final report

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Prepared by: Graham Treffone
JBS Australia Pty Ltd

Neil McPhail
CSIRO Animal, Food and Health Sciences

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JBS Commercial evaluation and viability of lamb frenching using the prototype McLaren iFrench water racking technology

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Abstract

JBS Australia has evaluated a machine called an iFRENCH, manufactured by McLaren Stainless of New Zealand, which continuously removes the tissue from the rib bones of lamb racks using high-pressure water jets. Its performance has been compared with manual frenching for its suitability for Australian lamb industry for reliability, adaptability, cost effectiveness, yield and shelf life of chilled vacuum-packed product.

The machine produced a product with very clean bones and excellent presentation. Compared with hand-frenching there was an estimated reduction in value of $0.77 per lamb body due to the loss of trim with the machine liquid effluent.

The water-frenched racks had a slightly higher microbial count than hand-frenched samples at the time of packing and this increased to just below 6 $\log_{10}$ cfu/cm^2 by week 13 of chilled storage. There was no increase for hand-frenched samples. The water-frenched racks had slightly more purge in the vacuum packs and a shelf life of up to 13 weeks when stored at just below -1°C.

Water-frenching reduced the shelf life of lamb racks but the chilled storage life of 13 weeks achieved in this trial is acceptable and use of the iFRENCH is recommended provided hygiene and temperature parameters are adhered to.

Executive Summary

Frenching of lamb racks is a labour-intensive task and the appearance of the finished product is dependent on the skill of the individual. JBS Australia has obtained a machine known as an iFRENCH, manufactured by McLaren Stainless of New Zealand which uses high-pressure water jets to remove the tissue from the rib bones. This machine has been evaluated in a full-scale commercial trial for:

1. Suitability for processing the variation of Australian lamb product;
2. Chilled shelf life, yield and quality of water-frenched racks compared with those that were hand-frenched.

The McLaren iFRENCH machine is 1340 mm long x 680 mm wide and 1180 mm high and weighs 475 kg and requires the connection of the following services:

- Electrical (400 V, 3 phase, 32 A)
- Cold water (<30 L per min)
- Compressed air (4 mm dia, 4 bar)
- Drain (100 mm)

The full range of both cap-on and cap-off lamb racks were frenched through the machine and yield trials were conducted. The shelf life of chilled, vacuum-packaged water-frenched racks was compared with that of racks from the same bodies that were hand-frenched. The chilled racks were stored at -1°C for up to 13 weeks. Shelf life was evaluated by assessment of the odour of the meat on opening the pack and by microbiological analysis.

The machine proved easy to operate by unskilled labour and removed almost all the tissue from the bones resulting in a product with excellent presentation. The tissue removed by the high-pressure water jets is washed down the drain and the value lost compared with trimmings from hand-frenching which can be packed and sold. It is estimated that this results in a reduction in value of $0.77 per lamb body.

The surface of lamb racks that had been frenched by high-pressure water were moist on exit from the machine due to overspray from water jets. This resulted in a slightly larger amount of purge in the water-frenched vacuum packs. This became more apparent after about 9 weeks of storage with the liquid tending to gather around the rib bones at this point.

The water-frenched racks had a slightly higher microbial count than the hand-frenched samples at the time of packing and the total viable count increased to just below 6.00 $\log_{10}$ cfu/cm^2 after 13 weeks of storage. The hand-frenched racks, in contrast showed no measurable increase in TVC over the 13 weeks of storage at -1.2°C.

The vacuum packs of water-frenched racks were considered to be at or near the end of their shelf life at 13 weeks when assessed by the aroma on opening whereas the hand-frenched samples had very little odour. This shelf life for the ifrenched racks attained in this trial was acceptable and would allow JBS to service all markets.

The use of the McLaren iFRENCH is recommended provided the following conditions are followed:

- Efficiently chill carcases to <5°C meat temperature before boning;

- Chill water used for water-frenching to <7°C and chlorinate to a minimum 1.25 ppm residual chlorine;
- Rapidly chill cartoned vacuum-packaged racks to below -1°C and store at this temperature until despatch;
- Ship to export customers at -1 to -1.5°C.

Contents

1 Background

A frenched lamb rack (HAM No. 4938) is prepared from a standard rack by removal of the feather bones and the chine and the cap muscle, if specified. The ribs are cut parallel to the chine and trimmed (frenched) of intercostals muscles and other tissue to a specified distance from the eye of the loin muscle. This is a labour-intensive operation and the appearance of the finished product depends to a large extent on the skill of the operator. McLaren Stainless Ltd of New Zealand manufacture a machine known as the iFRENCH, which uses high-pressure water to undertake the task of trimming the rib bones. JBS Australia Pty Limited has an R&D project with Meat & Livestock Australia to test the capability of one of these machines, which has been installed in the lamb boning room of their Bordertown plant.

The machine is being evaluated for its cost effectiveness, appearance of the finished product and shelf life of the vacuum-packaged frenched racks.

2 Project objectives

The objectives of the project were to:

1. Evaluate a modified McLaren water iFrencher suitable for processing Australian lamb product.
2. Validate the process through a full scale commercial trial at a JBS processing site.
3. Conduct a comprehensive shelf-life study testing regime, yield analysis and quality assessment (purge, colour and palatability) of water cutting versus the current manual methods.
4. Enlist a third party (CSIRO) to conduct the assessment to quantify the results.

