



# final report

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## **Further development of the Macpro exos lamb loin deboning machine to remove the chine from racks as well as remove tenderloin fillets.**

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## **Milestone**

Delivery to site, Longford and commence testing. Production trials and final report including commercialisation plan for Australia market

## **Abstract**

The prototype machine was installed, initially off-line for initial commissioning, then moved to the boning room. The LOIN fillet removal module showed good potential but significant work is required to achieve complete tenderloin extraction. The LOIN (striploin) boning operation showed very consistent, high yield results and a rate of 8/minute on the first morning of training an operator. The RACK CHINE removal module showed very consistent, high yield results. The multi-function operation where LOINS and RACKS are processed alternately was commissioned successfully, without the need for any blade changes.

## **Project objectives**

- Chine module

Based on prototype trials, MACPRO have claimed a yield advantage over manual methods of 40 to 50g/head and over existing technology of 20 to 40g/head. Assuming an average 20g/head saving and a wholesale product value of \$21.70/kg, then the value of yield gain is potentially \$134,750/annum(0.020kg x \$21.70/kg x 1,350 head/day @ 230 working days) using comparison with other mechanical solutions. Compared to manual methods that benefit is potentially doubled to \$269,500 per 230 working days.

- Potential labour savings of up to 4 units of labour as a result of the Automation of this process.  
Elimination of saw-dust may provide additional value in terms of shelf-life and product presentation.

- Fillet/tenderloin module

A labour saving of 1 boner per shift of 1,350 head being processed will be possible by elimination of the manual removal of the fillet.

Assuming a labour cost \$60,000 per year then the value of labour savings is AUD60k/annum/shift.

The exos machine needs to be proven on the range of Australian lamb.

### **Success in achieving milestone**

The machine has been installed, temporarily, in the boning room with both lamb and mutton loin and rack saddles processed to a consistent high standard. The prototype tenderloin removal module was removed after initial trials, prior to installation of the machine in the boning room.

### **Tenderloin (fillet) removal:**

The prototype showed very good potential with almost complete, clean removal of the fillet except for the part close to the vertebrae. This was, to some extent, expected as the blades could not be moved as close to the centreline as desired due to the current configuration of the Product Support and Product Pusher Systems. This aside, that part that was removed was removed cleanly, with good yield.



*Loin Bone with fillet removed*

### **LOIN deboning:**

Results at initial commissioning were not up to expectations, with some product damage evident. The cause was identified as processing product different from that encountered in New Zealand, it being larger, fatter and “dry” chilled meaning that the resistance through the blade set was such that the striploin was “lifted” prior to lateral blade separation.

Commissioning was halted, a new module to restrict the movement of the product was designed and built and fitted to the machine on a return visit.

With the modified set-up results were excellent, with consistent high yield achieved at a production rate up to 8/minute within the first 2 hours of operator training.



*Bones following LOIN deboning*

The results of a yield trial (Appendix 3,) show the exos machine producing a yield of 2.59% ccs wt. From a carcass sample of average fat score 4. Observation of the image (loin bones) above demonstrates that very little tissue remains on the bones.

**Rack CHINE removal:**

The CHINE module was set up to achieve the product desired by the company at the plant and tested. No great effort was expended to optimise yield, other than aiming to make the cuts so that the product would meet the specification for being able to run a knife between the ribs. Notwithstanding, the yield was consistent and very good and the product quality excellent.



*Racks and removed Chine bone*

One yield analysis was performed by an independent contractor, (Greenleaf Enterprises Pty.) Results are shown in Appendix 1. Manual figures quoted are Baseline yields for normal commercial production using a band-saw, as researched by Greenleaf. The analysis shows an increase in yield, (of untrimmed, fat-cap-on product,) of 8.2%.

A second yield analysis performed by site staff is shown in Appendix 2: This trial shows an increase in yield, (of untrimmed, fat-cap-on product,) of 15%.

Note these tests were performed on the first day of production trial where no opportunity to optimise yield had been available. We expect that with further optimisation, these results will be doubtless be exceeded. Notwithstanding, the results show a very good standard of yield.

**Multifunction LOIN/RACK operation:**

The concept of processing both product types in the same machine with seamless alteration from one type to the other was proven at a rate of approximately 3 carcasses per minute. No blade changes are required and the operator just has to load the products and turn a selector switch to either LOIN or RACK.

**Discussion:**

The exos mf machine has proven capable of providing consistent high yield and high product quality on both LOIN deboning and RACK CHINE removal operations. It has also proven successful at being able to process both products randomly without the need for any operator intervention other than to turn a product selector switch to the appropriate position. The tenderloin removal method was proven worthy of further development.

**Overall progress of the project**

Complete

**Recommendations**

Further development of the tenderloin removal module is recommended. MACPRO is preparing a proposal for this project.

**Commercialisation**

Food Processing Equipment Pty Ltd are sales agents for this technology and will be promoting it. An MLA initiative to compare available CHINE removal technologies will include this exos machine in the report due soon. It is expected the exos machine will compare favourably with other technologies in terms of yield and product quality, as well as having advantages in terms of physical size, simplicity and cost.

