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Development of value-added lamb cuts for the modern consumer

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Abstract

As genetics and management practices have improved within the Australian lamb industry, the weight of lamb carcases has increased. Yet, the demographics of lamb consumers and their consumption patterns have changed, as household size has become smaller. Consequently, the traditional lamb cuts have less appeal to consumers from smaller households when taken from heavy carcases (>25kg). Therefore, research has been conducted to determine the potential for fabricating new cuts from heavier lamb carcases, determine the nutritional composition of new cuts and examine the impact of increasing carcase weight and fat depths on the time and labour required to process larger carcases into smaller cuts. Development of an information matrix of available lamb data on the eating and nutritional qualities and contribution to total carcase yield highlighted the potential to create further value-added cuts from the forequarter and leg. However, the time taken to fabricate these increasingly value-added cuts from heavier carcases increased with carcase weight (0.44 minutes/kg (s.e. = 0.065) and changes to the saleable meat yield resulted in increased average product prices. Based on the program, a new cut called the Compact Shoulder Roast was developed to provide an option for retailers when processing heavy carcases. This paper outlines some of the outcomes of this program.

Keywords: lamb; retail cuts; value-added

Introduction

Improvements to animal management practices and genetic gains within the Australian lamb supply chain in the last two decades have led to an increase in the weight of lamb carcases (Pattinson, Wilcox, Williams & Kimbal 2015). During the same period, the demographics of Australian lamb consumers and their consumption patterns have also changed, as household size has become smaller (Australian Institute of Family Studies 2016). Consequently, traditional lamb cuts, such as a whole forequarter roast, are becoming increasingly larger and have less appeal to consumers from smaller households. This points to the need for the development of new smaller cuts.

Industry consultation during the development of the 'Trim Lamb' retail cuts in the 1990s highlighted the need for retailers to be provided with information on the profitability of different types of cutting methods and carcases (Hopkins, Wotton, Gamble & Atkinson 1995a, Hopkins, Wotton, Gamble, Atkinson, Slack-Smith & Hall 1995b). Thus, the impact of fabrication of smaller cuts needs to be examined as new value-added cuts are developed.

Therefore, complementary studies were completed to determine the potential to fabricate new lamb cuts and examine the impact of increasing carcase weight and fat depth on the time and labour required to process larger carcases into smaller cuts.

