

Short communication

Nutrient content of uncooked and cooked meat from South African classes A2 lamb and C2 mutton

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Abstract

The study compared the nutrient content of selected joints of South African mutton (Class C2) (n = 18) and lamb (Class A2) (n = 18) carcasses of fat code 2 in both classes. South African sheep carcasses are classified according to age by dentition: Lamb carcasses of class A2 show the ruction of no incisors and mutton carcasses of class C2 of more than six incisors. Fatness is assessed by the thickness of subcutaneous fat. Chilled carcass sides were subdivided into the primal cuts. The cuts were dissected into meat (muscle, intermuscular and intramuscular fat), bone and subcutaneous fat (SCF). The soft tissue of the carcass was analysed for selected nutrients. It was found that South African lamb and mutton contain less fat than the nutrient values previously assumed as scientifically correct and presented in the National Food Composition Tables of the Medical Research Council (MRC), USDA. The results from this study emphasize the importance of country specific nutrient data on own food commodities.

Keywords: *Ovis aries*, chemical composition, fat content, shoulder, loin, leg

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The South African Red Meat Classification System for beef, lamb, sheep and goats is based on the age of the animal and the fatness of the carcass. Age classes are A (0 incisors), AB (1 - 2 incisors), B (3 - 6 incisors) and C (7 - 8 incisors) and fatness classes are 0 (no fat) to 6 (excessively over fat). The overall class designation is by both age and fatness (National Department of Agriculture, 1990:9-14, in SAMIC, 2008).

The study determined the nutrient contents of three cuts of South African lamb (A2) and mutton (C2).

The study included two carcass classes (A2 and C2) and primal cuts (shoulder, loin and leg) as they represent the most commonly consumed sheep meat in South Africa. Eighteen carcasses from both the A age (0 teeth, <9 months) and C age (>6 teeth, >4 years) groups and fat code 2 (<4 mm subcutaneous fat) (SAMIC, 2008) were randomly selected from three regions, Ermelo, Kalahari and Karoo.

The meat and fat of each of the three primal cuts of the right side were physically dissected before being analysed for raw chemical content (vitamins, minerals, fatty acids and cholesterol), and of the left side were cooked according to standardized moist or dry heat cooking methods in identical ovens at 163 °C to internal temperature of 73 °C measured in the geometrical centre of the cut (American Meat Science Association, 1995). After cooking the cuts were analysed. The analytical procedures were done on a double blind basis in the laboratories (ISO/IEC:17025:2005) that form part of the South African National Accreditation Services (SANAS).

Data were analysed with GenStat for Windows (2000). The significance of the variables measured for each sample was tested with split-plot analysis of variance (ANOVA), whereby the main effect of the cuts

(whole plots) and treatment (raw and cooked – sub-plots), and the cut-by-treatment interactions were tested at the 5% level of significance. The Fisher's protected t-test with Least Significant Difference (LSD) was applied if a main effect was significant (Snedecor & Cochran, 1980).

Table 1 Mean values of the nutrient composition of three raw and three cooked cuts per 100 g edible portion of South African A2 lamb

