

final report

Project Code:

Prepared by:

PRTEC.020

June 2004

Ray White and Andrew Finney Food Science Australia

Date published:

PUBLISHED BY Meat and Livestock Australia Limited Locked Bag 991 NORTH SYDNEY NSW 2059

Automated Hot Fat Trimming – Tool Development Proof of Concept

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government and contributions from the Australian Meat Processor Corporation to support the research and development detailed in this publication.

This publication is published by Meat & Livestock Australia Limited ABN 39 081 678 364 (MLA). Care is taken to ensure the accuracy of the information contained in this publication. However MLA cannot accept responsibility for the accuracy or completeness of the information or opinions contained in the publication. You should make your own enquiries before making decisions concerning your interests. Reproduction in whole or in part of this publication is prohibited without prior written consent of MLA.

EXECUTIVE SUMMARY

An investigation into the practice of removing fat from the outside of beef carcass sides prior to chilling has been carried out and information collected from a number of Australian beef processors.

Two different powered tools were identified as currently being used:

- A Wizard[®] ring knife for the removal of excess surface fat predominately from the flank, rib and shoulder areas (spencer roll, blade and brisket meat cuts)
- A "works prototype" hot fat trim tool used to remove surface fat to final thickness in the striploin, silverside and rump meat cut areas.

Industry figures of 5 to 20 Kg of fat removed per carcass but with minimal trimming occurring in the high value areas as only the Wizard hand tool was used.

Feed back from plants was that if the prototype tool is able to be used in the high value areas it will help to reduce OH&S and other issues related to the processing of "hard fat". However they are not interested in further automation of the tool (full automatic system or fat depth sensing) unless payback, product quality and consistency can be proven. All plants expressed interest in obtaining a manual prototype hot fat trim tool for in plant trialling. Rockdale Beef currently use the developed manual tool on the high value areas of their carcasses and are very happy with the results, and have expressed interest in obtaining a redesigned or upgraded trimmer.

Areas where processors considered benefits could be achieved from removing fat prior to chilling were:

- Reduced carcass weight to chill
- Increased carcass chill efficiency due to reduction in fat cover thickness
- Reduced hard fat OH&S issues in the boning room including a reduction in work effort and processing time
- Opportunity to pack fat hot, allowing packaging efficiencies to be realized
- Remove the cooling & heating steps associated with rendering cold fat.
- Possible increase in marble score for marginal product due to effective chilling
- Improved product appearance via reduced incidence of air bubbles in vacuum packs
- Potential increase in customer product acceptance due to improved fat surface finish.

TABLE OF CONTENTS

Page No.

EXECUTIVE SUMMARY	2
1. INTRODUCTION	4
1.1. PROJECT AIM 1.2. BACKGROUND	4
2. SITE VISITS	6
JOHN DEE (WARWICK, QLD.) AMH - BEEF CITY (TOOWOOMBA, QLD.) TEYS BROTHERS (BEENLEIGH, QLD.) VALLEY BEEF (GRANTHAM QLD.) ROCKDALE BEEF (LEETON, NSW).	6 7 8 8 9
3. CONCLUSIONS	11
APPENDIX A - HOT FAT TRIM SURVEY	12
APPENDIX B – DISCUSSION NOTES FOR HFT ROCKDALE OBSERVATIONS	15

TABLE OF FIGURES

FIGURE 1 WIZARD KNIFE	5
FIGURE 2 FIRST WORKS PROTOTYPE DEVICE	5
FIGURE 3 HFT AT ROCKDALE1	0

1. INTRODUCTION

1.1. PROJECT AIM

The aim of this project milestone is to evaluate fat trimming and to develop and understanding of related issues including current practice; opportunities and benefits of hot fat trimming; and process parameters such as processing speed, quality of finish and directional cut requirements. To carry out this work site visits and/or communication was undertaken with the following plants:

- Rockdale Beef
- Teys Bros
- AMH Beef City
- Cargill
- Nippon Meats, Oakey
- John Dee
- Valley Beef
- Nebru Exports
- Australian Country Choice

The data collected will also be used in future project milestones to perform a cost benefit analysis.