Materials and methods

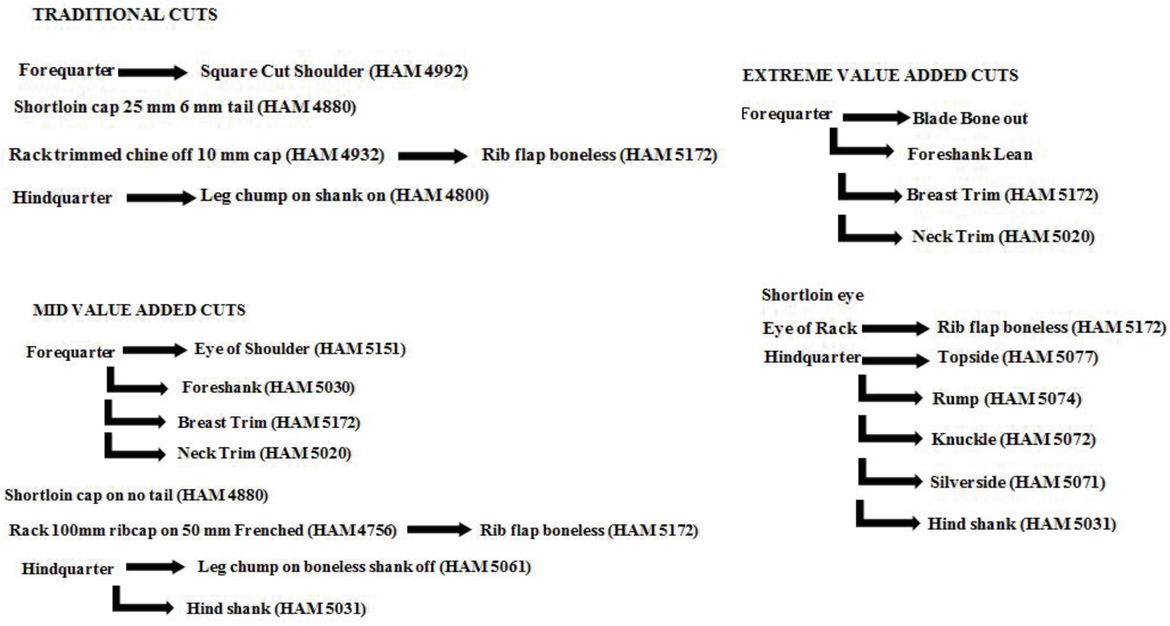
Initially, a literature review was undertaken to collate the available data on the eating quality and nutritional composition of lamb cuts as well as their contribution to total carcase yield and the best cooking methods. Details included in the review also included a fabrication description, estimation of cut weight and serve size, interaction of cooking method and animal age, as well as relationship to other fabricated carcase units. The comparison also includes Australian lamb cuts against lamb cuts currently prepared in Australia, New Zealand and the USA, beef cuts prepared in Australia, New Zealand, USA and Europe and pork cuts prepared in Australia, USA and Europe. This information was collated into a document "The Nutritive Value and Eating Quality of Australian lamb cuts" (Hopkins, Holman, Fowler & Hoban 2015) in an endeavour to determine the potential to develop cuts that are currently utilised in other markets which have not been commercialised in Australia for lamb. This process identified a number of possible "new" cuts.

Once the literature review was completed, several value-added cuts were highlighted and complementary studies were conducted to determine the nutritional composition (data not reported) and impact of fat depth and carcase weight on fabrication times.

To examine the time required to prepare value-added cuts and "new" cuts, 95 lamb carcases were progressively broken down from traditional retail cuts into *mid value-added* cuts and *extreme value-added* cuts by experienced butchers at two different tables as standard in commercial processing plants. The time taken by the butchers to fabricate each cut from traditional to value-added cuts was recorded.

The combinations of cuts which were chosen for traditional, *mid value-added* and *extreme value-added* cuts are given in Figure 1 (data for the full combinations of cuts are available upon request).

Figure 1 Flow charts illustrating the various combinations of cuts fabricated within the creation of traditional, mid value-added and extreme value-added retail lamb cuts in Australia.



Also recorded were day, person recording the time, carcase weight (CWT), GR tissue depth (on the 12th rib 110 mm from the midline of the carcase), eye muscle area (EMA; surface area of the *m. longissimus thoracis* at 12th rib measured in square cm using a grid), sex of the lamb and weights for each individual cut. Times were converted to decimal units prior to analysis.

Times for each cut were regressed on weights of selected cuts of the carcase after adjusting for Timer x Date and CWT to determine if the weights of any of the cuts significantly influenced the time to prepare the cut after adjusting for Timer, Date and CWT. A multivariate linear mixed model (MLMM) regression analysis was also conducted to estimate the difference in time to section the *mid value-added* and *extreme value-added* cuts within a carcase, compared with the traditional cut; and to determine if this changed with other variables, in particular CWT, EMA, GR depth and Sex

