

final report

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Automated "Skin-on" goat meat processing

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1 EXECUTIVE SUMMARY

The project has successfully developed an integrated system that substantially improves the cost efficiency of processing skin-on goats whilst ensuring that the skin on goat meat complies with food safety requirements of importing countries. Utilising the combined expertise of Norvic Food Processing Pty Ltd staff, collaborating commercial engineering companies and DPI Victoria scientists the performance targets sought from this initiative have been met. When benchmarked against the previous system substantial productivity gains have been achieved. These include

- production levels have increased from a capacity of 800 to 1200 goats per shift
- the new system has reduced the labour manning units required to process skin on goats from 16 to 12 per shift.
- Labour costs have been reduced by \$4 per head (or 28.5c/kg for a 14kg dressed goat) from the increased productivity gains in increased throughput and reduced manning levels.
- The percentage of reject carcases was reduced from 5.6 % to almost zero. This
 has reduced manning levels previously required for the trimming of retained
 carcases by a further 2 labour units. The new system has almost eliminated
 carcase defects due to either broken ribs, torn muscles, beater marks on the skin
 etc which occurred in the previous system and required carcases to be either
 heavily trimmed or totally rejected.

The opportunity for further significant reductions in labour cost exists with the introduction of a purpose built polisher/automatic wash and some further refinements to the scald/ dehairing system

The results of the microbiological testing program conducted on skin on goats processed through the new integrated system at Norvic Food Processing Pty Ltd indicate that the production were of high microbiological quality that clearly met the food safety requirements of the USA and other skin on goat importing countries.

It is anticipated that the technology will have enormous benefits for the Australian goat meat industry with the jumps in plant efficiencies, food safety and quality compliance rates derived from the new integrated system will enhance Australia's competitive position in the global marketplace for skin on goat meat. An open day to demonstrate the new integrated skin on goat dehairing system to industry was conducted at Norvic Food Processing Pty Ltd Wodonga on Wednesday 25th May 2005.

2 BACKGROUND

Australia is the world's largest exporter of goat meat shipping to 25 overseas destinations. There is a strong preference in a number of these export markets for skin-on goat meat. Industry processing of skin-on goats is currently characterised by a high level of manual effort to de-hair goats and the resultant high labour costs, additional carcase downgrading cost arising from processing defects and concerns about the level of microbial safety of the processed product. MLA partnership project PSHIP 051 involving Norvic Food Processing Pty Ltd and DPI demonstrated that adaptation of the highly automated scald, de-hair, singe and wash processes operating in the pig industry to processing skin on goats was both feasible and favourable from a cost benefit perspective. The second stage of this project proposes to acquire, modify and commission an integrated system that efficiently processes skin on goats whilst ensuring the skin on goat meat complies with the food safety requirements of importing countries.

3 OBJECTIVES

- To develop an integrated system that efficiently processes skin-on goats
- To ensure goats processed through the integrated system comply with the food safety requirements of importing countries.
- To hold an open day in conjunction with MLA to demonstrate the outcomes of the project to industry

4 **RESULTS**

4.1 Design and performance of Norvic's previous skin on goat scald/dehair system

Norvic's previous system was a conventional pig dip lift system with a steam heated scald tank, mechanical operated basket to scoop carcases from the tank and a single chamber dehairer. It operated on a batch basis. Five goats at a time were placed in the scald tank for 2 minutes, transferred to the dehairing chamber for a further 2 minutes after which they are tipped out onto a table for manual shaving on those parts of the carcase that have not been effectively dehaired. The goats were then re suspended back onto the processing rail for evisceration etc. Production levels achieved under this system were 90 goats per hour with a total manning level of forty-two labour units. Other issues of concern relevant to the previous system relate to the variable level of dehairing achieved on carcases (65 to 90%). Also a carcase defect incidence rate of 5 to 6% was experienced due to either broken ribs, torn muscles, beater marks on the skin which required carcases to be either heavily trimmed or totally rejected. Compliance to food microbiological standards was mandatory hence a high priority issue. Table 1 summarises the production performance and manning levels of the previous system at Norvic.

4.2 Design of the New Integrated System

The design and performance specifications of an integrated scald/de-hairing unit for processing goat's skin-on were developed during stage 1 after conduct of the following activities:

- Benchmarking the performance of the existing system at Norvic Food Processing Pty Ltd.
- On site visits to 3 commercial pig processing plants with modern automated scald/ dehairing systems installed achieving throughputs of up to 400 pigs per hour.
- Results from wet trials collected on goats processed through a commercial pig scald and dehairing systems considered to best meet the preferred design specifications
- Assessment of the design and performance specifications of "off the shelf" pig systems commercially available, their price and the manufacturers interest in modifying design elements to customise the system for skin on goats.

4.2.1 Restrainer

After an assessment of site space limitations and projected production targets it was established that a purpose built goat restrainer would be required. The restrainer was developed specifically to handle goats in the 12 to 16 kg dressed weight ranges. An operator platform, access ramps and significant electrical works were also required for the restrainer



Figure 1 Restrainer Viewed from Outside SOG Room



Figure 2 Restrainer Viewed from Inside SOG

4.2.2 Bleed Conveyor

After electric stunning in the restrainer the goats are transferred onto a horizontal bleed conveyor where they are bled in accordance with Muslim requirements. The bleed conveyor was designed to ensure the blood from the goats could be recovered using the vampire knife/pneumatic suction system (still under trial).