1.2. BACKGROUND

The Australian Meat Industry has identified cold fat trimming on well conditioned carcass sides as a procedure that is costly due to the following:

- Highly labor intensive task of reducing the fat thickness to specification.
- Occupational health and safety issues of cutting hard fat.
- The necessity of providing a high quality product appearance and finish of meat products destined for Asian markets where appearance is paramount.
- Gas bubble formation that can reduce the visual product acceptance of vacuum packed meat.

Fat trimming predominantly occurs in the boning room, where the fat to be removed has been chilled and as a result becomes very tough resulting in what is known as "hard" fat. The fat is manually removed from the meat cut with a hand knife, resulting in significant stress injuries to the hand, wrist and elbow. As this is the final process for the appearance of the cut, the skill of the operator is important in being able to achieve a product to meet the customer's specification of fat thickness and expectation of appearance.

Fat trimming is also carried out by some meat processors prior to carcass chilling while the fat is "hot". These processors remove excess surface (and internal) fat usually using hand held Wizard trimmers, or similar. These powered knives are used in production process lines for fat trimming operations due to their cutting speed. The use of Wizard trimmers to carry out specific cuts requires considerable experience and skill to be able to manually achieve a consistent fat thickness, while maintaining an acceptable meat product surface finish. For this reason, when the fat is removed "hot" it is generally only removed from low value cut surfaces, allowing the trimmers in the boning room to remove the fat from the primal cuts to the customers specification. Inexpertly operated, the round shape of the cutter (as shown in Figure 1) can leave the surface of the carcass with an uneven smoothness, and a defined "scalloped" appearance. An even surface finish is a major goal of fat trimmers to improve the market value of primal cuts in Asia and other international markets.





Figure 1 Wizard Knife

Food Science Australia (FSA), in collaboration with a commercial partner, Rockdale Beef and under the Food into Asia research program has developed a hand-held mechanised hot fat trimming device (see Figure 2) for beef carcasses. This tool is able to consistently trim the fat from a hot carcass or side and provide a finish with a smooth, flat and non-scalloped surface appearance.



Figure 2 First Works Prototype Device Developed under CSIRO's Food into Asia Program

2. SITE VISITS

In order to develop an understanding of the various issues concerning hot fat trimming from a processors' point of view, a number of site visits to processing plants were arranged. A total of 8 different processors were visited and a further 3 processors were contacted by phone and email. A three page questionnaire was developed (see APPENDIX A - Hot Fat Trim Survey) to help capture relevant information. This document was then used for the site visits as well being sent to those processors contacted by phone. The site visits consisted of meetings with the appropriate personnel to inform them of previous research into hot fat trimming (HFT) and the current state of that research/technology. Discussions were held relating to the specific requirements of their plants and in some cases a tour of the plant was carried out to assess their current HFT operation or to look at potential areas for future operations. Any suggestions or specific concerns were noted and included with the questionnaire information.

The details of each site visit and the conclusions from each visit are listed below in the order they were visited. When communicating with some beef processors, complete data was not available and has not been included in this report.

John Dee (Warwick, Qld.)

The John Dee processing plant was visited on 31.03.2004 and discussions were held with the works manager, Mr John Hart. A tour of the plant floor was also conducted to view their existing HFT operation. The plant currently processes around 390 head per day, of which approximately 100 are lot fed destined for the Japanese market. Some hot fat trimming is being carried out in the plant on the lot fed cattle at present using standard Wizard type hand tools. Fat is removed from the forequarter and flank areas but the loin and rump regions are left untouched due to the high value of those areas and the risk of downgrading through heavy trim and/ or poor surface finish. Some internal fat is also removed with the Wizard trimmers. All fat removed at present is sent to render. John believes there is markets for edible beef fat, but does not currently have the facilities to pack and handle this product.

John is enthusiastic about the potential he sees in the FSA developed hot fat trimmer prototype and believes this type of tool would improve the appearance of John Dee's higher value meat cuts as well as providing labour savings in the boning room. From the perspective of the operation at Warwick, John does not see a need for automation of the HFT tool nor would he support such a project, however he does see a need for fat depth sensing and automatic fat depth adjustment of the tool to maintain a uniform fat cover complying with customers' specifications.

