June 2006

Composition of Australian red meat 2002. 1. Gross composition

P. G. Williams
University of Wollongong, peterw@uow.edu.au

V. Droulez
University of Wollongong

G. Levy
University of Wollongong

T. Stobaus
National Measurement Institute, South Melbourne

Composition of Australian red meat 2002. 1. Gross composition

Abstract

This study aimed to update data on the gross composition Australian red meat to reflect changes in butchering practices since the 1980s and 1990s when the current values were derived. Australian retail samples of fifteen beef, eleven lamb, four veal and two mutton cuts were purchased from 10 retail outlets (butchers and supermarkets) in different socio-economic areas of Sydney and Melbourne. For both raw and cooked samples, mean external fat width (mm) was measured and the average percentage of separable internal, external and total fat, lean and waste was determined by dissection of each cut. For raw beef, total separable fat varied from 1% to 12% and for lamb and mutton from 2% to 22%. All veal cuts tended to be lean: 6% fat in the cutlets and less than 2% in the other cuts. There was great variability in the internal separable fat content of cuts but the majority in a selected sub-sample of visually lean red meat cuts had less than 5% total separable fat with no cut containing more than 10%. External fat width was not a good predictor of total separable fat in cooked red meat cuts except for round and rump steak. The separable fat of red meat in 2002 was lower than that reported in the 1980s.

Keywords

nutrient composition, gross composition, red meat, beef, veal, lamb, mutton

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

Publication Details

This article was originally published as Williams, PG, Droulez, V, Levy, G and Stobaus, T, Composition of Australian red meat 2002. 1. Gross composition, Food Australia, 58(4), 2006, 173-181.

Title: **Composition of Australian red meat 2002. 1. Gross composition**

Authors: **Peter Williams PhD APD MAIFST** [1]

Veronique Droulez MPH APD [1]

Gina Levy PhD APD MAIFST [1]

Tim Stobaus BAppSci (Chem) [2]

[1]Smart Foods Centre, University of Wollongong, Wollongong, NSW 2522, Australia.

[2]National Measurement Institute (formerly Australian Government Analytical Laboratory), 51-65 Clarke Street, South Melbourne, Vic 3205, Australia

* Previously at Meat and Livestock Australia, Locked Bag 991, North Sydney, NSW 2059, Australia

Correspondence: Dr Peter Williams
Smart Foods Centre
University of Wollongong
Wollongong NSW 2052

Tel. 61 2 42214085
Fax. 61 2 42214844
Email: peter_williams@uow.edu.au

Word count: 4050

Version: FoodAust1-v2

Running title: Gross composition of Australian red meat

Abstract

This study aimed to update data on the gross composition Australian red meat to reflect changes in butchering practices since the 1980s and 1990s when the current values were derived. Australian retail samples of fifteen beef, eleven lamb, four veal and two mutton cuts were purchased from 10 retail outlets (butchers and supermarkets) in different socio-economic areas of Sydney and Melbourne. For both raw and cooked samples, mean external fat width (mm) was measured and the average percentage of separable internal, external and total fat, lean and waste was determined by dissection of each cut. For raw beef, total separable fat varied from 1% to 12% and for lamb and mutton from 2% to 22%. All veal cuts tended to be lean: 6% fat in the cutlets and less than 2% in the other cuts. There was great variability in the internal separable fat content of cuts but the majority in a selected sub-sample of visually lean red meat cuts had less than 5% total separable fat with no cut containing more than 10%. External fat width was not a good predictor of total separable fat in cooked red meat cuts except for round and rump steak. The separable fat of red meatin 2002 was lower than that reported in the 1980s.

Key words:

Nutrient composition; gross composition; red meat; beef; veal; lamb; mutton;
external fat width

Introduction

Accurate and reliable data on the nutrient composition of Australian red meat (defined as beef, veal, lamb and mutton) are required to support nutrition labelling and marketing as well as nutrition research and dietetic practice. Previous studies have reported a wide variation in the amount of separable fat in retail red meat cuts, partly as a result of differences in butchering practices and the introduction of new lean cuts of red meat (Watson and others 1992; Cobiac and others 2003). Furthermore, nutrition surveys in Australia indicate that the majority of consumers trim red meat prior to consumption (Baghurst and others 2000). Thus differences in the estimated amount of separable fat in red meat impact significantly on studies reporting nutrient composition and intake, particularly fat content. Existing gross composition data (ie, the proportions of lean, fat and waste) for Australian red meat are based on survey data from more than a decade ago, and measurements from raw cuts only; the gross composition after cooking was estimated from published values from the mid 1980s (Lewis and others 1993). Furthermore, the gross composition data do not distinguish between the external and internal separable fat components and report the mean value for percentage separable fat, without any indication of the range between samples (Hutchison and others 1987; Greenfield and others 1987a; Greenfield and others 1987b). It is therefore timely to attempt to update information on the gross composition of Australian red meat.

Current Australian food composition tables provide data for beef and lamb with four different levels of fat trim: 'lean', '75% trimmed', '50% trimmed' and 'lean and fat' (Cashel and others 1989) or as 'lean and fat', or 'fat trimmed' (Australia New Zealand Food Authority 1999). A recent study of 15 Australian red meat cuts suggested that the amount of external fat width (measured in millimetres) may be a more useful visual guide to

differentiate between the amount of separable fat for nine cuts of raw red meat (generally those with lower proportions of intermuscular fat), than the rather arbitrary trimming percentages currently used (Cobiac and others 2003). However, it is not clear whether this descriptor would be useful for a wider variety of red meat cuts or for cooked meat. The objectives of this study were: (1) to update gross composition data for Australian red meat to reflect more contemporary retail red meat products available for purchase and current consumer consumption patterns, particularly in relation to differences in separable fat components, and (2) to examine the usefulness of external fat thickness as a predictor of total separable fat in a wider range of raw and cooked red meat. This describes the collection, sample preparation and calculation of the gross (physical) composition of 32 Australian retail red meat cuts.