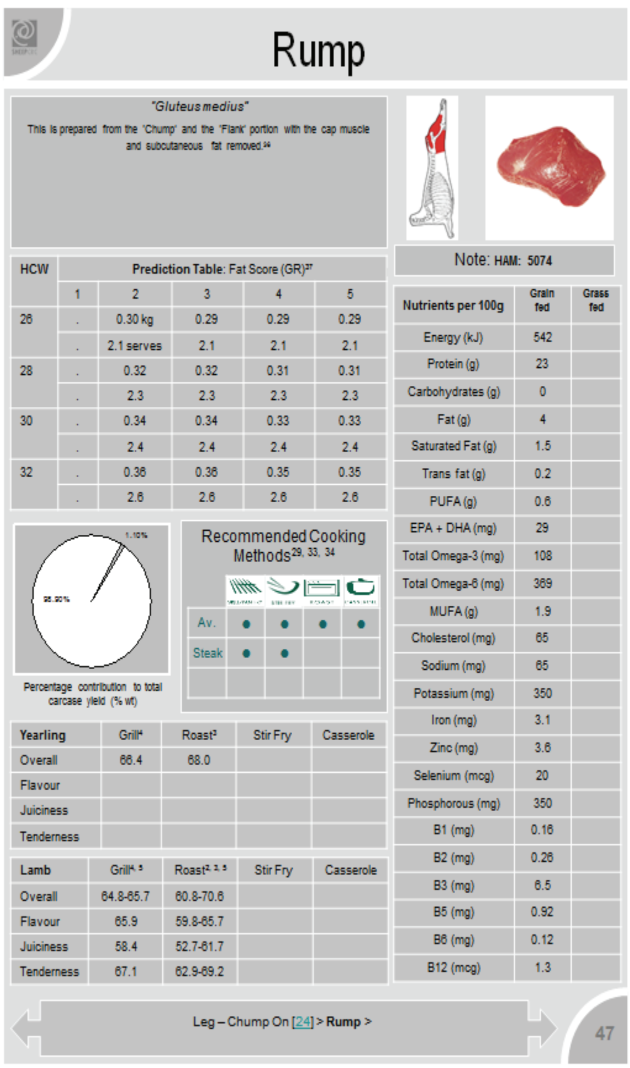
All models for the fabrication time data were fitted using *asreml* (Butler, Cullis, Gilmour & Gogel 2009) using R core software (R Core Team, 2015).

Results

The literature review of cuts which was completed demonstrated that there were opportunities to develop leg and shoulder cuts and adapt retail cuts from other species. However, there is little scientific data available for these cuts as much information is absent throughout the document, particularly data related to eating quality from cooking methods as affected by age (lamb vs hogget) and nutritional data. Indeed, some of the most complete information sets, such as the data for the rump (Figure 2), are missing some of this information (Hopkins et al. 2015).

One cut that did emerge as having potential is a "new" shoulder cut (Figure 3) named the Compact Shoulder Roast

Figure 2 The "Rump" from "The Nutritive Value and Eating Quality of Australian lamb cuts" (Hopkins et al. 2015).



Rump

"Gluteus medius"

This is prepared from the 'Chump' and the 'Flank' portion with the cap muscle and subcutaneous fat removed.[34]

HCW	Prediction Table: Fat Score (GR)[37]				
	1	2	3	4	5
26	.	0.30 kg	0.29	0.29	0.29
	.	2.1 serves	2.1	2.1	2.1
28	.	0.32	0.32	0.31	0.31
	.	2.3	2.3	2.3	2.3
30	.	0.34	0.34	0.33	0.33
	.	2.4	2.4	2.4	2.4
32	.	0.36	0.36	0.35	0.35
	.	2.6	2.6	2.6	2.6

1.10%
98.90%

Percentage contribution to total carcase yield (% wt)

Recommended Cooking Methods[29, 33, 34]

Av.	●	●	●	●
Steak	●	●		

Yearling	Grill[4]	Roast[3]	Stir Fry	Casserole
Overall	66.4	68.0		
Flavour				
Juiciness				
Tenderness				

Lamb	Grill[4, 5]	Roast[2, 3, 5]	Stir Fry	Casserole
Overall	64.8-65.7	60.8-70.6		
Flavour	65.9	59.8-65.7		
Juiciness	58.4	52.7-61.7		
Tenderness	67.1	62.9-69.2		