Nutrients analysed	Unit	Raw cuts (n = 12)					Cooked cuts (n = 12)				
		P-value	SEM	Shoulder	Loin	Leg	P-value	SEM	Shoulder	Loin	Leg
Proximate analysis											
Moisture	g	0.012	0.741	70.8 ^a	70.1 ^a	73.7 ^b	<0.001	0.478	66.8 ^b	63.5 ^a	66.0 ^b
Protein (N x 6.25)	g	0.346	0.638	18.0	17.8	19.0	<0.001	0.541	23.1 ^a	27.8 ^b	24.5 ^a
Fat	g	0.003	0.814	9.63 ^a	11.3 ^a	6.15 ^b	0.018	0.515	9.86 ^a	7.80 ^b	7.67 ^b
Ash	g	0.918	0.711	2.93	2.65	3.06	<0.001	0.016	0.95 ^a	1.20 ^c	1.05 ^b
Food energy (calculated)	kJ	0.014	33.9	662 ^a	718 ^a	552 ^b	0.438	20.4	757	755	722
Minerals											
Magnesium (Mg)	mg	0.076	3.01	13.9	22.7	23.8	<0.001	0.674	17.7 ^a	24.2 ^b	22.9 ^b
Potassium (K)	mg	0.134	51.7	201.	323	351	<0.001	7.51	261 ^a	331 ^c	303 ^b
Sodium (Na)	mg	0.495	19.1	68.0	101	82	<0.001	1.528	68.9 ^b	83.3 ^c	61.9 ^a
Zinc (Zn)	mg	0.512	0.474	1.99	2.05	2.71	0.208	0.357	1.24	2.20	1.71
Iron (Fe)	mg	0.397	0.197	0.75	0.99	1.14	0.227	0.439	-	0.62	1.20
Vitamins											
Thiamin (B ₁)	mg	0.822	0.021	0.11	0.09	0.10	0.740	0.030	0.03	0.04	0.06
Riboflavin (B ₂)	mg	0.954	0.027	0.09	0.08	0.09	0.535	0.018	0.04	0.07	0.05
Niacin (B ₃)	mg	0.525	0.479	1.70	1.02	1.71	0.736	0.342	1.37	1.25	1.63
Pyridoxine (B ₆)	mg	0.099	0.122	0.26	0.32	0.64	0.716	0.030	0.12	0.13	0.10
Cyanocobalamin (B ₁₂)	µg	0.803	1.085	4.02	3.61	3.00	0.697	0.188	0.8	0.2	1.1
Lipids											
Saturated fatty acids (SFA)											
14:0	g	0.111	0.095	0.62	0.69	0.39	0.694	0.066	0.50	0.47	0.42
16:0	g	0.010	0.238	2.50 ^a	2.67 ^a	1.50 ^b	0.562	0.120	2.06	1.97	1.86
18:0	g	<0.001	0.132	1.64 ^a	1.86 ^a	0.88 ^b	0.329	0.101	1.10	1.08	1.30
20:0	g	0.120	0.006	0.03	0.03	0.01	0.045	0.005	0.02	0.01	0.02
Monounsaturated fatty acids (MUFA)											
16:1	g	0.152	0.028	0.21	0.21	0.14	0.113	0.009	0.20	0.18	0.16
18:1n9t	g	0.061	0.061	0.33	0.42	0.19	0.907	0.048	0.23	0.24	0.21
18:1n9c	g	<0.001	0.206	3.53 ^a	3.70 ^a	2.14 ^b	0.294	0.102	2.88	2.63	2.71
Polyunsaturated fatty acids (PUFA)											
18:2n6t	g	0.607	0.005	0.03	0.02	0.02	0.886	0.005	0.02	0.02	0.02
18:2n6c	g	0.018	0.029	0.28 ^a	0.29 ^a	0.17 ^b	0.891	0.034	0.24	0.22	0.24
Cholesterol	mg	0.966	6.09	64.0	61.8	62.7	0.732	6.23	85.0	86.3	91.7

Value not available. Means with different superscripts (a, b or c) are significantly different.

P-value - F-probability to test for significant differences between composite samples.

SEM - Standard error of means. The significance of all the variables measured for each sample was tested with split-plot analysis of variance (ANOVA), whereby the main effect of the cuts (n = 12 – whole plots) and treatment (n = 18 raw and cooked – sub-plots), as well as the cut-by-treatment interaction (n = 6) was tested at the 5% level of significance ($P \leq 0.05$).

Table 1 shows the nutrient composition of three primal cuts of South African lamb (A2) and Table 2 that of the mutton (C2). Table 3 presents the calculated composition values of South African lamb (A2) and mutton (C2) and values published in the MRC National Food Composition Tables, obtained from the United States Department of Agriculture (USDA) nutrient databases (1998 and 2008).