3 Methodology

3.1 Equipment evaluation

The McLaren iFRENCH (Figure 1) was evaluated against the current manual hand-frenching process to:

1. Determine whether the McLaren iFRENCH is capable of processing the variation in size, weight, fat classes and breeds of Australian lambs
2. Determine whether the McLaren iFRENCH is capable of satisfactorily processing the full JBS specification range of french-trim lamb racks
3. Determine if there was any difference in presentation and yield
4. Measure the yield variation and the financial impact of iFrenching on final product revenue
5. Identify the potential labour savings iFRENCH can deliver and the financial benefits gained by the project.

Racks from lambs of all weight ranges and fat classes were processed through the machine to fully test the performance of water frenching against hand frenching on the full range of JBS french rack specifications. The JBS specifications for frenched racks are:

1. CFO 8 rib cap-off lamb rack, 100mm, 50mm French
2. CFO 8 rib cap-off lamb rack, 75mm, 37mm French
3. CFO 8 rib cap-on lamb rack, 75mm, 37mm French
4. CFO 4 rib lamb shoulder rack, 100mm, 50mm French
5. CFO 8 rib cap-off denuded lamb rack, 50mm full French

Yield testing was conducted by comparing the finished weigh and trimmed weight of an iFrenched rack from one side of a carcase with that from a hand-frenched rack from the other side. The change in value from a lamb carcase was calculated taking into account any change in weight of the finished rack and the value of the residual trim. Racks trimmed to each of the above specifications from carcases ranging in weight from less than 20 kg to greater than 28 kg were included in the yield trials. Racks from a total of 85 carcases were assessed.

Figure 1: McLaren iFRENCH machine

3.1 Chilled shelf life

Thirty lamb carcases were selected after overnight chilling and transferred to the boning room. All carcases were broken into primal cuts by bandsawing and the full racks collected. Thirty randomly selected racks were completely frenched and cap removed by hand and the other 30 prepared with the cap removed to the rib trimming stage. These untrimmed samples, were then passed through the iFRENCH machine which trimmed the rib bones using high pressure water. Five samples of each of the hand-trimmed and water-trimmed racks were sampled for microbiological analysis. All cuts were then transferred to the packaging area, a drip keeper applied and then wrapped in clear bone guard, vacuum packaged, and packed in to cartons which were labelled as hand or water frenched.

All cartons were chilled overnight and consigned to the Bremer River Cold Store at JBS head office site at Dinmore in Queensland where they were stored at -1°C ±0.5°C until removed for assessment. Samples were withdrawn for assessment after 3, 6, 9, 11 and 13 weeks of storage.

On each assessment day, five racks that had been water trimmed and five racks that had been hand frenched were randomly selected from the cartons for assessment. Each cut was assessed for quality of vacuum, visual appearance and odour on opening. Scores were recorded on a nine-point scale of 0 to 8 with 8 being very good vacuum, no discolouration or fresh odour accordingly.

Immediately after processing in the boning room at JBS Bordertown and immediately after opening the pack, two x 10 cm^2 core samples approximately 2 mm deep were collected from the ends of each rack and another two from the surface, using a sterile corer. The samples were placed in sterile stomacher bags, kept chilled and transported to the JBS Dinmore NATA-accredited laboratory for analysis for:

- Total viable count;
- Lactic acid bacteria
- Coliforms and *E. coli*;
- *Brochothrix thermosphacta*

Serial dilutions were inoculated onto Petrifilm according to manufacturer's instructions and results were recorded as CFU/cm^2.

The amount of weep (or purge) in each pack was measured by weighing each pack prior to opening, weighing the amount collected for microbiological analysis and weighing the rack after patting dry with a paper towel. Each numbered vacuum bag was washed and dried then weighed. The dry weight of the drip keepers and clear bone guard was added to the weight of the vacuum bag which was deducted from the total package weight to calculate the 'wet weight'. The percent weep was calculated by: ((wet weight-dry weight)/wet weight) x 100.

4 Results and discussion

4.1 Equipment evaluation

4.1.1 Machine operation

The iFRENCH machine is 1340 mm long x 680 mm wide and 1180 mm high and weighs 475 kg. It requires the connection of the following services:

- Electrical (400 V, 3 phase, 32 A)
- Cold water (approv' 20 L per min)
- Compressed air (4 mm dia, 4 bar)
- Drain (100 mm)

The belt speed and water pressure are adjustable via the touch screen panel and the bottom belt height, which sets the frenching length, is adjusted using a hand wheel at the end of the machine. The setting is displayed on the screen. The normal water pressure setting is 2,500 psi. Once set up the machine is ready to process racks of that specification.

The lamb racks are loaded into the throat of the machine, ensuring that the rib bones are firmly contacting the bottom belt. A removable stainless steel plate creates an acute angle that wedges the rack firmly in position. The drive belts (Figure 2) grip the racks and carry them through the covered area where the water jets remove the tissue from the bones to the specified length. They are then discharged from the end of the machine onto a conveyor. The machine is operated by one person and can process up to 20 racks per minute.

The water discharged to the drain carries the trimmed tissue to waste.

In this trial the water used for frenching was chlorinated (1.44 ppm residual Cl_2) and chilled to 5.2°C.