Materials and methods

Sampling

Fifteen beef, eleven lamb, four veal and two mutton cuts were purchased at random from a stratified sample of 10 retail outlets in different socio-economic areas of Melbourne and Sydney in June 2002, including three supermarkets and two butchers in each city. The outlets were chosen to represent a cross section of high, medium and low socioeconomic status suburbs, determined by using the classification system of the Australian Bureau of Statistics, namely the index of relative disadvantage (Australian Bureau of Statistics 1996).

The fifteen beef cuts were stir-fry strips, diced beef, rump steak, round steak, topside roast, silverside roast, sirloin steak (also called New York cut or Porterhouse steak), fillet steak, T-bone steak, Scotch fillet (also called cube roll, rib-eye, or rib fillet steak), blade steak and chuck steak as well as hamburger mince, regular mince and lean mince. The eleven lamb cuts were stir-fry strips, diced lamb, cutlet (Frenched), forequarter chop, chump chop, loin chop, leg (bone-in) roast, Easy carve leg (boneless) roast, Easy carve shoulder roast, lamb mini roast as well as lamb mince. The four veal cuts were leg steak, veal cutlet, stir-fry strips and diced veal. The two mutton cuts were baking leg and casserole.

Duplicate samples (one for raw analysis and one for a cooked sample) of at least 500g of each of the cuts were purchased at each of the retail outlets by an unidentified shopper. Where possible, both samples of meat were selected with the same use-by date to increase the likelihood that the meat originated from the same carcase.

Once purchased, the retail samples were placed in labelled plastic bags in cold storage containers and transported to the Australian Government Analytical Laboratory (AGAL) in Melbourne in a chilled condition within 24 hours of purchase. One of each of the two purchases was designated for measurement of external fat width for all raw cuts and determination of gross composition within 48 hours of purchase for selected raw cuts only (stir-fry strips, diced meat, chuck steak, mutton casserole, topside roast, silverside roast, lamb leg roast, easy carve leg, easy carve shoulder, mini roast, chump chop, mutton baking leg, beef blade steak, veal leg steak, veal cutlet). The gross composition of the other raw cuts had already been determined previously as part of a recent large retail survey(Cobiac and others 2003) and so was not repeated in this study. The second duplicate purchase was cooked and then frozen prior to measurement of external fat width. Determination of gross composition was undertaken for all cooked samples, since values for cooked product were not determined in the previous study (Cobiac and others 2003). Photographs were taken of all raw samples as well as cooked samples before and after cooking.

Gross (physical) composition and external fat measurement

Purchases of raw meat were weighed and external fat width (defined as visible fat on the outside of meat cuts) was measured at seven sites per cut using the protocol previously reported by Cobiac et al (2003). External fat width was not measured on cuts that either had no visible external fat or too variable an amount to be meaningful descriptor: fillet and veal steaks, stir-fry and diced cuts, roasts and minces. The purchases were then dissected by trained dissectors into separable lean, total separable fat (or into external and internal separable fat where appropriate), and waste/bone/heavy connective tissue components. Dissection was conducted as quickly as possible to minimise moisture loss. Samples were kept covered and chilled when not being dissected. Dissectors trimmed the lean component

of all traces of fat. Heavy connective tissue was considered to be inedible waste whereas lighter connective tissue and some gristle, which were potentially edible and difficult to dissect from the separable fat, were retained in that component. Internal separable fat describes inter-muscular separable fat within a cut of meat whereas external separable fat was defined as selvedge fat or visible fat located on the outside of the cut. Each component was weighed and the gross composition determined as percentage of the original purchased weight; dissection loss (ie, drip loss) was calculated by difference.

A trained home economist cooked the second purchase of each cut according to recommended cut-specific meat cooking protocols but with no addition of any fat (Australian Meat and Livestock Corporation 1986). Roasts were cooked in an oven to an internal temperature of 70°C; diced meat, stir-fry strips and mince were cooked in a non-stick frying pan (3-5 minutes); steaks, chops and cutlets were grilled to medium doneness using an electric grill (6 10 minutes); mutton casserole and chuck steak were browned then simmered with minimal water for 2 hours. Portions of raw meat were weighed before and after cooking. Meat cuts were cooked as purchased, with separable fat intact. Cooked meat was sealed in large snap lock bags, labelled and frozen for no more than one month before dissection. Once thawed, drippings were designated to the lean component. Prior to dissection, the whole cooked purchase was weighed to determine weight change on cooking. External fat width and gross composition were determined as per raw purchases.

The mean gram weight of each of the dissected components was converted to a percentage of the purchased weight. The dissected weights were normalized to account for the dissection losses, which were less than 2% for raw and cooked samples. For cuts such as diced, stir-fry, chuck steak and casserole mutton, where it was not easy to differentiate between external and

internal separable fat, only the total separable fat was determined. For cuts where the external and the internal separable fat were clearly differentiated, the 'as purchased' and 'semi-trimmed' relative proportions are reported.

Statistical analysis

For external fat width and physical composition data, the mean and standard deviations of the data from 10 purchases for the raw and cooked samples were calculated. These mean values provide the basis for reporting the nutrient composition for edible portions (EP) of Australian red meat in terms of 'as purchased' and 'semi-trimmed' meat. The physical composition of 'as purchased' red meat is the mean proportion of lean, internal separable fat and external separable fat measured for each cut. For 'semi-trimmed' red meat, it was calculated without bone or external separable fat, using the proportions of the lean and internal separable fat only, since consumer research indicates that consumers who trim fat off meat remove all of the external fat (Millward Brown, 2003).