In general, John is keen to test a HFT tool in his plant and believes that in order to properly evaluate the benefits to the plant he would need to trial one for a period of time.

Summary:

- Some HFT already carried out in plant using Wizard trimmers but high value cuts not touched.
- Believe FSA type tool would improve surface finish and reduce labour.
- Keen to trial a tool in their plant to evaluate full benefits.
- Can see a need and benefit for fat depth sensing and auto depth adjustment to be developed, but not for automation.

AMH - Beef City (Toowoomba, Qld.)

The AMH Beef City plant was visited on 23.04.2004 and discussions were held with Mr Neil Brereton, Mr Graham Payne and Mr Keith Smith. The Beef City plant processes about 800 head per day which can include short fed animals (100 day fed) to long fed (200 or more day fed). Hot fat trimming is currently being carried out in their plant with an average of 20 Kg of fat removed hot from each carcass. Some fat is removed from the loin areas, but care is taken to leave sufficient fat cover in those areas to do a final trim to specification in the boning room. Most of the fat is sent to render, however some fat is packed when required for sale as edible. A possible concern for AMH is that as final carcass assessment is determined after chilling, then the final specification for fat thickness on individual cuts is not always known during slaughter. Therefore it may be difficult to determine correct final fat depth when trimming hot. However, at the very least, it would be possible to remove the bulk of the fat by trimming all carcasses to the maximum specified fat cover and then only hand trim the cuts that require less fat depth in the boning room.

Generally, AMH were positive about the FSA prototype tool and might invest in one if the opportunity was available, however they stressed that they would need to try one in their plant first to assess the full benefits before committing to purchase a unit. They could also see the benefits of having fat depth sensing and auto depth adjustment, pointing out that the depth adjustment needs to measure from the meat surface up instead of from the fat layer down. They also said they had no interest in automation of the tool unless both payback and product quality consistency were proven as any product loss is totally unacceptable.

Aside from the above AMH could see possible benefits in areas such as achieving a better/faster chill on carcasses and thereby better food safety if more fat were removed hot. They also believe that if the equipment performs well then the potential exists to reduce boning room labour by up to 1 slicer per shift using the hot fat trim tool. Other possible benefits may be gained in maintenance, by eliminating the need for sharpening Wizard blades (however this cost benefit may be offset by the cost of blade replacement on the FSA tool) and in OHS by reducing the problems caused by hard fat and the number of strokes an operator needs to use to achieve the same result in comparison with a Wizard tool. They would also like to see the design of the unit improved to achieve up to 800 carcasses per blade, ie. 1 blade per day (the current tool used by Rockdale achieves approximately 1 blade per 250 to 280 carcasses) and an appropriate steriliser designed to suit the unit.

Summary:

- HFT is currently carried out in their plant, primarily to reduce the OH&S issues of hard fat.
- Approximately 20 Kg of fat is removed from each carcass, but with a minimal amount of fat being removed from high value areas.
- Can see benefits in using prototype tool, but need to trial a unit to properly assess the potential benefits.
- Not interested in automation unless payback and product quality/ consistency proven.
- May be difficult to determine correct final fat depth specification when trimming hot with the FSA tool.
- Would like to see improvement in blade life.

Teys Brothers (Beenleigh, Qld.)

The Teys Bros. plant was visited on 7.05.2004 and discussions were held with Mr John Hughes and Mr Paul Day. Teys currently use Wizard type trimmers to trim hot fat on carcasses using one to two workers in the process. Teys have said that they would like to evaluate a prototype tool, however they feel it would be unlikely that they would purchase one due to a number of concerns they have with the equipment.

In particular, Teys Bros raised the following concerns on the equipment potential:

- 1. The tool design restricts the areas where it can be used on the carcass. Ok for flat areas, loin, rump, some forequarter and flank but not on areas where a curved blade is required.
- 2. Equipment unable to handle different fat specifications such as 6mm fat depth over the striploin but 12mm at the rump.
- 3. Equipment may not be able trim to specification properly on areas where there are fat 'pockets' possibly around rump area.
- 4. Expressed concern of the size and weight of the tool combined with the action of the operator when using the tool would create OHS problems due to long strokes and possible bending of legs/back.
- 5. Automation of the tool would not make it any more attractive due to the above perceived equipment restrictions.