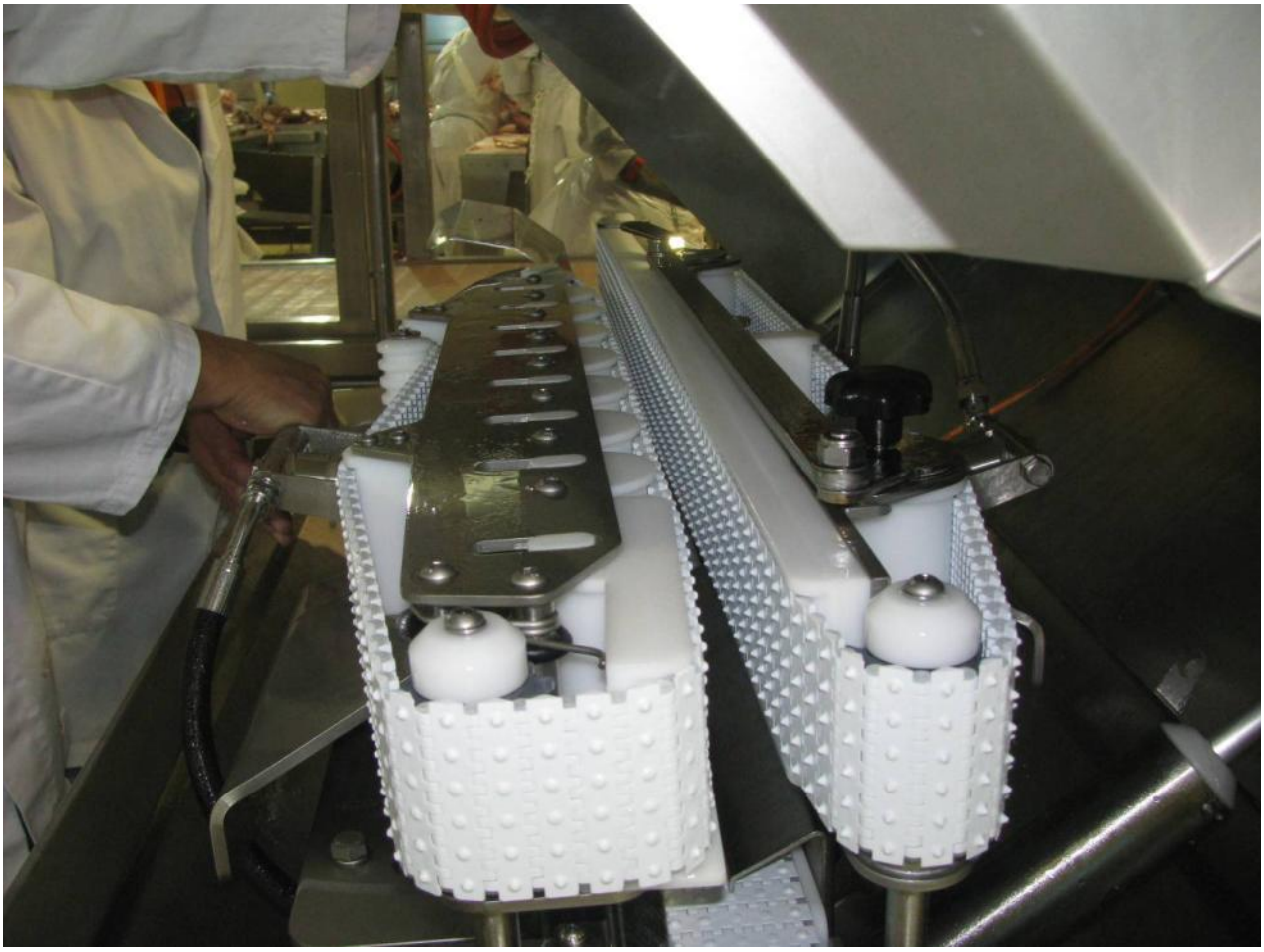

Figure 2: iFRENCH machine with cover open showing the drive belts from the exit end

4.1.2 Operational observations

When processing cap-off racks, the stainless steel in-feed plate works well but with cap-on racks, the additional thickness of the product prevented the rib bones from reaching the bottom height-adjustment belt. An alternative plate for cap-on racks is to be designed by McLaren Stainless. The plate was removed during trials with cap-on racks.

It was found that the width between the in-feed belts needed to be manually adjusted to cope with all product sizes. When cap-off denuded, full French-trim racks were processed, the drive belts had to be positioned at the narrowest setting and water pressure lowered to 2,000 psi to prevent the racks being dislodged.

The machine does a very good job of removing the fat and muscle to leave a clean bone but some connective tissue can sometimes remain (Figure 3). The frenching length is generally more accurate and even than can be achieved by hand. However the product surface becomes moist from overspray during the jet cutting process and the belt leaves small indentations in the surface.

During initial shelflife tests, variation in the stability of the water frenched product was noticed. This prompted a review of the iFrench processJBS has modified the preparation of its racks prior to frenching. All muscle and fat lying over the frenching area is removed prior to water frenching to reduce yield loss and the cap membrane is left over the LD muscle and

removed after frenching. Chilled water was also introduced into the frenching process to stabilise water temperature.

Figure 3: iFrenched rack (foreground) and hand-frenched rack

A sufficient diameter drain needs to be provided to ensure the waste water is removed to prevent a safety issue in the processing area.

Throughout the duration of the R&D trial numerous modifications have been made to improve the equipment and make it more suitable for Australian processers:

1. The drive belts that convey the racks through the machine for frenching would not open wide enough to allow cap-on racks to be processed. A new assemble had to be made;
2. There was too much overspray causing excessive moisture retention on the finished product. The bottom carry belt was removed and replaced by a solid stainless plate, and
3. The noise level generated during the frenching process was approximately 90 dB. Funnels were positioned directly across from the water jets to capture water and frenching waste and direct it to the drain. This reduced overspray and dampened the noise to 80 dB.

From a safety point of view the lid (which is very heavy) was originally opened using water pressure service to hydraulic lifters. These continually failed making it extremely difficult to lift the lid open and just as hard to lower to the closed position. It became too difficult and dangerous for cleaning operations to be conducted. McLaren have since modified the lifters

and fitted a safety locking device to prevent any chance of the lid accidently closing during maintenance or sanitation.