**Appendices:**

Appendix 1:

Greenleaf Chine bone removal Yield Analysis:

Method	Untrimmed rack after chine removal		Rack yield benefit vs Manual	Chine		Meat Scraped from Chine		Rack Value			Benefit vs Manual
	Grams	% of total	Rack %	Grams	% of total	Grams	% of total	Rack %/hd	Render \$/hd	TOTAL \$/hd	\$/hd
Manual	1500	80.20%	0.00%	365	19.53%	77	4.13%	\$22.80	0.02	\$22.82	0
exos	1654	88.44%	8.20%	216	11.11%	21	1.12%	\$25.14	0.01	\$25.16	\$2.33

Appendix 2:  
In-house Chine bone removal Yield Analysis:

EXOS , LONGFORD Nov 2013									
8R CFO Rack, 100mm									
				Cap-on Rack		Cap-off Rack		50mm Frenched	
	exos								
	CCS wgt	Rack pair	Chine bone	2 x cap-on	Cap	2 x cap-off	Trim waste	cap-off french	Trim
1	22.80	1.885	0.235	1.645	0.510	1.100	0.045	1.030	0.070
2	23.00	2.900	0.275	2.625	1.090	1.435	0.085	1.320	0.125
3	23.20	2.735	0.280	2.455	0.920	1.450	0.055	1.350	0.105
4	22.20	2.430	0.295	2.135	0.650	1.415	0.070	1.320	0.095
5	22.20	2.505	0.305	2.200	0.815	1.315	0.075	1.230	0.085
6	22.80	2.675	0.290	2.380	0.895	1.395	0.090	1.305	0.090
7	19.20	2.785	0.315	2.470	0.890	1.500	0.075	1.390	0.120
8	22.90	2.775	0.315	2.455	0.835	1.555	0.050	1.440	0.110
9	24.40	3.030	0.290	2.735	1.025	1.615	0.090	1.500	0.110
10	22.00	2.990	0.350	2.635	0.095	1.580	0.110	1.475	0.100
Total	224.70	26.710	2.950	23.735	7.725	14.360	0.745	13.360	1.010
Average	22.470	2.671	0.295	2.374	0.773	1.436	0.075	1.336	0.101
Yield%	100.00%	11.89%	1.31%	10.56%	3.44%	6.39%	0.33%	5.95%	0.45%
	Manual								
	CCS wgt	Rack pair	Chine bone	2 x cap-on	Cap	2 x cap-off	Trim waste	cap-off french	Trim
1	21.40	1.970	0.260	1.710	0.660	1.035	0.260	0.955	0.080
2	18.20	2.085	0.220	1.865	0.695	1.075	0.085	0.995	0.090
3	19.60	2.125	0.230	1.895	0.690	1.090	0.095	0.995	0.095
4	17.60	1.805	0.200	1.605	0.620	0.990	0.100	0.915	0.070
5	19.80	2.080	0.240	1.840	0.685	1.155	0.115	1.045	0.110
6	17.80	1.900	0.195	1.705	0.610	1.090	0.090	0.995	0.095
7	18.40	1.915	0.190	1.725	0.600	1.125	0.115	1.050	0.095
8	20.60	2.200	0.235	1.965	0.740	1.225	0.120	1.140	0.090
9	19.80	1.815	0.205	1.610	0.545	1.065	0.085	0.980	0.080
10	23.00	2.225	0.200	2.025	0.655	1.200	0.170	1.095	0.095
Total	196.20	20.12	2.18	17.95	6.50	11.05	1.24	10.17	1.71
Average	19.620	2.012	0.218	1.795	0.650	1.105	0.124	1.017	0.171
Yield%	100.00%	10.25%	1.11%	9.15%	3.31%	5.63%	0.63%	5.18%	0.87%
Yield Increase (% ccs wt)	0.00%	1.63%	0.20%	1.42%	0.12%	0.76%	-0.30%	0.76%	-0.42%
Yield Increase (% Product)		15.92%	18.43%	15.49%	3.77%	13.47%	-47.33%	14.76%	-48.43%



Appendix 3:

<b>BONELESS LOIN YIELD</b>				
			<b>EXOS Loin</b>	
	<b>HSCW</b>	<b>Fat</b>		<b>Hot Yield</b>
	26	4	0.600	2.34%
	25	3	0.630	2.54%
	33	5	0.855	2.56%
	26	4	0.615	2.40%
	27	4	0.910	3.37%
	26	4	0.615	2.33%
	35	5	0.815	2.34%
	31	5	0.795	2.56%
	22	3	0.550	2.55%
	21	3	0.605	2.88%
Total	271	40	7.0	
<b>Average</b>	<b>27.1</b>	<b>4.0</b>	<b>0.699</b>	<b>2.59%</b>
<b>JBS Loin</b>				
	29	4	0.645	2.26%
	26	4	0.710	2.71%
	19	2	0.610	3.18%
	22	3	0.595	2.68%
	20	2	0.560	2.80%
	23	3	0.610	2.63%
	25	3	0.650	2.62%
	34	4	0.750	2.19%
	26	3	0.655	2.50%
	25	3	0.565	2.24%
Total	250	31	6.4	
<b>Average</b>	<b>25.0</b>	<b>3.1</b>	<b>0.635</b>	<b>2.58%</b>