Note: HAM: 5074

Nutrients per 100g	Grain fed	Grass fed
Energy (kJ)	542	
Protein (g)	23	
Carbohydrates (g)	0	
Fat (g)	4	
Saturated Fat (g)	1.5	
Trans fat (g)	0.2	
PUFA (g)	0.6	
EPA + DHA (mg)	29	
Total Omega-3 (mg)	108	
Total Omega-6 (mg)	369	
MUFA (g)	1.9	
Cholesterol (mg)	65	
Sodium (mg)	65	
Potassium (mg)	350	
Iron (mg)	3.1	
Zinc (mg)	3.6	
Selenium (mcg)	20	
Phosphorous (mg)	350	
B1 (mg)	0.16	
B2 (mg)	0.26	
B3 (mg)	6.5	
B5 (mg)	0.92	
B6 (mg)	0.12	
B12 (mcg)	1.3	

Leg – Chump On [24] > Rump >

47

Figure 3 The "Compact Shoulder Roast" developed as a new value-added lamb retail cut suitable for fabrication from the forequarter of heavier lamb carcases (>25 kg) in Australia.

Table 1 Carcase components (saleable meat, trim, fat and bone) weighed during the progressive breakdown of carcases into traditional, *mid value-added* and *extreme value-added* retail cuts including the mean (kg) and standard error of the mean.

Carcase Component	Average weight fabricated per cutting method (kg ± standard error)		
	Traditional	Mid Value-Added	Extreme Value-Added
Saleable Meat	16.54 (0.37)	12.54 (0.29)	9.05 (0.20)
Trim	2.13 (0.06)	3.86 (0.11)	5.51 (0.13)
Fat	1.32 (0.07)	2.20 (0.10)	4.24 (0.17)
Bone	1.95 (0.04)	4.43 (0.09)	4.41 (0.08)

(CSR). It comes from the pork industry and is prepared as follows from a Square Cut Shoulder (HAM4992) by removing a section off the neck side and the top of the leg using a straight cut through the joint between the scapula and the humerus. The four rib rack is removed and the scapula can be boned out for a boneless option. This cut is perfect for roasting and slow cooking, especially for pulled meat which is currently popular with consumers.

Data collected on this cut shows that for a 19 kg carcase with an average GR of 12mm the average weight of the cut is 0.5kg with a range of ±300g. For a 25 kg carcase with an average GR of 19mm the average weight of the cut is 0.7kg with a range of ±500g.This is an ideal weight as it stays under the $20 total price level, which for many consumers in Australia is a consideration.

Measurement of the time taken to fabricate these value-added cuts demonstrated that EMA, GR depth or Sex, either individually or jointly, do not remove any variation in fabrication time after adjusting to Timer x Date and CWT. Regressions on time differed significantly across cuts and ($P < 0.001$) and Time was correlated with CWT. The estimated time to create *mid value-added* cuts increased by 0.32 minutes (s.e. = 0.034) (21 sec) for each extra kg of carcase weight, when averaged over the two Timers x four Dates. The corresponding coefficient for CWT when predicting the extra time to fabricate the *extreme value-added* cuts compared with the traditional cuts, 0.44 minutes / kg (s.e. = 0.065), is larger ($P < 0.05$) again. In summary, the estimated difference in times for *mid value-added* compared with *traditional*, and for *extreme value-added* compared with *traditional* were:

$$\text{mid} - \text{traditional: } 12.1\ (\text{s.e.}=3.3) + 0.315\ (\text{s.e.} = 0.048)\ \text{CWT}\ \ (\text{marginal } R^2 = 0.08)$$

$$\text{extreme} - \text{traditional: } 21.8\ (\text{s.e.}=3.5) + 0.440\ (\text{s.e.} = 0.065)\ \text{CWT}\ (\text{marginal } R^2 = 0.12)$$

The mean weights (kg) and standard error of carcase components for each cut fabrication method measured during the collection of timing data are outlined in Table 2.