Other issues that have arisen during extensive trials include:

- The water jets continually worked loose from their settings causing fluctuation in final performance. The nozzle holding bracket had to be modified to lock the nozzle into position.
- The hoses that deliver water from the pump to the jet nozzles kept blowing out under pressure. These were replaced with a different braided hose and this has fixed the issue.
- The gripping prickles on the product carry belts showed early signs of wear. McLaren have replaced the belt on the bone carrying side with a blue belt with stainless spikes.
- Finally, several fittings such as nuts, bolts and latches showed early signs of rust. These have been all been replaced.

During cleaning, both the product drive belts need to be removed and the bottom belt (which cannot be removed) slackened to allow thorough removal of fat and protein from all sprockets, drives and structure to facilitate complete sanitation. The belts are cleaned separately and can be soaked in a sanitiser solution.

The R&D work that has been conducted under PIP 0320 has been quite extensive and very thorough and has resulted in modifications and upgrades to the machine which has improved operational reliability and hygiene. Figures 4 to 8 show the modifications to the iFRENCH machine and the setup in the boning room.

Figure 4: iFRENCH machine showing modified drive belt

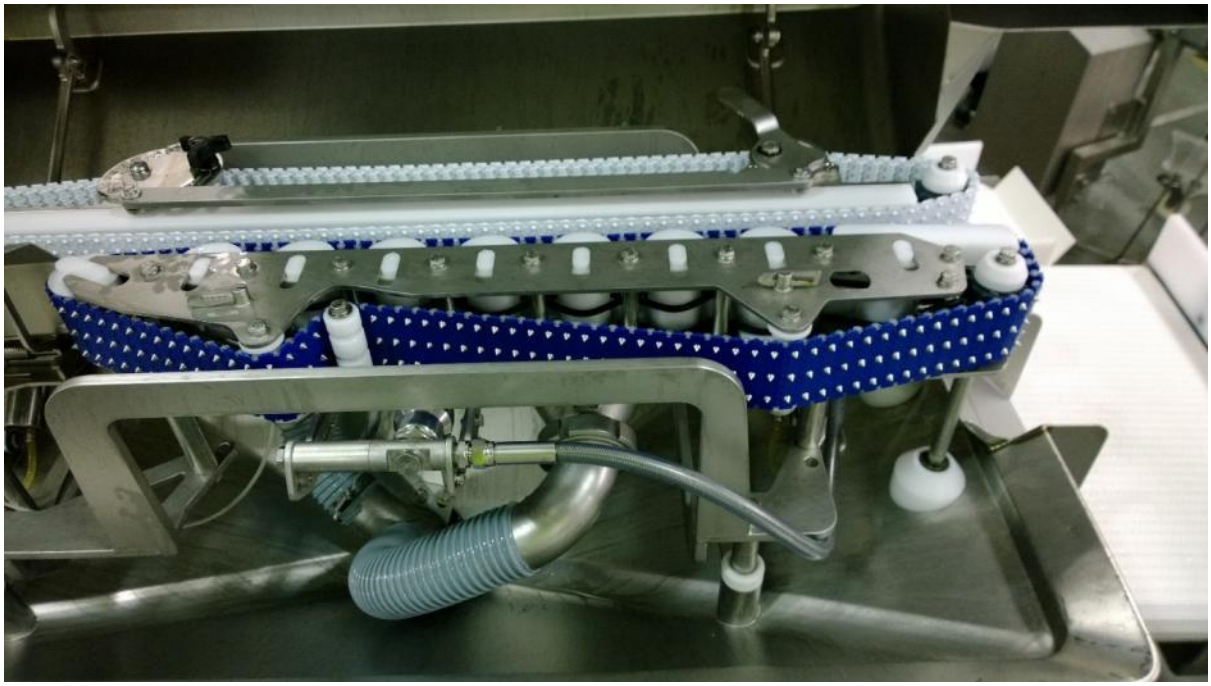

Figure 5: iFRENCH machine showing waste capture funnels

Figure 6: iFRENCH belt width adjustment mechanism

Figure 7: iFRENCH showing modified cover lifters

Figure 8: iFRENCH machine setup in boning room and product discharge conveyors

4.1.3 Yield trial

When lamb racks are frenched using high pressure water, the fat, muscle and connective tissue are mixed with the water and pass to the drain but can be screened out on exiting the machine or at an early stage of the wastewater treatment process. Therefore the value of this material is either lost completely or significantly downgraded compared with the value of hand-frenched trimmings which can be packed and sold. In calculating the effect of water frenching on overall product value, a nominal price of $0.25/kg has been applied to water-frenching residual material and $3.10 to hand-frenching trimmings.

By its nature, hand frenching is more variable than water frenching, therefore the weight of material removed from the ribs by water has been used to calculate material value for both processes. The summaries of the results for each rack specification are presented in tables 1 to 5 and shows that iFrenching results in a reduction in value per lamb of $0.12 to $0.77 per carcase.