The carcases are transported along the bleed conveyor and are machine counted onto the lifter, which transfers them into the scald tank. This takes place automatically when the rake conveyor is in the correct position.

As a result of the extensive modification to the Goat Dehairing Machine it has also been necessary to modify the bleed conveyor.

Variations to the bleed conveyor include raising the overall height. Construction of a raised working platform, complete with sterilisers, arm washes and an apron wash. Additional water sprays were fitted to the discharge end roller for continuous cleaning.

4.2.3 Scald/ Dehairing Machine

After discussions and site visits to a number of European commercial pig scald/dehairing system manufacturers Norvic Food Pty Ltd commissioned JWE to build and supply an integrated scald /twin chamber dehairing system (Model No.151+11/160/4 DGB 2000mm). As anticipated from the trials conducted in stage 1 a number of major design variations were required to adapt a machine essentially designed for pigs to process goats. The major design variations made to the machine are summarised as follows:

- The scald tank has been raised relative to Dehairing chamber 1.
- The transfer plate from the scald tank to Dehairing chamber 1 has been replaced.
- The action Flap operation on Dehairing chamber 1 has been modified.
- Additional water sprays have been fitted to Dehairing chamber 1
- Dehairing chamber 1 has been raised relative to Dehairing chamber 2.
- Dehairing chamber 2 has been raised to provide an appropriate working height on the discharge table.
- The transfer plate between Dehairing chamber's1&2 has been replaced with a new design incorporating transfer bars and flat plate.
- The machine PLC program and settings have been modified extensively.



Figure 4 New Discharge Table with Extension

4.2.4 Carcase Transfer to the Small Stock Chain

As the dehaired carcases are discharged from the dehairer a sliding gambrel is fitted to the hind hocks. The gambel then used to hook the carcase onto an ergonomically designed transfer chain conveyor that lifts the carcases onto an overhead rail that feeds carcases into the small stock processing area. The carcase transfer chain is central to the line of the dehairing machine enabling an operator to work on both sides.



Figure 5 Carcass Transfer Chain in Operation

The transfer chain incorporates variable speed drive to enable it to be synchronised with the existing small stock chain. The electrical control systems have been interfaced with the emergency stop systems to enable the complete system to be shutdown from any of the emergency stops strategically placed along the entire processing line.



Figure 6 Dehaired Carcasses after Transfer to the Small Stock Processing Area

4.2.5 Polisher Development

It is recognised that a polisher is required to complete the integrated system developed at Norvic. Polishers are an integral component of most automated pig dehairing systems. They are particularly valuable in removing hair in those parts of the carcase that are protected from the beaters (between the legs) or where the hair is more difficult to remove (back of the neck). Inclusion of a polishing stage in the Norvic system would capture further potential efficiencies in the dehairing process, which is inherently more challenging in goats because of their more angular physical shape and greater quantity of hair compared to pigs.

A purpose built polisher for goats is currently being developed. The current proposal is a machine incorporating four rotating brushes and controlled water sprays. The unit would be located in the dehairing room. It is expected that the polisher will achieve a further reduction in manning levels of 2 labour units.

4.2.6 Occupational Health and Safety

To ensure compliance with OH&S requirements a considerable number of modifications were required to each of the modules that collectively comprise the integrated dehairing system. Some of the key OH&S issues that required corrective action before the equipment could be able to be placed in production are detailed below:

- All equipment were fitted with additional; stands to facilitate worker safety during operation and cleaning
- All equipment were fitted with mechanical guarding and/or locking devices to prevent the risk of injury to staff working in the vicinity of the machine.
- The discharge table was enlarged to eliminate the risk that workers may come into contact with the hydraulically operated discharge flap.
- The electrical control system was modified to provide safety interlocking for the overall system and provision of sufficient emergency stops to facilitate emergency shutdown of the system during operation.
- Training and where appropriate hazard signage was provided on all plant equipment to ensure staff were fully trained on the safe operating procedures that needed to be followed for all operational equipment.



Figure 7 OH&S Guarding & Signage on Carcass Lifter Prior to Entry to Scald Tank

4.3 **Productivity of the New Integrated System**

Following final commissioning the performance of the integrated unit to process "skin on" goats was assessed by Norvic Food Processing Pty Ltd. A comparison of the design features manning levels and throughput of the new integrated system with the original system is detailed in Table 1 and summarised in Table 2. When benchmarked against the previous system the following productivity gains have been achieved

- production levels have increased from a capacity of 800 to 1200 goats per shift
- the new system has reduced the labour manning units required for the de-hairing stage of processing skin on goats from 16 to 12 per shift
- Labour costs have been reduced by \$4 per head (or 28.5c/kg for a 14kg dressed goat) from the increased productivity gains in increased throughput and reduced manning levels.
- An opportunity for further significant reductions in labour cost (reduction of 2 labour units) exists with the introduction of a purpose built polisher/automatic wash
- The percentage of reject carcases was reduced from 5.6 % to almost zero. This
 has reduced manning levels previously required for the trimming of retained
 carcases by a further 2 labour units. The new system has almost eliminated
 carcase defects due to either broken ribs, torn muscles, beater marks on the skin
 etc which occurred in the previous system and required carcases to be either
 heavily trimmed or totally rejected.