A simple linear regression analysis was performed to determine whether the mean external fat width measure (mm) for each cut of meat could significantly predict the percentage of total separable fat (as measured by gross composition). Analysis was not carried out on the following raw cuts which had already been analysed in a larger representative survey: rump steak, round steak, scotch fillet, T-bone steak, forequarter chop, loin chop, and Frenched cutlet. SPSS for Windows (version 10.0, 1999, Chicago, IL) was used for all statistical analyses. Means and standard deviations (SD) are presented for descriptive data and the mean and range for the calculated values of the relative proportions of edible portion. A value of $p < 0.05$ was taken as statistically significant.

Results

Raw meat

The gross composition percentages of the dissected components of the raw beef, veal, lamb and mutton cuts as purchased are given in Table 1. For four of the cuts data from only nine samples is reported, due to accidental losses of samples during processing.

There was a wide variation in the amount of total separable fat between the different beef and lamb cuts. For beef, total separable fat varied from 1% to 12% and for lamb and mutton from 2% to 22%. There was less variation in the amount of total separable fat in veal cuts, which all tended to be lean (6% in the cutlets and less than 2% in the other three cuts). The amount of total separable fat was lowest for all stir-fry and diced beef and lamb cuts as well as veal leg steak, with no more than 3% total separable fat. Casserole mutton had a significantly higher separable fat content than other diced meats (10%). Forequarter lamb cuts (chump chop and easy carve shoulder) had the highest proportions of total separable fat (more than 20% total raw sample). Beef leg roasts (topside and silverside) had less total separable fat (around 10%) than lamb and mutton leg roasts (12-15%).

The amount of external separable fat was higher than the amount of internal separable fat for roasts and chops, but not for veal leg steaks and cutlets. Consequently, the mean total separable fat of roasts and chops was reduced by approximately 50% when trimmed of external fat. Mean separable fat in semi-trimmed roasts was as low as 3% for beef, 7% for lamb and 6% for mutton. The mean total separable fat of semi-trimmed forequarter lamb cuts was 12%. In blade steak, separable fat was evenly distributed internally and externally.

In Table 1, the range of internal and external separable fat for each cut as %EP is listed. There was a wide variation in the relative proportions of internal and external separable fat between different purchases for all red meat cuts sampled. For instance, in the blade steak purchases, internal separable fat varied from 3 to 20%EP and external separable fat from 1 to 15%EP. A comparison of the gross compositional data with the corresponding photograph of the raw purchase confirmed these differences between purchases. For each of the cuts sampled, there were a few purchases with much higher levels of separable fat compared to the other purchases.

The photographs revealed some discrepancies between the purchases and meat industry specifications for specific cuts (Aus-Meat 1996). For example, of the ten lamb mini roasts sampled, only two resembled the specifications for lamb mini roast (which require a visually lean product). The remaining eight purchases appeared to have significant amounts of internal and external separable fat, resulting in a higher reported mean separable fat content for both 'as purchased' data and the 'semi-trimmed' calculated values than would be expected if prepared to specifications. For blade steak, one purchase incorrectly contained bone whereas the others were boneless. However, since this survey aimed to present the data for meat typically available for purchase, the results from all samples are included in the mean values for 'as purchased' and 'semi-trimmed meat' presented in Table 1.

In order to establish results representing the red meat industry's definition of 'lean' read meat, a selection of the samples with the leanest visible appearance and the lowest measured fat content in the gross composition data was made. Selection of gross composition data was based on examination of the photographs and corresponding distribution of gross composition in the purchase samples for each of the cuts. Where gross composition for

certain cuts were not available, data from the previous recent comparable retail sample were used (Cobiac et al., 2003). Only when at least three appropriately 'lean' samples could be identified were calculations made of the average gross composition of the 'lean' cuts. Data showing gross composition as a percentage of edible portion from these 'lean' purchases are summarised in Table 3.

To check the accuracy of these data, the gross composition of 'lean' red meat cuts, prepared by a butcher according to set specifications (i.e. no external separable fat and minimal internal separable fat), was determined. Comparison with cuts butchered to industry specifications indicated that the data was consistent with that of 'lean' red meat. The majority of these 'lean' red meat cuts had less than 5% total separable fat with no cut containing more than 10% total separable fat. There were no differences in the type of retail outlets providing these 'lean' cuts of red meat. The data suggest that industry defined 'lean' cuts of red meat are available from both supermarkets and butchers, irrespective of the socio-economic area in which the retail outlet is located.

Cooked meat

Table 2 presents the gross composition data from the cooked red meat samples. The mean weight loss on cooking was 28.6% (± SD 4.5) and showed no relationship to cooking method. Cooking reduced the percentage of total separable fat in the edible portion (compared to the raw values) by around 5% in the lean fillet steak up to close to 40% in the fattier lamb chops. Unlike some other reports casserole cooking in this study did not result in lower yields than grilling or roasting (Wahrmund-Wyle and others 2000) although that US study used controlled butchering to fabricate retail cuts from carcasses, rather than retail samples purchased at consumer outlets as in this study. The estimated values for fat in the cooked

'semi-trimmed' meats, assuming trimming of all external fat, show all cuts had values ≤ 10% EP, with the exceptions of T-bone steak, and lamb chump and forequarter chops, and cutlets.