Table 1: Effect of water frenching on value of cap-off 100, 50 mm racks (average of 46)

	iFrenched	Hand Frenched
Rack saleable value	$9.79	$9.79
Residual value	$0.03	$0.42
Combined value	$9.82	$10.21
Diff in value per rack		$0.38
Diff in value per lamb		$0.77

Table 2: Effect of water frenching on value of cap-off 75, 37 mm racks (average of 12)

	iFrenched	Hand Frenched
Rack saleable value	$12.70	$12.70
Residual value	$0.02	$0.21
Combined value	$12.71	$12.91
Diff in value per rack		$0.19
Diff in value per lamb		$0.39

Table 3: Effect of water frenching on value of cap-on 75, 37 mm racks (average of 6)

	iFrenched	Hand Frenched
Rack saleable value	$14.37	$14.37
Residual value	$0.01	$0.06
Combined value	$14.37	$14.43
Diff in value per rack		$0.06
Diff in value per lamb		$0.12

Table 4: Effect of water frenching on value of shoulder 100, 50 mm racks (average of 18)

	iFrenched	Hand Frenched
Rack saleable value	$5.65	$5.65
Residual value	$0.02	$0.20
Combined value	$5.67	$5.85
Diff in value per rack		$0.18
Diff in value per lamb		$0.37

Table 5: Effect of water frenching on value of denuded full 50 mm racks (average of 6)

	iFrenched	Hand Frenched
Rack saleable value	$6.15	$6.15
Residual value	$0.01	$0.13
Combined value	$6.16	$6.28
Diff in value per rack		$0.12
Diff in value per lamb		$0.24

4.2 Shelf life

4.2.1 Pack assessment

The cartoned lamb racks were stored in a chiller at an average temperature of -1.2°C±1.0°C and five water-frenched and five hand-frenched samples removed for assessment after 3, 6, 9, 11 and 13 weeks of storage. Each pack was assessed for appearance and odour on opening and the mean scores are presented in Figures 9 and 10. The quality of the vacuum was excellent for most packs with only one obvious leaker noted which was replaced with a spare pack.

The appearance of most packs was assessed as very good right up to 13 weeks (Figure 9 and Figure 11 photo). At most assessment times, the water-frenched packs appeared to have more liquid accumulating around the rib bones and the ‘cleaner’ bones took on a different colour to the hand-trimmed ones. Additional photos at other assessment times are presented in Appendix 1.

The odour from a vacuum pack of meat immediately on opening provides a good indication of the wholesomeness of the product. A vacuum pack will have a slight meaty aroma at the early stages of storage which develops into a ‘confinement’ odour with some cheesy notes during further storage. Off aromas become obvious as the product nears the end of the shelf life. Both the hand-frenched and water-frenched samples were very acceptable at 3, 6 and 9 weeks and exhibited very little aroma on opening. The water-frenched samples began to develop storage aromas at 11 weeks but most packs were still acceptable at 13 weeks. One pack at 13 weeks had a slight off aroma and several others exhibited a cheesy aroma. The

water-frenched racks were assessed as being very close to or at the end of their storage life after 13 weeks at -1.2°C. The hand-frenched packs were still very acceptable at 13 weeks and exhibited virtually no aroma on opening at any of the assessment times. These results are quite similar to those obtained during assessment of the shelf life of spray-chilled lamb in 2010 (Project P.PIP.0254) where unfrenched, cap-on racks were acceptable at 13 weeks. The product was stored at -1.2°C during this current trial compared with 0°C for the spray chilling trial.

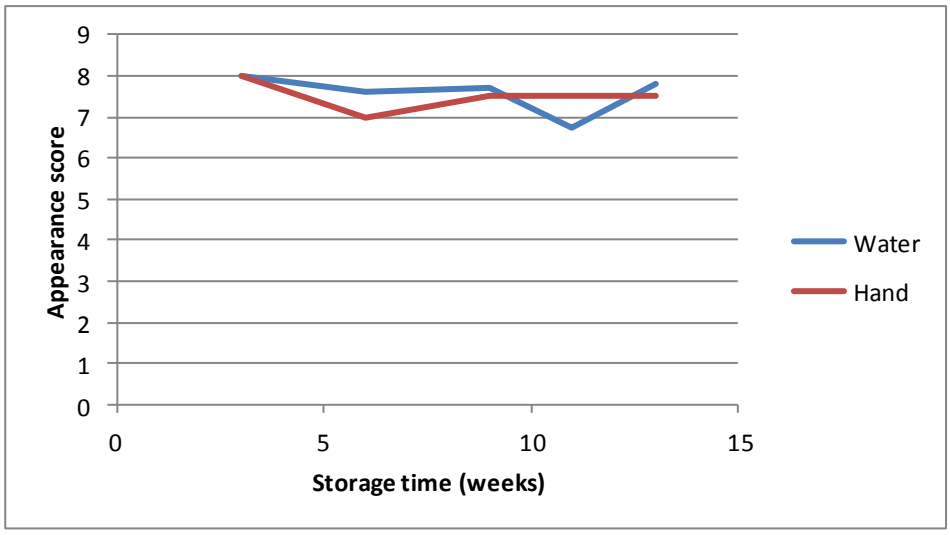

Figure 9: Mean appearance scores for water and hand-frenched lamb racks (8 – excellent appearance, 0 – very poor appearance)

