Variation in nutritional composition of lamb leg cuts

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Abstract – The nutritional composition of the knuckle, topside, outside and silverside excised from 15 lamb carcases were measured to determine the variation in protein, energy, total fat, minerals and fatty acids between muscles. The findings indicate that the silverside had significantly higher values for most fatty acids (excluding EPA + DHA) and higher energy content while the topside had higher concentrations of cholesterol, iron and zinc and the knuckle had higher concentrations of sodium and zinc. Overall this information will assist industry in promoting the benefits of consuming lamb to increasingly health-conscious consumers.

Key Words – nutrient composition, fats, muscles

I. INTRODUCTION

Over recent decades consumers have become increasingly concerned about the nutritional composition of red meats. Although this has prompted a significant amount of research to determine the intramuscular fat (IMF) and fatty acid (FA) composition of some lamb cuts due to the perception among consumers of lamb that it is high in saturated fatty acids, little research has been conducted to ascertain the nutrition value of lamb leg cuts commonly produced and consumed. Furthermore, there is limited literature available which examines the variation in nutritional composition between muscles and compilation of global data has indicated a number of cuts for which there is no information [1].

Consequently, the aim of this research was to determine the nutritional composition of lamb leg cuts including knuckle, silverside, outside and topside from heavy lamb carcases.

II. MATERIALS AND METHODS

For this study, 100 mixed sex lambs were fed a diet which consisted of barley (10%), triticale (10%), oats (9%), lucerne hay (9.5%), almond hulls, grape marc, lupins, canola expeller, vegetable oil, sodium bentonite, limestone, urea and an acid buffer. After being fed for 70 days, lambs were processed using standard commercial procedures.

At 24 h post mortem, the knuckle (HAM 5072) silverside (HAM 5071), outside (HAM 5075), and topside (HAM 5073) [2] were removed from the 15 carcases representing a range in fat depth and carcase weights and were held at -20 °C until processing. The samples were then freeze dried, samples were diced, mixed and ground before 200g of each sample underwent analysis for energy [3], total fat analysis [4], protein (Leco FP628 Nitrogen analyser, Leco Corp., UK), fatty acid composition [5], cholesterol [6], iron, potassium, sodium, phosphorus, zinc and selenium [7].

Data were analysed using a REML procedure performed with Genstat® software [8] using muscle as a fixed effect. Differences between means were determined using least significance differences (LSD).

III. RESULTS AND DISCUSSION

The levels of energy and protein found in this study are consistent with what would be expected from lamb leg cuts in Australia [9, 10]. However, the total fat content was higher and fatty acid composition was found to differ from those previously reported [11-13]. The mean nutritive values for the muscles and significant differences between muscles are outlined in Table 1.

Table 1. The mean nutritive composition of lamb knuckle, outside, silverside and topside cuts including the standard error of the mean (S.E.M).

Trait		Knuckle	Outside	Silverside	Topside	*P*- value	S.E. M
Energy (kJ/ 100g)		1125.3b	1149.1b	1423.0a	1130.6b	<0.001	22.3
Protein (%)		30.6b	32.0a	31.2b	32.2a	n. s.	0.4
Fat (%)		10.7b	10.7b	18.3a	9.4b	<0.001	1.0
Fatty Acids	SFA (g/ 100g)	3.2b	3.1b	5.0a	3.0b	<0.001	0.2
	PUFA (g/ 100g)	0.7b	0.7b	0.9a	0.7b	<0.001	0.3
	EPA + DHA (mg/ 100g)	40.2b	49.1a	48.5a	47.7a	n. s.	2.0
	MUFA (g/ 100g)	3.5bc	3.4b	5.5a	3.1c	<0.001	0.2
	Omega-3 (mg/ 100g)	183.5b	175.4b	213.4a	177.2b	<0.001	6.0
	Omega- 6 (mg/ 100g)	485.7b	477.2b	596.4a	461.1b	<0.001	21.3
Cholesterol (mg/ 100g)		34.4b	36.3b	26.1ac	46.0ac	<0.001	2.1
Iron (mg/ 100g)		2.8a	2.9a	2.6b	3.2a	<0.001	0.08
Potassium (mg/ 100g)		516.4b	530.3a	505.2b	538.5a	n. s.	9.8
Sodium (mg/ 100g)		101.3a	94.6bc	90.2bc	87.9c	<0.001	2.1
Phosphorus (µg/ 100g)		312.5b	329.6a	312.3b	336.0a	n. s.	6.4
Selenium (µg/ 100g)		27.1a	26.7a	26.2a	26.9a	n. s.	0.6
Zinc (mg/ 100g)		7.3a	4.8c	4.6c	5.4lb	<0.001	0.07

Values within a row followed by a different letter are statistically different.
n. s. denotes not significant

Of the muscles, silverside had the largest variation in nutritive values due to significantly higher percentage of total fat from the heel muscle subcutaneous fat and silverskin which is not present on the knuckle, topside and outside. This is reflected in the significantly higher values for most fatty acids (excluding EPA + DHA) and the higher overall energy content. However, fat level was not significant when included as a covariate for modelling EPA + DHA concentrations.