Gross composition data forcooked 'lean' red meat cuts was determined in the same manner as for raw meat cuts and is described in Table 4. For cooked meat, gross composition data for cooked samples of each cut was determined as part of this study.

External fat width

External fat width measurements significantly predicted total separable fat (%EP) for raw lamb chump chops and Frenched lamb cutlets, but not for raw blade steak or veal cutlet, nor for any of the ten cooked cuts, with the exceptions of loin chops and round and rump steak (Table 5).

Discussion

Although the samples in this study were collected from only two major metropolitan centres, it is likely that they are reasonably representative of the Australian food supply generally since a previous survey found there were no significant differences in the retail supply of beef and lamb across socio-economic areas or states (Cobiac and others 2003). The sample size of 10 purchases per cut is consistent with previous studies (Sadler et al., 1993) and guidelines for the analyses of red meat (Greenfield & Southgate, 1992). Although efforts were made to ensure that duplicate samples for analysis of raw and cooked meat for each cut were as similar as possible, there were differences, particularly in the proportion of waste in cuts such as veal cutlet, mutton leg and casserole and lamb shoulder roast.

The gross composition values show that there generally appears to be less separable fat in the untrimmed raw retail samples collected in 2002 compared to those reported from 1983-86 (Greenfield and others 1987a, 1987b). For example, the percentage separable fat has declined from 28% to 21.5% in chump chops, from 18% to 12% in rump steak from 12% to 7.8% in silverside and 10% to 6.6% in fillet steak. The values are also less than those reported in recent studies of Australian lamb exported to the US (Hoke and others 1999). There was a wide variation in the percentage of total separable fat between the samples of retail cuts. Previous studies in Australia and in the United States of America have also reported similar variability in the percentage separable fat, particularly inter-muscular fat (Savell and others 1991; Watson and others 1992; Cobiac and others 2003). This has implications for users of food composition data who often rely on average values when calculating the nutrient intakes of individuals and have to choose appropriate figures from the range of values presented in Australian food composition tables – eg, 50% trimmed, 75% trimmed or fat trimmed.

In the USA, meat is described in terms of inches of selvedge fat. In the UK food tables, there is no data for trimmed meat. Instead, values are provided for the meat 'as purchased' (lean and fat) and for muscle meat only (ie, 'lean') (Royal Society of Chemistry and Ministry of Agriculture Fisheries and Food 1995). However, in this study, we found that the mean data for 'trimmed' meat (ie, 0 mm of external fat width) overestimated the fat content of the visually 'lean' red meat cuts since there is such a wide variability in the percentage of internal separable fat between purchases of the same cut.

Today there is an increasing trend amongst retailers to market lean branded cuts of red meat trimmed of external fat and with minimal internal separable fat, including seamed cuts which are totally denuded of all visible fat. Examination of the gross compositional data from this study and the photographs of the individual purchases reflected this segmentation within the retail supply of red meat into 'leaner' and 'fattier' versions of the same cut in the retail supply, which is consistent with data collected in a previous study (Cobiac and others 2003). Consequently, the mean total separable fat of 'semi-trimmed meat' is not an accurate representation of truly 'lean' meat since it includes some purchases with high levels of internal separable fat. A descriptor is therefore required for food tables to differentiate between red meat with different levels of separable fat.

In this study, for each cut, gross compositional data is presented for 'lean', 'semi-trimmed' and 'as purchased' meat and these may be more useful descriptors for users of food compositions tables. 'Lean' red meat represents meat that is trimmed of all external or selvedge fat and has little internal separable or inter-muscular fat. 'Semi trimmed' meat represents meat that has been trimmed of all external or selvedge fat, but may still have some visible internal fat. 'As purchased' meat represents meat that has both internal and external

separable fat. In this study, at least a third of the purchases collected for each cut met the industry specifications for 'lean' red meat, reflecting the increasing trend in butchering practices to remove all visible fat. The majority of Australians are trimming the fat off red meat prior to consumption. Of those that trim the fat off meat, most remove all of the external or selvedge fat and half remove the internal or inter-muscular fat (Millward Brown, 2003). Data for 'semi-trimmed' red meat cuts therefore represent the trimming practices of the majority of Australians. Where more extensive trimming occurs, data for 'lean' meat could be used.

Considering the data for 'lean' meat only (Table 3), the cuts with the least separable fat included diced and stir fry cuts, all veal cuts, beef topside and silverside. Cuts with the highest total separable fat tended to be those that contain bone (eg, chops) and/or more than one muscle (eg, forequarter chop and chuck steak). Differences in butchering practices may explain the wider range of total separable fat found in 'lean' loin chops, Frenched cutlets, scotch fillet and T-bone steak - for instance, differences in the removal of the 'tail' in loin chop and T-bone steak.

A previous study of raw cuts only concluded that external fat width was useful in predicting total separable fat in some but not all cuts of meat (Cobiac and others 2003). In this study, regression analysis indicated that, in general, external cooked fat width was not a good predictor of total separable fat in cooked red meat cuts except for cuts with a very defined selvedge and little internal separable fat, like round and rump steak. For other cooked red meat cuts, removal of external separable fat, as calculated in the 'semi-trimmed' cut values, did not control for variability in total separable fat since there was such a wide range of internal separable fat between purchases and significant differences in the proportion of fat

lost during cooking. For two of the cuts that were not measured in the previous study by Cobiac and others (2003) – chump chops and Frenched lamb cutlets – the raw external fat width was significantly related to total separable fat, but this was not so in the cooked samples. This may be because the raw and cooked samples in this study purchased from retail outlets were not well matched, or it may reflect the natural variability in changes of fat width during cooking. While external fat width is not a significant predictor of total fat for many cuts, clearly trimming external fat is still a useful strategy for consumers to reduce the total fat, since this component makes up more than half of all the separable fat for most cuts of red meat.