 Table 1 Design and performance specification s of the previous and new integrated systems for the processing of skin on goats

Process stage	Design "previous system"	Performan ce Spec's "original" system"	Design "new integrated system"	Target Performance Spec's "new integrated system"	Actual Manning
Livestock class	Mixed age & weight		Goats 10 to 18kg CWT	Throughput 1200 per shift	
Stun Shackle Stick and Plug,	Manual Manual Manual	*LU 1 LU 1 LU 1	As per current As per current As per current	LU 1 LU 1 LU 1	LU 1 LU 0 LU 1
Weasand clip De-shackle Scald Tank	Manual Automatic/manual Process- batch (5 per time) Type-dip lift Scald time- 2 mins Scald temp 65C Filtration system Nil Heating method steam Refill time 10 mins Water agitation nil Wetting agent nil	LU 1 LU ½ LU 1	As per current As per current Process- revolving wheel batch system(3) Scald temp 65C Filtration (coarse filter only) Heating method steam Refill time 10 mins Water agitation Yes Wetting agent TBC	LU 1 LU 0 LU 0	LU 1 LU 0 LU 0
De-hair	Process-batch (5 per time) Type- Rotation speed 110 rpm De-hairing time 2mins Beater type rubber No. of beaters 66 Beater protrusion 100-110mm Hair clean-up manual	LU ½ Hair removal 60-70% Carcase defects Broken ribs 4% Ruptured viscera 4%	Process- Double chamber de-hairer Rotation speed-110 rpm Dehairing time 1 mins per dehairer No. of beaters 66 Beater protrusion 100 –110mm Hair clean-up TBC (open chute under or conveyor belt under de-hairer)	LU 0 Hair removal 95-100% Carcase defects Broken ribs 0.5% Ruptured viscera 0.5%	LU 0
Shave Table	Manual	LU 4	Required for hard to remove places	LU 1	LU 4
Hocks and Hang	Manual	LU 1	Manual/Auto hock cutter. De-hocking of 2 front leg is recommended prior to scalding to facilitate tumbling /reduce jamming in the de-hairer	LU 1	LU 0
Wash	Manual	LU 1		LU 0	LU 1
Shave Rail	Manual	LU 2		LU 0	LU 2
Singe Polisher/ Wash Floor space	Manual Manual	LU 1 LU 1	Auto (S Hookey engineering system) Auto(modified Daylesford system) Additional floor space required	LU 0 LU 0	LU 1 LU 1
Microbial status Throughput	800 per 8hr shift	LU 16	E.coli &coliforms Staphylococcus aureus Salmonellae Range 800 to 1200 per 8hr shift	Compliance to USDA/FSIS pathogen reduction scheme (Mega regs) LU 6	LU 12***

* LU labour unit

** TBC to be confirmed

*** An additional reduction of 2 LU's (trimmers) achieved in small stock

processing area due to major reduction in incidence of retained carcases

TARGETS	Previous system performance	Integrated system performance (April 05)	Norvic Long term target (April 06)
THROUGHPUT/ SHIFT	800	1200	1200
LABOUR UNITS	16	12	6
QUALITY ATTRIBUTES % Hair removal	70	>95	99
% Carcase rejected	5.6	<1	<1

 Table 2
 A comparison of the productivity of the previous and new integrated of skin on goat processing systems

4.4 Compliance of the integrated system with the food safety requirements of importing countries

The microbiological quality of goat carcases (skin on) processed through Norvic's new integrated system was assessed in relation to compliance to AQIS carcase microbiological monitoring program (ESAM). VIAS food microbiology staff collected samples from 49 goats after approximately 15 hours chilling. The 49 goats were representative of the total production of skin on goats processed at Norvic on the 16th February 2005. The samples were tested at VIAS Attwood for the following organisms

TESTS PERFORMED:

FM304 - *Eschericia coli* and Coliforms by Petrifilm FM309 - *Salmonella* spp. (Sal.)* FM311 - Total Plate Count 25°C (TPC 25°C)

• Brilliant Green agar was substituted for Bismuth Sulphite agar and thus FM309 deviates from AS1766.2.5-1991

The results obtained from the testing indicate that, for those days production were of high microbiological quality. The results obtained show:

- Salmonella was not detected on any the 49 carcases. The product easily meets AQIS requirements (as per AQIS Notice 2003/6) for Salmonella
- The product met AQIS performance criteria for E coli with 9 of the 49 samples meeting the Good category (1-10 E coli/ cm²) and the remaining 40 samples being in the Excellent category (not detected)
- TVC counts were in the Excellent range according to Meat Standards Committee guidelines of <1000

Figure 8 Quality of the skin on goat carcases processed through the new integrated system at Norvic Food processing Pty Ltd on 16th March 2005