Summary:

- Current prototype tool too restrictive in its use.
- Concerns whether tool can achieve correct specification over fat 'pocket' areas and where specification varies between rump and loin.
- Concerned about possible OHS problems with operator.
- Not interested in automation.
- Would still like to evaluate a unit.

Valley Beef (Grantham Qld.)

The Valley Beef plant was visited on 12.05.2004 and discussions were held with Mr Mike Jackson and Mr Rod Schultz. Valley Beef have a medium sized operation processing around 560 head per day and working 5 ten hour shifts per week. A typical week's kill would include around 600 head at 70 day lot fed, 600 head at 120 day lot fed, 200 head at 350 day fed (of which 150 head would be classed as Wagyu) and at least 400 head grass fed. They presently carry out hot fat trimming using standard Wizard trimmers on all their lot fed carcasses except the 70 day fed cattle. Some fat is packed as edible (mainly from the Wagyu cattle). The fat trimmed from carcasses is only from the lower value areas with the striploin, rump and area near the cube roll not touched. They estimate that at least 5 kilograms of hot fat is removed from each carcass.

Valley Beef were very positive about the benefits they could see in using the FSA prototype tool. They would be keen to trial a tool in their plant, but once again are uncertain of what the full potential of this type of tool would be until they have tested a unit.

The main areas they would expect to see benefits are as follows:

- Improve the finish of the final fat surface
- A reduction in workload of the slicer tasks by providing a final finish or removal of the bulk of the fat layer so that only the skilled task of final finishing by slicers is required.

© 2004 CSIRO, Food Science Australia

- A reduction in issues relating to hard fat
- Reduce gas bubble formation in vacuum packs
- A better/faster chill of carcasses with resultant improvement in food safety.

Another possible benefit due to an improvement in the carcass chill is the possible upgrading of some carcasses to a higher marbling score. Valley Beef believe that when some carcasses have a borderline score, for example between a score of 7 and 8, the carcasses would normally be rated at the lower score however a better chill would more clearly show a higher marbling score. At current prices, realising a higher marbling could improve the carcass value by up to \$200.

They also believe that although the prototype tool is limited in where it can be used on the carcass, there is definitely still a place for it, working in conjunction with a Wizard knife to remove fat in low value areas.

Valley Beef believe that automation is always a worthwhile pursuit however they have some reservations about the development of a fat depth sensing system that would be capable of automatically adjusting the depth of cut accurately at operator speeds. They believe that the cost to develop a system like this could be prohibitive.

Summary:

- Some HFT already carried out in plant using Wizard trimmers (approximately 5 kilograms per carcass) but high value cuts not touched.
- Believe prototype tool would improve surface finish, provide for a better/faster chill, improve food safety and reduce labour and hard fat problems.
- Believe in some cases better chill may improve marbling score and hence considerably increase value of carcass.
- Keen to trial a tool in their plant to evaluate full benefits.
- Believe HFT automation is worthwhile, however have some doubts about cost effectiveness of fat depth sensing.

Rockdale Beef (Leeton, NSW)

On 18.05.2004 the Rockdale Beef plant was visited and discussions were held with Mr Paul Troja and Mr Gary Thomas. Rockdale have had the FSA developed hot fat trimmer in service since July 2001 and the tool is used on a daily basis for all their grain fed export beef. They are very happy with the performance of the tool and with the benefits that flow from it. Their current kill is about 520 to 560 head per day and approximately half of that number is their premium 'F1' and 'F2' grades on which the prototype tool is used. The tool is used mainly to trim the striploin and rump regions of the carcass with little or no further trimming required on those areas in the boning room (see Figure 3). A standard Wizard ring knife is also used to trim internal fat and to trim fat from lower value areas of the carcass.

Although the tool was originally developed for Rockdale to specifically address the problem of gas bubbling occurring in vacuum packed meat cuts where fat had been trimmed cold, a number of other advantages were also realised. The tool has significantly reduced the work effort for slicers in the boning room as well as reducing the problems associated with hard fat. There is an improvement in the surface finish of the fat and savings in refrigeration costs have been made.