Presenting red meat nutrient composition data in terms of the proportion of separable lean, separable internal and external fat provides a useful visual 'picture' of the data. It allows more flexibility in calculating data to match specifications, particularly with 'branded' lean and trimmed red meat products. Nutrient composition data described in terms of the amount or proportion of separable lean, separable internal and external fat could be depicted pictorially or graphically which may be useful for educational purposes.

This study provides updated gross composition data on red meat retail cuts in Australia, and reports the distribution of separable fat between the internal and external components. While there appears to be considerable variation in the fat content of retail samples of different cuts, overall the red meat in retail outlets today is leaner than that reported 20 years ago. These data will be of potential source of information that could be used by the FSANZ food composition program when updating the current national database of Australian foods (Australia New Zealand Food Authority 1999)

Acknowledgements

This research was funded by Meat and Livestock Australia. Our thanks to Judy Cunningham, Luisa Trevisan and Greg Milligan from the Food Composition Program of Food Standards Australia New Zealand for advice on the study design.

References

Aus-Meat. 1996. Users' Guide to Australian Meat. Aus-Meat, Brisbane.

Australia New Zealand Food Authority. 1999. NUTTAB - Australian Food and Nutrient Database. ANZFA, Canberra.

Australian Bureau of Statistics. 1996. Australia in profile - a regional analysis. Cat 2032.0. ABS, Canberra.

Australian Meat and Livestock Corporation. 1986. Master recipe, many meals cookbook. The Custom Book Company, Sydney.

Baghurst K, Record S & Leppard P. 2000. Red meat consumption in Australia: intakes, nutrient contribution and changes over time. Aust J Nutr Diet. 4(Suppl): S1-S36.

Cashel K, English R & Lewis J. 1989. Composition of foods, Australia. Australian Government Publishing Service, Canberra.

Cobiac L, Droulez V, Leppard P & Lewis J. 2003. Use of external fat width to describe beef and lamb cuts in food composition tables. J Food Comp Anal. 16: 133-145.

Greenfield H, Kuo YL, Hutchison GI & Wills RBH. 1987a. Composition of Australian foods. 33. Lamb. Food Aust. 39: 202-207.

Greenfield H, Kuo YL, Hutchison GI & Wills RBH. 1987b. Composition of Australian foods. 34. Beef and veal. Food Aust. 39: 208-215.

Hoke IM, Buege DR, Ellefson W & Maly E. 1999. Nutrient and related food composition of exported Australian lamb cuts. J Food Comp Anal. 12: 97-109.

Hutchison GI, Thomas DE & Truswell AS. 1987. Nutrient composition of Australian beef. Food Technol Aust 39: 199-201.

Lewis JL, Sadler MF & Buick DR. 1993. Estimation of the nutritional value of retail fat-trimmed beef cuts from new gross composition data. Food Aust. 45(Suppl): S13-S19.

Millward Brown (2003). Meat Expectations 2003. Meat & Livestock Australia, Sydney.

Royal Society of Chemistry and Ministry of Agriculture Fisheries and Food. 1995. Meat, Poultry and Game. Supplement to McCance and Widdowson's 'The Composition of Foods'. HMSO, London.

Savell JW, Harris JJ, Cross HR, Hale DS & Beasley LC. 1991. National beef market basket survey. J Anim Sci. 69: 2883-2893.

Wahrmund-Wyle JL, Harris KB & Savell JW. 2000. Beef retail cut composition: 1. Separable tissue components. J Food Comp Anal. 13: 233-242.

Watson MJ, Mann NJ, Sinclair AJ & O'Dea K. 1992. Fat content of untrimmed retail beef and lamb cuts 2: Influence of outlet and neighbourhood over a year. Food Aust. 44: 516-518.

Table 1
Gross composition of raw red meat as purchased and calculated composition semi-trimmed[a]

Cut [b] (n = 10 unless specified otherwise)	Separable lean (% purchased weight) Mean ± SD	Separable Fat (% purchased weight) Mean ± SD			Waste (gristle/bone) (% purchased weight) Mean ± SD	Calculated relative proportions (% edible portion) Mean (Range)			
		Total	% external	% internal		% Lean	% Total fat	% External fat	% Internal fat
BEEF									
Diced									
- *as purchased*	95.1 ± 5.7	2.0 ± 1.8	na[c]	na	2.8 ± 5.7	98 (94-100)	2 (0-6)	na	na
Stir fry									
- *as purchased*	98.2 ± 0.9	1.2 ± 0.7	na	na	0.6 ± 0.6	99 (97-100)	1 (0-3)	na	na
Topside roast									
- *as purchased*	89.7 ± 5.6	-	6.4 ± 4.5	3.2 ± 2.1	0.7 ± 0.9	91 (81-98)	-	6 (1-17)	3 (1-7)
- *semi - trimmed*						97	3		
Silverside roast									
- *as purchased*	87.5 ± 3.4	-	7.4 ± 3.9	0.0 ±0.0	1.2 ± 0.9	89 (86-93)	-	7 (2-13)	4 (1-9)
- *semi trimmed*						96	4		
Blade steak									
- *as purchased*	86.3 ± 6.7	-	5.7 ± 4.6	5.7 ± 5.0	2.3 ± 2.9	88 (79–97)	-	6 (1–15)	6 (3–20)
- *semi trimmed*						94	6		
Chuck steak	87.4 ± 4.7	12.1 ± 4.7	na	na	0.5 ± 0.3	88 (81-95)	12 (5-19)	na	na
- *as purchased*									
VEAL									
Diced									
- *as purchased*	97.6 ± 2.3	1.8 ± 2.0	na	na	0.6 ± 0.6	98 (93-100)	2 (0-7)	na	na
Stir fry									
- *as purchased*	97.6 ± 1.3	1.7 ± 1.2	na	na	0.7 ± 0.2	98 (96-99)	2 (1-4)	na	na
Leg steak									
- *as purchased*	97.6 ± 1.3	-	0.0 ± 0.0	1.2 ± 0.8	1.2 ± 0.9	99 (97-99)	-	0 (0)	1 (0-3)
- *semi trimmed*						99	1		
Cutlet									
- *as purchased*	76.3 ± 8.0	-	1.0 ± 0.7	4.6 ± 1.4	18.1 ± 7.3	93 (89-96)	-	1 (0-3)	6 (3-9)
- *semi trimmed*						94	6		