Discussion

The review of literature highlighted the absence of much information throughout the development of lamb retail cuts. This is particularly pronounced for eating quality data and nutritional data. However, there are also cuts used in other species which are yet to be commercialised in Australia. These observations highlight the need for additional scientific research to fill the identified gaps in knowledge and include novel cuts from lambs and other species in other global markets, which will facilitate better cut selection for retail cuts from lambs over 25 kg. Consultation with the major retailers in Australia was undertaken to gauge their insights in the preparation of such "new" cuts and in the last two years since the program commenced these retailers have produced a number of new cuts linked to the increasing use of new packaging methods such as skin packaging. Based on this interest from retailers in new cuts, a document that outlines the specifications for the development of the CSR has been prepared for dissemination to retailers.

The study to examine the impact of time taken to fabricate these cuts demonstrated that a significantly longer time is required to break carcases into value-added cuts compared to traditional retail cuts, an effect which is compounded by increasing carcase weights. Granted that the industry requires alternative options for carcases which weigh between 25 – 30 kg, this equates to a minimal difference of 1.6 min and 2.2 min respectively over this heavier weight range for the two value-added options relative to the traditional cuts.

Although previous research on the development of value-added lamb cuts has been conducted by Hopkins et al. (1995b) as this study considers the difference in time taken between and CWT rather than the total time taken to create all cuts and CWT. Therefore, it is not possible to compare these two studies. However, this study demonstrates that preparation time of retail cuts increases as more value-added cuts are created from larger carcases. Yet only marginal improvement in the prediction of the increase in time taken to prepare value-added cuts was achieved, when additional variables EMA, GR tissue depth and Sex were included. Consequently, more research is required to determine which other factors, such as tissue growth patterns and experience of butchers, contribute to the time taken.

Nonetheless, this research is informative in terms of the labour requirements needed to break down lamb carcases heavier than 25 kg into value-added lamb cuts as the time taken to fabricate value-added lamb cuts needs to account for the increased preparation time and labour costs (Hopkins et al. 1995b), as well as changes to saleable meat yield. In an hour of labour, a butcher can break down approximately 4.5 average weight (25 kg) lamb carcases, generating 81 kg of retail cuts and trim, including bones, which equates to a $0.22/kg cost of labour based on a current average industry wage of $18 (Fair Work Ombudsman 2016). When 25 kg carcases are further broken down into *mid value-added* retail cuts, the fabrication takes longer and a butcher can break down 1.7 carcases in an hour, resulting in 28 kg of product. Therefore, the average price of labour increases to $0.64/kg to create *mid value-added* retail cuts. Breaking down carcases into *extreme value-added* cuts results in only 14 kg of retail cuts, as a butcher is capable of breaking down 1.2 25 kg lamb carcases in an hour. Consequently, the average labour cost per kilo increases to $1.29/kg.

Changes to the saleable meat yield result in a loss of value from the total value of the carcase drops from $247 ($240 saleable meat, $7 trim) with traditional cuts to $193.13 with *mid value-added* cuts ($180 saleable meat, $13.13 trim) and $149.63 with *extreme value-added cuts* ($131.25 saleable meat, $18.38 trim) at current market prices of $15/kg for saleable meat and $3.50/kg for trim (MLA, 2016) and an average carcase (25kg) in this study.

An overall price increase from $15/kg for saleable meat cut into traditional retail cuts, to $20.64/kg for mid value-added retail cuts and $28.72/kg for extreme value-added cuts is required to offset both the increased labour costs and losses due to changing percentages of saleable meat and trim.

Overall, this program demonstrates that there is potential in the Australian lamb industry to improve the utilisation of heavier lambs by taking advantage of opportunities to develop new cuts and market them based on their nutritional quality provided that the retail price can offset the increased labour costs and changes to the percentage of saleable meat. The Australian lamb industry must continue to focus on quality and to adapt to consumer demand for innovative high quality lamb cuts so as to maintain *per-capita* domestic consumption at record retail prices and stay in front of competitors. This is because competitor sources of protein are developing new eating options and city based consumers in particular are displaying a preference for new, more versatile cuts.

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