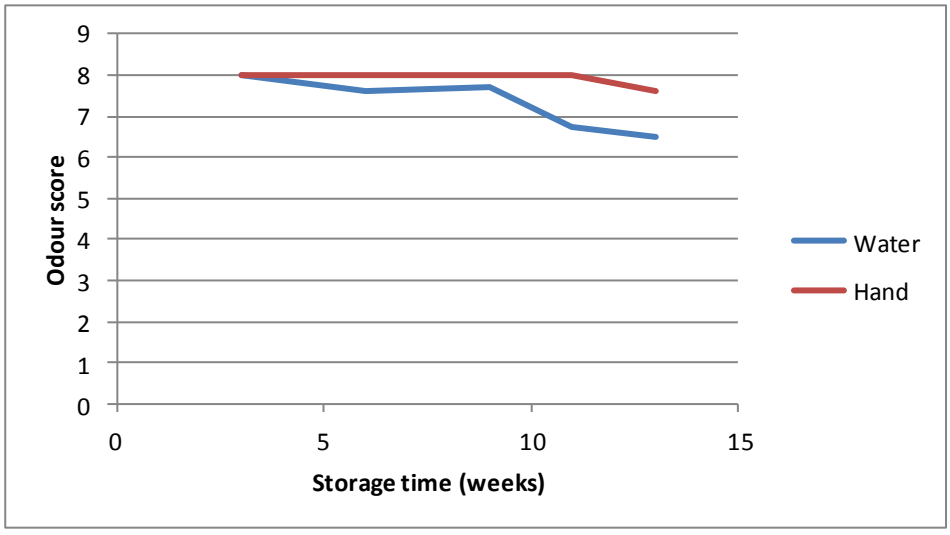

Figure 10: Mean odour scores for water and hand-frenched lamb racks (8 – no odour, 0 – strong off odour)

Figure 11: Water (left) and hand-frenched lamb racks after 13-weeks storage

4.2.2 Microbiological quality

The hand-frenched lamb racks had a slight but not significantly lower ($P > 0.05$) total viable count (TVC) at the time of packing (2.35 vs 2.76 $\log_{10}$ cfu/cm^2). By week 13, the TVC of the water-frenched samples had increased to reach an average of 5.67 $\log_{10}$ cfu/cm^2. Similar increases in TVC on hand-frenched racks were not observed with week 13 counts consistent with the TVC counts observed at packaging. Previous trials with vacuum-packed lamb had shown the TVC reaching 7 – 8 $\log_{10}$ cfu/cm^2 and levelling off by about 9 weeks but in this case the water-frenched had not reached a plateau and there was no increase on the hand-frenched racks by 13 weeks (Figure 12). From week 3 onwards the TVC was significantly higher ($P < 0.05$) on the water-frenched samples than the hand-frenched samples. The counts for lactic acid bacteria (LAB) showed that the growth of these organisms followed a very similar pattern to TVC growth and increased to an average value of 4.88 $\log_{10}$ cfu/cm^2 by week 13 on the water-frenched racks and remained at about 2.0 $\log_{10}$ cfu/cm^2 on the hand-frenched samples.

The spoilage organism *Brochothrix thermosphacta* was not isolated from any of the samples at the level of detection of 2 $\log_{10}$ cfu/cm^2 at any of the sampling occasions. This was in contrast to previous trials with vacuum-packaged lamb where *B. thermosphacta* was regularly isolated after several weeks of chilled storage. No *E. coli* were found at the level of detection of 1 $\log_{10}$ cfu/cm^2.

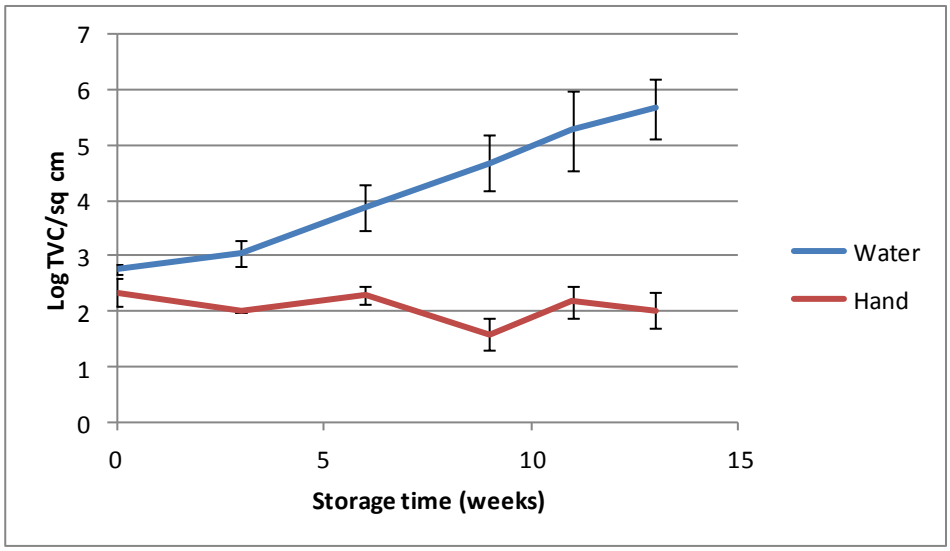

Figure 12: TVC (log cfu/ cm^2) for water and hand-frenched lamb racks (error bars show standard error of the means)

Meat pH can have a significant influence on the rate of growth of microorganisms on vacuum-packaged product. The mean pH of the five samples from each of the water and hand-frenched racks is presented in Table 6. This shows an increase in pH during storage but no consistent differences between the water and hand-frenched samples.

Table 6: Mean pH of frenched lamb racks

Weeks of storage	Water-frenched	Hand-frenched
0	5.60	5.62
3	5.65	5.58
6	5.73	5.74
9	5.84	5.79
11	5.97	5.98
13	5.93	5.89

4.2.3 Weep

Because the water-trimmed racks were visibly wetter than the hand-trimmed ones, it is possible that there may be more weep (purge) in the vacuum bag. The results of measurements at each sampling time are shown in Figure 13 and indicate that the amount of purge increased with storage time up to 11 weeks. The water-frenched packs contained slightly more weep at all assessment times but although visually more apparent, the difference was only significant at 13 weeks ($P < 0.05$). Previous trials had indicated quite low quantities of less than 1% purge in lamb rack packs but amounts of over 5% by week 11 were measured in this case for both water and hand-frenched samples. Drip keepers were

supplied in all packs for this trial and it is likely that the location against the exposed muscle surface has increased the weight of purge although it was not visually apparent especially in the hand-frenched rack packs.