Cut (n = 10 unless specified otherwise)	Separable lean (% purchased weight) Mean ± SD	Separable Fat (% purchased weight) Mean ± SD			Waste (gristle/bone) (% purchased weight) Mean ± SD	Calculated relative proportions (% edible portion) Mean (Range)			
		Total	% external	% internal		% Lean	% Total fat	% External fat	% Internal fat
LAMB									
Diced									
- *as purchased*	97.3 ± 1.7	1.9 ± 1.5	na	na	0.8 ± 0.3	98 (94-100)	2 (0-6)	na	na
Stir fry									
- *as purchased*	95.8 ± 1.7	2.8 ± 2.1	na	na	1.4 ± 1.1	97 (94-99)	3 (1-6)	na	na
Leg roast (n=9)									
- *as purchased*	63.7 ± 2.8	-	8.2 ± 1.4	4.7 ± 0.6	23.4 ± 1.7	83 (80-87)		11 (8-14)	6 (5-7)
- *semi trimmed*						93	7		
Easy carve Leg (n=9)									
- *as purchased*	72.8 ± 6.1	-	8.7 ± 2.9	6.0 ± 1.1	12.5 ± 7.2	83 (78-86)		10	7
- *semi trimmed*						92	8		
Mini roast									
- *as purchased*	85.4 ± 10.3	-	7.2 ± 7.8	6.0 ± 3.4	1.4 ± 1.0	87 (74-98)		7 (0-18)	6 (1-12)
- *semi trimmed*						93	7		
Chump chop									
- *as purchased*	65.3 ± 9.7	-	12.7 ± 3.9	8.8 ± 1.5	13.2 ± 7.8	75 (62-80)		15 (10-27)	10 (8-12)
- *semi trimmed*						88	12		
Easy carve shoulder (n=9)	69.2 ± 7.3	-	11.0 ± 1.8	9.7 ± 3.2	10.1 ± 2.3	77		12	11
- *as purchased*						(69-85)		(5-18)	(6-15)
- *semi trimmed*						88	12		
MUTTON									
Leg (n=9)	64.8 ± 6.5	-	7.2 ± 2.4	4.3 ± 1.7	23.7 ± 5.7	85		9	6
- *as purchased*						(83-91)		(5-14)	(3-9)
- *semi trimmed*						94	6		
Casserole					na				
- *as purchased*	87.7 ± 13.9	9.7 ± 10.0				90 (57-99)	10 (1-43)	na	na

[a] Semi-trimmed = lean and internal fat only (without external separable fat or waste)
[b] Results are not presented for the three mince samples, which could not be dissected for gross composition
[c] na = not analysed

Table 2
Gross composition of red meat cooked as purchased, and calculated composition semi-trimmed [a]

Cut (n = 10 unless specified otherwise)	Cooking weight loss (%)	Separable lean (% cooked weight) Mean ± SD	Separable Fat (% cooked weight) Mean ± SD			Waste (gristle/bone) (% cooked weight) Mean ± SD	Calculated relative proportions (% edible portion) Mean (Range)			
			Total	% external	% internal		% Lean	% Total fat	% External fat	% Internal fat
BEEF										
Diced										
- *stir-fried*	29	98.1 ± 2.5	1.5 ± 2.1	na[b]	na	0.4 ± 0.5	98 (91-100)	2 (0-7)	na	na
Stir fry										
- *stir-fried*	28	98.8 ± 1.1	0.8 ± 0.7	na	na	0.4 ± 0.6	99 (97-100)	1 (0-2)	na	na
Topside roast										
- *roasted*	28	91.3 ± 4.9	-	4.6 ± 3.3	3.4 ±2.5	0.7 ± 0.6	92 (82-97)		5 (1-10)	3 (0-8)
-*semi – trimmed*							97	3		
Silverside roast										
- *roasted*	28	90.9 ± 2.4	-	5.7 ± 2.1	2.2 ± 1.1	1.2 ± 0.5	92 (88-95)		6 (4-9)	2 (0-4)
- *semi trimmed*							98	2		
Blade steak										
- *grilled*	32	85.1± 11.2	-	3.0± 2.3	4.9± 3.2	7.0±12.2	92 (58-99)		3 (1-7)	5 (0-9)
-*semi trimmed*							95	5		
Fillet steak										
- *grilled*	17	92.7 ± 7.6	-	4.3 ± 8.1	2.3 ± 2.8	0.7± 1.7	93 (73-99)		4 (0-27)	3 (0-7)
- *semi - trimmed*							97	3		
New York (sirloin) steak	27	77.9 ± 6.0	-	16.4 ± 7.8	4.3 ± 4.9	1.4 ± 2.4	79 (69-89)		17 (92-24)	4 (0-12)
- *grilled*										
- *semi - trimmed*							95	5		
Round steak										
- *grilled*	30	93.8 ± 4.5	-	2.4 ± 3.0	2.4 ± 1.5	1.4 ± 1.5	96 (84-99)		2 (6-11)	2 (1-4)
- *semi - trimmed*							98	2		
Rump steak										
- *grilled*	31	84.1 ± 5.4	-	6.8 ± 4.3	5.2 ± 2.7	3.9 ± 0.6.	88 (74-92)		7 (1-16)	5 (2-10)
- *semi – trimmed*							95	5		