Furthermore, it was found that topside had significantly higher concentrations of cholesterol zinc and iron while the knuckle had higher concentrations of sodium and zinc.

At present there is a scarcity of literature reporting the mineral composition of these specific lamb leg cuts. For example, one study [9] has omitted results for the mineral composition of lamb leg cuts, while another has focused on the measurement of zinc and iron in lamb loin [14] or the mineral composition of an easy carve semi-trimmed lamb leg roast [15].

A comparison with such studies, suggests that the topside, knuckle, silverside and outside in this study tended to have higher concentrations of zinc, phosphorus, potassium, sodium, saturated fatty acids (SFA) and polyunsaturated fatty acids (PUFA) then previously reported for the easy carve leg roast and loin [14-17]. However the zinc levels are similar to those previously reported for forequarter chops and easy carve shoulder [18] and iron levels are similar to those found in lamb loin [14] but are higher than those published under the Australian standards nutrition database for an easy carve semi-trimmed leg roast [15].

Given that variability in the nutritional composition of retail cuts due to the effects of muscle, diet, age, breed, season and geographical differences [17, 19, 20], it is not surprising that the nutritional composition of the lamb leg muscles measured in this study differs from the lamb retail cuts measured in previous research. For example, the higher levels of zinc found in this study may be the result of incorporating grape marc and/or almond hulls into the diet.

Despite the higher fat content than previously reported for commercial lambs [11], these retail leg cuts had approximately half the concentration of cholesterol compared to the 70 mg/ 100g previously reported for leg roast [15].

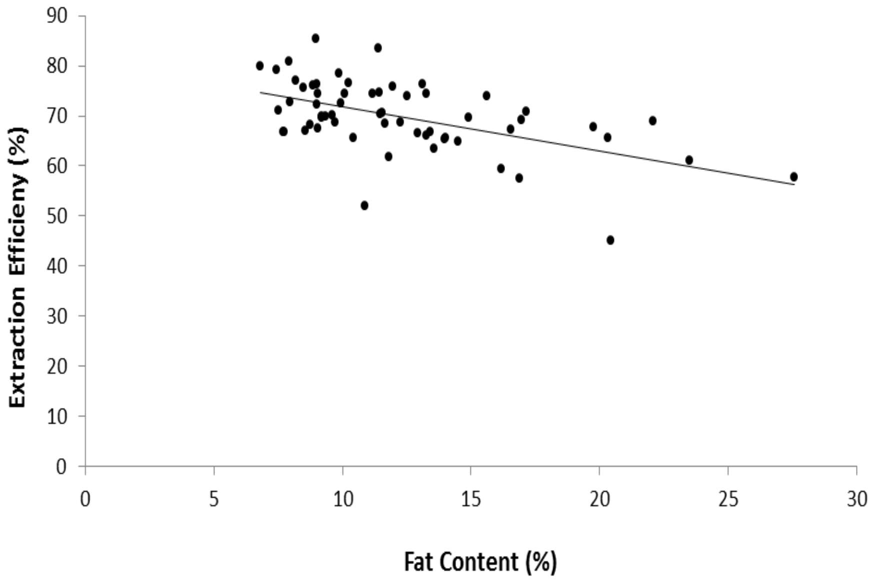

Figure 1. Efficiency of the fatty acid extraction (%) plotted against the total fat content (%) of retail lamb leg cuts (R^2 = 0.29).

Based on the levels of individual fatty acid groups an investigation into the efficiency of the fatty acid extraction revealed that the efficiency of extraction decreases with increasing fat content (Fig 1; R^2 = 0.29).

Since the fatty acid analysis uses gas chromatography (GC) to quantify the fatty acid composition and high performance liquid chromatography (HPLC) to measure cholesterol, it is plausible that at higher total fat contents the columns within the GC and HPLC are 'flooded' and therefore, are not able to measure the total amount of the individual fatty acids at the detectors. Consequently, the method of fatty acid and cholesterol analysis needs to be altered by changing the amount of fatty acid methyl ester which is run through the columns or by reducing the amount of meat in the extraction to improve extraction rates at higher fat contents. This will be examined in future work and given the effect of diet on nutritive composition data for lambs fed solely on grass [12] is required given the importance of this feeding system in Australian lamb production.

Overall the results in this study indicate that there is potential to promote the consumption of these retail leg cuts was the nutritive composition exceeds the amounts of EPA + DHA, iron and zinc required to be considered a 'good' dietary source according to dietary guidelines for recommended intakes [21].

IV. CONCLUSION

Overall this study demonstrates that there is significant variation in nutritive composition of lamb leg cuts. Consequently, there is a benefit to industry in developing and promoting new cuts using these muscles which meet nutritional targets for human health.

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