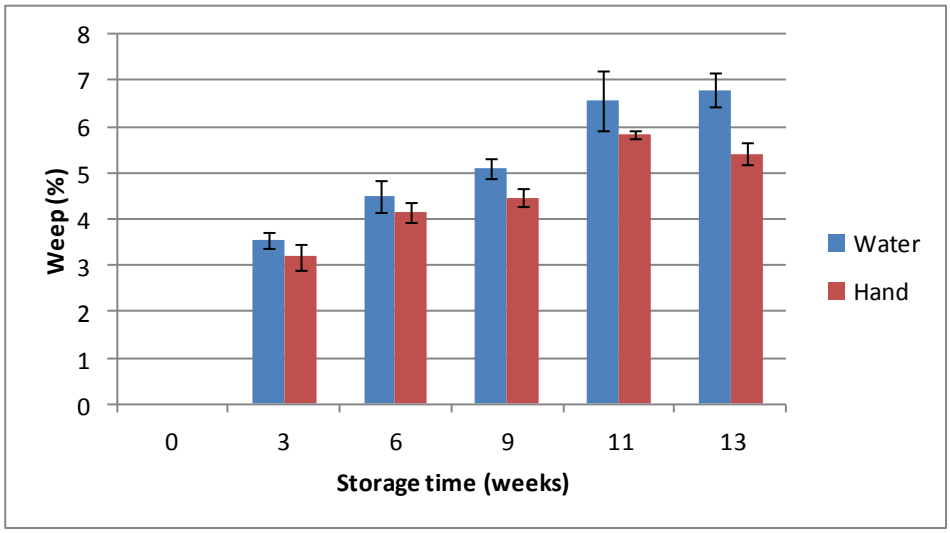

Figure 13: Percentage of weep in packs of water and hand-frenched lamb racks

5 Conclusions and recommendations

The McLaren iFRENCH is easy to operate by unskilled labour and does a good job of removing tissue from the rib bones of lamb racks resulting in a product with very clean bones and excellent presentation. With modifications to the loading plate, it will be suitable for all lamb rack specifications normally processed by JBS.

However the tissue removed by the high-pressure water jets is washed down the drain and the value of this material is essentially lost compared with hand frenching where the trimmings can be packed and sold. It is estimated that this results in a reduction in value from a lamb carcase of up to $0.77 per body.

The high-pressure water racking process generates overspray which wets all surfaces of the product. This results in a slightly larger amount of purge (weep or drip) in these vacuum packs during storage. The purge was more apparent in the water-frenched packs by about week 9 of storage and tended to gather around the rib bones.

It may be the presence of this extra moisture or some other source of contamination, but water frenching also appeared to result in a higher microbial count and a slightly reduced shelf life. The water-frenched racks had a slightly higher bacterial count at the time of packaging and the numbers grew steadily during the 13 weeks of storage to less than 6.00 $\log_{10}$ cfu/cm^2. In contrast to the hand-frenched samples showed no measurable increase in microbial counts. The shelf life of 13 weeks attained with the iFrenched racks in this trial is acceptable and would allow JBS to service all customers. The fact that the water-frenched racks have a shorter shelf life than the hand-frenched ones cannot be ignored, therefore it is recommended that ongoing monitoring of shelf life take place and that a similar in-house shelf life evaluation be conducted when machines are installed in other plants where conditions may be different.

It is believed that, with the modifications and trials that have been done on the machine and process disciplines developed during the 3 sets of shelf-life trials, the iFRENCH water racker definitely has a place in the Australian lamb processing industry.

JBS is satisfied that the modifications, technique changes and strict process protocols have proven that the iFRENCH can deliver stable, wholesome product and reduce labour costs associated with hand frenching.

This outcome was achieved under control conditions and to ensure that this can be translated to regular production, stringent parameters must be adhered to. These recommended parameters are:

- Efficiently chill carcases to 5°C meat temperature before boning;
- Chill water used for water-frenching to less than 7°C and chlorinate to a minimum 1.25 ppm residual chlorine;
- Rapidly chill cartoned vacuum-packaged racks to below -1°C and store at this temperature until despatch;
- Ship to export customers at -1 to -1.5°C.