Cut (n = 10 unless specified otherwise)	Cooking weight loss (%)	Separable lean (% cooked weight) Mean ± SD	Separable Fat (% cooked weight) Mean ± SD			Waste (gristle/bone) (% cooked weight) Mean ± SD	Calculated relative proportions (% edible portion) Mean (Range)			
			Total	% external	% internal		% Lean	% Total fat	% External fat	% Internal fat
Scotch steak										
- *grilled*	29	83.4 ± 7.5	-	6.1 ± 4.8	8.9 ± 6.4	1.6 ± 1.3	85 (67-91)		6 (1-11)	9 (3-220
- *semi – trimmed*							90	10		
T-Bone steak										
- *grilled*	25	62.0 ± 5.2	-	7.8 ± 2.7	8.4 ± 2.7	21.8 ± 5.8	79 (68-97)		10 (4-20)	11 (7-18)
- *semi – trimmed*							88	12		
Chuck steak										
- *casseroled*	29	88.6 ± 4.0	9.8 ± 3.2	na	na	1.6 ± 1.4	9 (80-94)	10 (6-15)	na	na
VEAL										
Diced										
- *stir-fried*	31	97.1 ± 3.5	2.8 ± 3.5	na	na	0.1 ± 0.3	97 (89-100)	3 (0-11)	na	na
Stir fry										
- *stir-fried*	33	98.2 ± 1.4	1.0 ± 0.7	na	na	0.8 ± 1.1	99 (98-100)	1 (0-2)	na	na
Leg steak										
- *grilled*	33	97.0 ± 2.1	-	0.0 ± 0.0	2.1 ± 2.0	0.9 ±0.9	98 (96-99)		0	2 (0-3)
- *semi trimmed*							98	2		
Cutlet										
- *grilled*	27	63.0 ± 5.3	-	0.5 ± 1.0	4.9 ± 2.4	31.6 ± 6.3	92 (78-99)		1 (0-4)	7 (2-11)
- *semi trimmed*							93	7		
LAMB										
Diced										
- *stir-fried*	24	97.1 ± 1.0	2.2 ± 1.8	na	na	0.7 ± 0.5	98 (94-99)	2 (0-6)	na	na
Stir fry										
- *stir-fried*	28	98.5 ± 1.1	1.2 ± 1.0	na	na	0.3 ± 0.2	99 (97-99)	1 (0-2)	na	na
Leg roast (n=9)										
- *as purchased*	32	60.0 ± 3.0	-	5.9 ± 1.8	4.2 ± 0.9	29.9 ± 3.0	86 (78-91)		8 (5-11)	6 (4-8)
- *semi trimmed*							93	7		

Cut (n = 10 unless specified otherwise)	Cooking weight loss (%)	Separable lean (% cooked weight) Mean ± SD	Separable Fat (% cooked weight) Mean ± SD			Waste (gristle/bone) (% cooked weight) Mean ± SD	Calculated relative proportions (% edible portion) Mean (Range)			
			Total	% external	% internal		% Lean	% Total fat	% External fat	% Internal fat
Easy carve Leg (n=9)										
- *roasted*	34	71.7 ± 7.2	-	6.8 ± 4.2	5.0 ± 2.3	16.6 ± 9.7	84 (70-93)		8 (5-20)	6 (2-10)
- *semi trimmed*							92	8		
Mini roast										
- *roasted*	22	87.4 ± 9.8	-	5.3 ± 5.2	5.8 ± 4.3	1.5 ± 1.1	89 (78-99)		5 (0-12)	6 (1-13)
- *semi trimmed*							94	6		
Chump chop (n=9)										
- *grilled*	32	68.1 ± 19.0		9.4 ± 6.1	11.6 ± 2.4	10.9 ± 4.2	76 (67-85)		11 (5-19)	13 (5-24)
- *semi trimmed*							85	15		
Loin chop										
- *grilled*	31	62.9 ± 8.7	-	12.5 ± 4.3	5.3 ± 2.3	19.3 ± 6.8	78 (65-96)		15 (10-22)	7 (2-11)
- *semi - trimmed*							92	8		
Forequarter chop										
- *grilled*	29	60.6 ± 4.5	-	4.3 ± 1.8	11.2 ± 3.3	23.9 ± 6.0	80 (72-91)		6 (2-9)	14 (11-24)
- *semi - trimmed*							85	15		
Frenched cutlets										
- *grilled*	28	58.0 ± 8.3	-	3.7 ± 4.5	13.7 ± 8.6	24.6 ± 5.8	77 (63-99)		5 (0-14)	18 (4-40)
- *semi - trimmed*							81	19		
Easy carve shoulder (n=9)							80		12	8
- *roasted*	34	75.6 ± 3.6	-	10.9 ± 3.4	7.7 ± 0.2	5.8 ± 5.2	(71-84)		(4-21)	(5-14)
- *semi trimmed*							91	9		
MUTTON Leg (n=9)										
- *roasted*	29	54.1 ± 4.1	-	6.3 ± 2.7	3.9 ± 0.9	35.7 ± 5.7	84 (72-94)		10 (1-15)	6 (4-8)
- *semi trimmed*							93	7		
Casserole	17	92.5 ± 5.9	5.8 ± 3.9	na	na	1.7 ± 4.7	94	6	na	na
- *casseroled*							(76-97)	(2-16)		

