sites, and were thus reduced to a different level than the high risk sites after treatment.

TABLE SIX: Effects of washing on various parts of the carcass.

Scoring:
Positive value (range 0 to 2.0) : Washed side judged better than unwashed
Negative value (range -2.0 to 0) : Unwashed side judged better than washed
Zero value : No difference between washed and unwashed side

	After 1 day			After 7 days		
	Cold	37°	65° (SE)	Cold	37°	65° (SE)
Crutch Fat Appearance	-0.75	-0.56	-0.42 (0.28)	-0.21	-0.61	-0.30 (0.21)
Abdominal Region						
(1) Rubberiness	-0.48	-0.50	-0.04 (0.17)	-0.16	-0.01	0.03 (0.06)
(2) Dampness	-0.56	-0.83	-0.06 (0.30)	All zero		(Not tested)
(3) Colour	-0.63	-0.48	-0.30 (0.26)	-0.21	-0.33	-0.20 (0.08)
Df 14				Df 12		

In Trial Three where only one half of each carcass received a washing treatment, the judges gave their opinions on the different parts of the carcass, along with an overall evaluation of each side. No differences were reported for 1) back fat; 2) leg colour or 3) overall appearance between washed and unwashed sides. Differences were reported for the other parts of the carcass, and these were subjected to statistical analyses.

The judges' opinions were given numerical values as follows: 3.0 = normal, 2.0 = slightly abnormal and 1.0 = abnormal. By subtracting the score for the unwashed side from the score for the washed side and dividing this by the number of judges, a value was obtained for the difference between the sides. As can be seen in Table Six, the majority of the scores were in favour of the unwashed sides (negative values). However, the only statistically significant difference ($p < 0.05$) which emerged between washed and unwashed sides was for the colour of the abdominal region treated with 37°C water (after 7 days).

Within the washing treatments (Cold, 37°C, 65°C) washing at 65°C was better than at the other temperatures when judged after 1 day for rubberiness

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and dampness of the abdominal region. These differences were significant ($p < 0.1$). The difference for dampness was not maintained after 7 days in the chill; while sides treated with cold water were significantly worse ($p < 0.05$) for rubberiness than those treated with 65°C .

It may be concluded then that washing did not significantly impair bloom, and that carcasses treated with hot water (65°C) dried off more quickly.

DISCUSSION

Although significant $1.0 \log_{10}$ reductions were obtained/sq cm using hot (65°C) water (unchlorinated), it is questionable whether this would give the carcass a longer shelf life, since it is generally accepted that a $2.0 \log_{10}$ reduction is required (Ingram, pers. comm 1974) before this happens. However, the lower level of chlorination (30 ppm) used did give \log_{10} 1.77 reductions, and the higher chlorination (450 ppm) \log_{10} 2.70 reduction when used with hot water, and an increased shelf life would most certainly result. Even without substantial reduction in bacterial numbers, all carcasses did become visibly cleaner, without losing bloom. It thus appears beneficial to wash carcasses, provided adequate precautions (well-ventilated storage chill rooms, the use of hot water etc) are taken to ensure the carcasses "dry-out".

ACKNOWLEDGMENTS

We wish to express our grateful thanks to Mr B. Lynch, A.I.S.T., Miss C Murphy and Mr S.N. Reid, F.I.M.L.T. for technical assistance and advice. Thanks are also due to Mr P. Nolan for the experimental facilities provided at the abattoir of Dublin Meat Packers Ltd., and to Dr J. Mitchell for statistical analyses.

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