6 Appendix 1 – Photographs of unopened packs

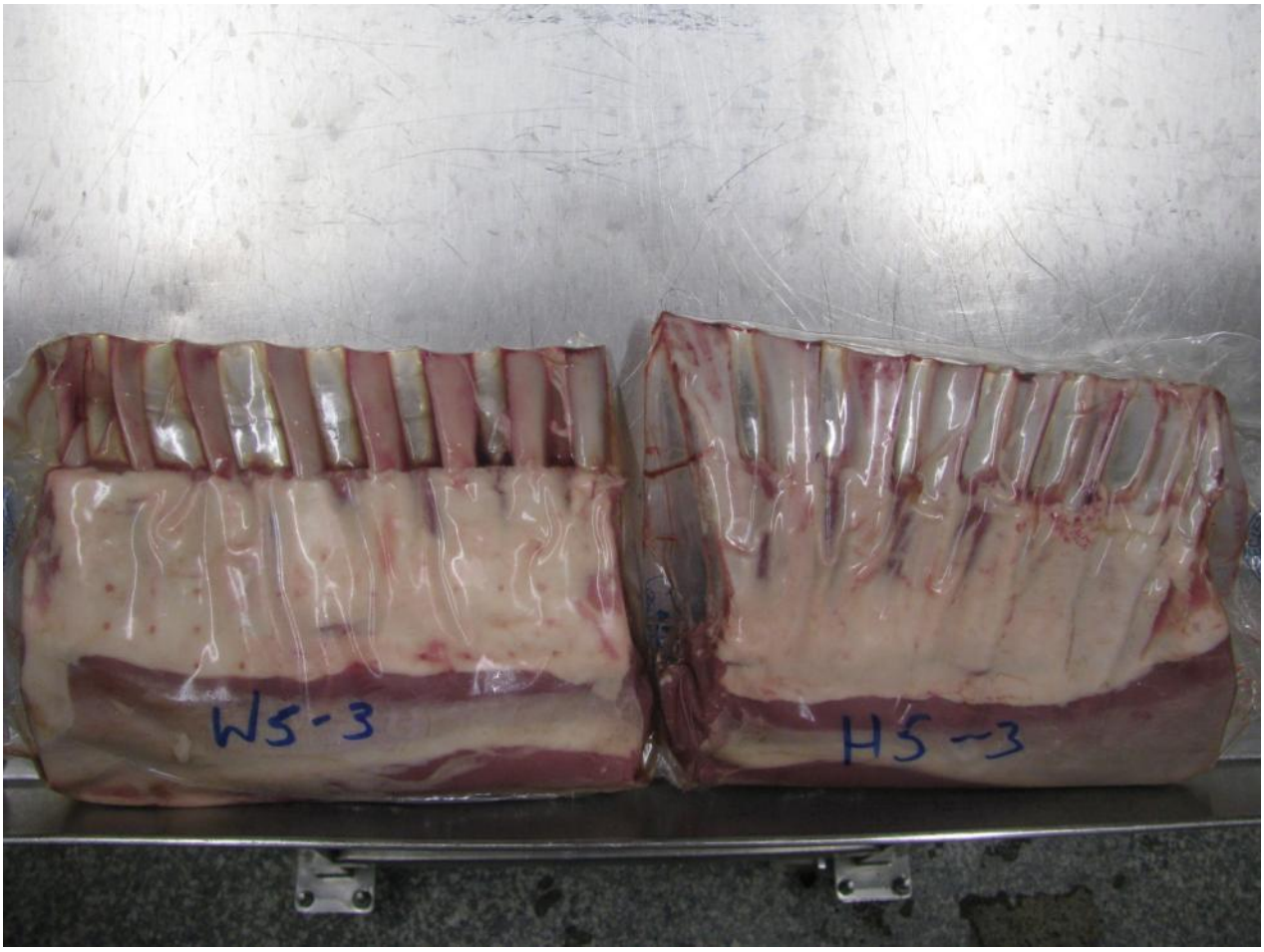

Figure 1-1: Water-frenched (L) and hand-frenched (R) racks after storage for 3 weeks

Figure 1-2: Water-frenched (L) and hand-frenched (R) racks after storage for 6 weeks

Figure 1-3: Water-frenched (L) and hand-frenched (R) racks after storage for 9 weeks

Figure 1-4: Water-frenched (L) and hand-frenched (R) racks after storage for 11 weeks

Figure 1-5: Water-frenched (L) and hand-frenched (R) racks after storage for 13 weeks

7 Appendix 2 – Microbiological results

Storage week	Sample No.	Water-frenched		Hand-frenched	
		TVC ($log_{10}cfu/cm^2$)	Lab ($log_{10}cfu/cm^2$)	TVC ($log_{10}cfu/cm^2$)	Lab ($log_{10}cfu/cm^2$)
0	1	2.85	<2.00	3.23	<2.00
	2	2.51	<2.00	2.22	<2.00
	3	2.60	<2.00	2.20	<2.00
	4	2.93	<2.00	2.32	<2.00
	5	2.91	<2.00	1.78	<2.00
	Mean	**2.76**	**<2.00**	**2.35**	**<2.00**
3	1	3.29	<2.00	<2.00	<2.00
	2	2.78	<2.00	<2.00	<2.00
	3	2.30	<2.00	<2.00	<2.00
	4	3.77	3.28	<2.00	<2.00
	5	3.11	<2.00	2.00	<2.00
	Mean	**3.05**	**2.26**	**2.00**	**<2.00**
6	1	5.48	5.19	<2.00	<2.00
	2	3.08	<2.00	2.48	<2.00
	3	3.83	3.34	2.85	<2.00
	4	3.51	2.00	2.18	<2.00
	5	3.48	<2.00	2.00	<2.00
	Mean	**3.88**	**2.91**	**2.30**	**<2.00**
9	1	3.85	2.00	<1.00	<2.00
	2	6.23	5.47	1.18	<2.00
	3	3.33	2.30	1.54	<2.00
	4	4.84	4.96	2.64	<2.00
	5	5.16	5.32	1.54	<2.00
	Mean	**4.68**	**4.01**	**1.58**	**<2.00**
11	1	4.38	3.32	2.95	2.60
	2	3.89	2.00	2.19	2.00
	3	7.13	5.81	1.78	2.30
	4	5.68	5.32	1.78	<2.00
	Mean	**5.27**	**4.11**	**2.18**	**2.23**
13	1	4.40	3.00	1.00	<2.00
	2	4.42	4.95	1.98	<2.00
	3	6.83	5.48	2.93	2.70
	4	6.71	5.48	2.38	<2.00
	5	6.03	5.48	1.78	<2.00
	Mean	**5.67**	**4.88**	**2.01**	**2.14**