[a] Semi-trimmed = lean and internal fat only (without external separable fat or waste)
[b] na = not analysed

Table 3
Gross composition of raw lean red meat, trimmed of external fat to represent the red meat industry definition of lean, as a percentage of the edible portion

	Number of samples	% separable fat mean (range)	% separable lean mean
Beef			
Diced	5	1 (0-1)	99
Stir fry	3	0 (0-0)	100
Topside steak[a]	10	1 (0–1)	99
Topside roast	4	1 (1–2)	99
Silverside roast	4	1 (0-2)	99
Round steak[a]	10	2 (1-3)	98
Rump steak[a]	3	3 (1-4)	97
Fillet steak[a]	10	2 (1-3)	98
T-bone steak (no tail)[a]	6	6 (3-8)	94
Sirloin steak (no tail)[a]	11	2 (1-4)	98
Scotch fillet[a]	8	5 (3-9)	95
Blade steak	5	3 (3-4)	97
Chuck steak	3	7 (6-8)	93
Lamb			
Diced	5	1 (0-1)	99
Stir fry	3	1 (1-1)	99
Miniroast	4	2 (1-5)	98
Leg roast	3	6 (5-7)	94
Easy Carve leg	4	6 (4-7)	94
Chump chop	3	10 (9-10)	90
Loin chop (no tail)[a]	6	4 (3-10)	96
Frenched cutlet[a]	3	4 (3-10)	96
Easy Carve Shoulder	3	9 (7-11)	91
Forequarter chop[a]	6	10 (7-19)	90
Veal			
Stir fry	7	1 (1-1)	99
Diced	6	0 (0-1)	100
Leg steak	8	1 (0-1)	99
Cutlet	3	4 (3-4)	96
Mutton			
Baking leg	3	4 (3-4)	96
Casserole	4	4 (1-5)	96

[a] Gross composition from retail survey (Cobiac and others 2003)

Table 4
Gross composition of cooked lean red meat, trimmed of external fat to represent the red meat industry definition of lean, as a percentage of the edible portion

	Number of samples	% separable fat mean (range)	% separable lean mean
Beef			
Diced	3	0 (0-0)	100
Stir fry	4	0 (0-0)	100
Topside roast	4	1 (0–2)	99
Silverside roast	3	1 (1-2)	99
Round steak	4	1 (0-1)	99
Rump steak	3	2 (2-3)	98
Fillet steak	4	0 (0-0)	100
T-bone steak (no tail)	3	7 (7-8)	93
Sirloin steak (no tail)	4	1 (0-2)	99
Scotch fillet	3	3 (3-4)	97
Blade steak	4	2 (0-3)	98
Chuck steak	3	6 (5-8)	94
Lamb			
Diced	4	1 (0-1)	99
Stir fry	6	1 (0-1)	99
Miniroast	4	1 (1-2)	99
Leg roast	4	6 (5-6)	94
Easy Carve leg	4	6 (4-7)	94
Chump chop	3	8 (6-10)	92
Loin chop (no tail)	5	5 (2-6)	95
Frenched cutlet	1	3	97
Easy Carve Shoulder	3	6 (6-6)	94
Forequarter chop	4	12 (10-13)	88
Veal			
Stir fry	8	1 (0-1)	99
Diced	5	1 (1-1)	99
Leg steak	4	1 (0-1)	99
Cutlet	3	4 (2-5)	96
Mutton			
Baking leg	3	5 (4-5)	95
Casserole	3	3 (2-4)	97

Table 5
Statistics produced from the simple regression equations conducted with external fat width (mm) as the predictor variable and total separable fat (%EP) as the outcome variable for raw and cooked cuts of meat

	n[a]	R^2	Intercept (± SEM)	Slope (± SEM)	p value [b]
Lamb raw					
Chump chop	9	0.69	13.55 ± 2.69	1.70 ± 0.43	0.006*
Frenched lamb cutlet	10	0.49	17.18 ± 3.23	3.06 ± 1.10	0.024*
Lamb cooked					
Chump chop	10	0.69	13.96 ± 5.60	1.51 ± 0.95	0.149
Forequarter chop	9	0.37	24.30 ± 1.90	-0.71 ± 0.35	0.083
Frenched lamb cutlet	10	0.01	24.19 ± 5.02	-0.96 ± 3.20	0.772
Loin chop	10	0.58	9.31 ± 4.09	2.16 ± 0.64	0.010*
Beef raw					
Blade steak	10	0.01	12.12 ± 3.36	-0.21 ± 1.44	0.886
Beef cooked					
Blade steak	10	0.25	5.35 ± 2.34	0.85 ± 0.52	0.143
New York cut	10	0.16	13.64 ± 6.24	1.53 ± 1.24	0.250
Round steak	10	0.79	1.39 ± 0.90	1.86 ± 0.34	0.001 *
Rump steak	9	0.71	5.65 ±1.51	0.82 ± 0.20	0.005 *
T-bone steak	10	0.18	31.78 ± 8.56	-2.33 ± 1.76	0.222
Veal raw					
Veal cutlet	10	0.04	6.11 ± 1.48	0.58 ± 0.96	0.563
Veal cooked					
Veal cutlet	10	0.01	7.95 ± 0.88	-0.38 ± 1.15	0.751

[a] number of samples
[b] Test of zero slope
* significant relationship