Rockdale have expressed an interest to be involved in any redesign of the prototype tool, however they would probably not be interested in the development of fat sensing/auto depth adjustment

technology and do not have confidence in the success of that technology. It is also unlikely that they would be interested in automation of HFT as they can not see the benefits for their plant.

While at Rockdale, the prototype tool was inspected during a worker break and also viewed during operation. A number issues related to the current design of the tool were noted. In particular, it was observed that at times the operator needed to reach forward with the tool in order to trim all the required areas. While this may not present any problems in a plant with low to medium throughput, it may be an issue for OHS in high throughput plants. Careful consideration must be given to the distance between operator platform and carcass in future plant installations. It was further noted that the operator seemed quite comfortable in turning the carcass sides slightly with the back of his hand to achieve the correct orientation for trimming however, once again, for high throughput plants, a carcass handling and stabilisation device may be required.

Summary:

- Currently using FSA developed prototype on all premium grain fed beef carcasses.
- Rockdale are very pleased with the performance of the tool and the benefits that flow from it.
- Would like a redesigned/upgraded HFT tool.
- Probably not interested in fat depth sensing or automation of HFT.



Figure 3 HFT at Rockdale

3. CONCLUSIONS

Due to the high cost of meat processing, the adoption of hot fat trimming of well conditioned lot fed cattle with excessive fat cover can be recommended. The practice of hot fat trimming on the exterior surface of grass fed and short period lot fed cattle is not usually necessary due to the carcass fat cover being within specification. If trimming of the fat is necessary to meet fat cover specification, then hot fat removal should be considered due to the potential productivity gains in reduced labour effort and hard fat issues.

Collating the information collected from industry it is found that

- Most plants processing well conditioned carcasses carry out some form of hot fat trimming generally utilising a Wizard trimmer on low value areas
- Plants are not interested in further automation of the tool (full automatic system or fat depth sensing) at this stage unless payback, product quality and consistency can be proven
- All respondents are interested in the use of a prototype HFT for a trial period.

The perception of the HFT tool developed by FSA is that it has large potential benefits including improved surface finish and reduced labour; however it is seen as being too restrictive in its use and needing improvement in blade life. Most plants expressed concern over the success of an automated fat depth sensing and adjustment system particularly in maintaining a correct trim specification when fat depth specification varies between different areas. The plants' believe if the prototype tool is able to allow high value areas to be safely trimmed flow on benefits like better/ faster chill, improved food safety, possible marble score improvement as well as a reduction in "hard fat" issues will be achievable. Rockdale Beef who currently use the existing manual tool are very happy with its performance and currently use it on all premium grain fed carcasses.

Industry report's figures of 5 to 20 Kg of fat removed per carcass but in both these cases minimal trimming occurred in the high value areas.

During discussions with the meat processing plants the following points were outlined as benefits of removing fat prior to chilling:

- Reduced carcass weight to chill
- Potential improvement in the carcass chill due to the reduction in fat cover thickness
- Reduced hard fat OH&S issues
- Opportunity to pack fat hot, allowing packaging efficiencies to be realized
- Eliminate the cooling & heating steps associated with rendering cold fat.
- Reduction in work effort associated with cold fat removal
- Potential of an increase in marble score from marginal product due to effective chilling
- Reduced incidence of air bubbles in vacuum packs
- Potential increase in customer product acceptance due to improved fat surface finish.

APPENDIX A - Ouestionaire –	HOT FAT TRIN Hot Fat Trin	A SURVEY		Date
Contact type – Face to Face	Phone	Other	r	
Company Name				
Company address /de	etails			
Contact Person				
Position			•••••	
Phone		Mobile		
Fax		Email		
Reference to other co Name	ompany staff:	Name		
Position		Position		
Phone		Phone		
Establishment type:	Export D D	Domestic		
Species: Beef	Head per Day		Sheep	Head per day
Day	Pig L Head p	ber DayC	Other	Head per
Lot fed beef kill (No	per day or % of tot	al kill)		
Lot feed types:	60 day LF			
	90 day LF			

	120 day LF		
	180 day LF		
Do they supply the Ja	apanese market?		
Boning system?	Quarter	Table	Other
Muscle Fat trim	Hot (pre-chiller)	.1 a010	Cold post boning
Shoulder	Tool type (eg. knife, whizzard etc)		
Cube Roll	Tool type		
Flank	Tool type		
Loin	Tool type		
Rump	Tool type		
Other areas	Tool type		
Weight of trimmed f	at		
Hot	Cold		Total
What do you do with	the trimmed fat – Edible %	Inedit	le%
Value of fat	Edible	Render	Other
Plant cost decrease fr	rom not having to refrigerat	e fat removed wh	ile hot-
Plant cost decrease in	n refrigerating beef sides du	e to the thermal in	nsulation lost from hot fat trim.
Plant cost increase in second fat transport s	n material handling and tran system.	sport of hot trimn	ned fat due to the requirements of a
Labour costs associa	ted with hot fat trim compar	red to cold fat trir	n
Where in plant is HF	T carried out or where wou	ld it be carried ou	t if implemented.
© 2004 CSIRO, Food So	cience Australia		Page 13

PRTEC.020 - Automated Hot Fat Trimming – Tool Development Proof of Concept

Cost of primal cut vacuum bags losing their tight fit from gas release from the fat after cold trim.
Any other advantages/ disadvantages from handling removed hot fat
Hot fat trim expectations: Surface finish, average depth range, tolerance on depth etc.
Estimate of yield loss due to too heavy trimming.
Are there any issues that would preclude the use of HFT in your plant eg. animals graded for final boning specification after chilling, specific customer requirements, etc.
Do you anticipate any additional market for fat that is removed and packed hot compared to the existing cold fat trim process?
Other notes:

APPENDIX B – DISCUSSION NOTES FOR HFT ROCKDALE OBSERVATIONS

The CSIRO Hot Fat Trimming Tool was developed in order to address the specific problem of gas emission from beef fats causing loose fitting ('blown') bags around cuts of vacuum packed meat. The cuts were high quality Japanese export beef and the loose bags gave the impression of either inferior product or faulty/damaged bags. By trimming the fat from the carcase while it was still hot instead of the usual practice of trimming it cold in the boning room, the production of gas from the fat was greatly reduced and thereby eliminated the problem of blown bags. The next planned stage for the project was to incorporate fat depth sensing with a view to fully automate the process (robot), however Rockdale were very happy with the performance of the manual tool and the fact that it solved their vacuum pack problem and were reluctant to commit to the substantial funds required to automate the process. They saw these stages (sensing/automation) as being much higher risk.

The manual HFT tool has been in operation at Rockdale for nearly 3 years now and is used on all their grain-fed export beef (at present about 250 - 280 Jap Ox/day, the rest of their kill is domestic). The tool is very reliable and the only problems they have had with it is when the blade occasionally rides up on the drive pulley and cuts into the aluminium cover plate. They have had to replace the cover a few times. The tool uses approx 1 cutting blade per day.

Some points to note regarding Rockdale HFT operation:

- They use the HFT tool only over the high value areas of the carcase eg loin, rump and back. They use a standard wizard trimmer over low value areas such as on forequarter and inside carcase.
- The main area of improvement of the tool Rockdale is interested in is for better fat depth control (current tool sometimes 'scalps' a small area of the rump, causing freezer burn of that area when chilled).
- HFT assists the slicers to do their job in the boning room, however Rockdale has not capitalised to reduce the number of slicers.
- Rockdale packs the hot fat directly into cartons for sale as edible product. The hot fat packs much easier and better than cold fat trimmings.
- Rockdale are not aware of any OHS issues regarding the use of the manual tool, but bear in mind they are only using it on 250 280 carcases per day.
- HFT at Rockdale is carried out immediately after side wash.

Some points regarding HFT in general:

- A viable method of sensing fat depth at line speeds has never been determined (ultrasound appeared to be the best hope, but very questionable if it will work given surface conditions and line speed) yet fat depth sensing is pivotal to successful automation.
- Thinking should not be limited to the current HFT tool for automation, as for example the power and speed of robotics may mean the use a static cutting device (possibly profiled) that would be less likely to cut muscle tissue.



© 2004 CSIRO, Food Science Australia