Table 2 Mean values of the nutrient composition of three raw and three cooked cuts per 100 g edible portion of South African C2 mutton

Nutrients analysed	Unit	Raw cuts (n = 3)			Cooked cuts (n = 3)		
		Shoulder	Loin	Leg	Shoulder	Loin	Leg
Proximate analysis							
Moisture	g	73.8	74.0	73.7	66.5	63.2	64.0
Protein (N x 6.25)	g	20.4	20.7	20.2	24.9	26.9	28.7
Fat	g	8.85	8.85	9.24	11.69	13.21	9.91
Ash	g	1.19	1.20	1.18	1.25	1.11	1.12
Food energy (calculated)	kJ	667	682	689	860	951	857
Minerals							
Magnesium (Mg)	mg	21.9	23.0	21.9	21.1	23.0	24.2
Potassium (K)	mg	255	282	256	262	280	280
Sodium (Na)	mg	86.9	85.7	86.9	74.8	77.6	68.0
Zinc (Zn)	mg	3.88	3.23	3.88	4.64	3.72	4.41
Iron (Fe)	mg	2.80	2.93	2.80	2.75	3.23	3.81
Vitamins							
Thiamin (B ₁)	mg	0.05	0.04	0.04	0.03	0.03	0.02
Riboflavin (B ₂)	mg	0.04	0.03	0.04	0.07	0.05	0.08
Niacin (B ₃)	mg	4.75	5.17	4.95	4.89	5.43	5.20
Pyridoxine (B ₆)	mg	0.17	0.23	0.21	0.09	0.12	0.11
Cyanocobalamin (B ₁₂)	µg	2.68	2.08	2.35	3.43	2.60	3.14
Lipids:							
Saturated fatty acids (SFA)							
14:0	g	0.25	0.25	0.26	0.32	0.37	0.27
16:0	g	2.27	2.27	2.33	2.97	3.42	2.49
18:0	g	1.90	1.99	1.94	2.68	3.28	2.07
20:0	g	0.02	0.03	0.02	0.03	0.04	0.03
Monounsaturated fatty acids (MUFA)							
16:1	g	0.15	0.14	0.16	0.19	0.20	0.18
18:1n9t	g	0.19	0.20	0.21	0.27	0.33	0.24
18:1n9c	g	3.39	3.30	3.58	4.41	4.67	3.88
Polyunsaturated fatty acids (PUFA)							
18:2n6t	g	0.04	0.04	0.04	0.05	0.06	0.04
18:2n6c	g	0.19	0.17	0.19	0.23	0.24	0.21
Cholesterol	mg	49.9	51.0	50.0	58.8	70.8	57.94

The proximate analysis values (Table 3.) differ only slightly between South African lamb and mutton, but a greater difference is evident between the data from both South African chronological age groups and the values reported in the MRC tables, derived from the USDA. Fat content of raw South African mutton (8.98 g) was similar to South African lamb (9.01 g), while the mutton in the USDA had a much higher fat content (21.6 g). A smaller difference occurred between the cooked fat content values of mutton from USDA and South Africa, with a larger difference between the age groups within South Africa for cooked edible portions. The extensive difference between raw and cooked values for mutton presented in the USDA tables

might be due to changes in the nutritional composition of the animals in the past decade, as significant changes in the composition of meat have been recorded (Schönfeldt & Gibson, 2008).

The ash content of South African mutton (raw) and those in the USDA tables decreased with age, while fewer differences are present in the cooked values (Table 2). Strangely, iron and potassium concentrations decreased with age, while magnesium, sodium and zinc concentrations increased. Noteworthy differences between the USDA data and South African mutton (both raw and cooked) occurred for most of the minerals, probably due to difference in chronological age between the mutton samples from the two countries.

Table 3 Comparison of the nutrient composition for raw and cooked 100 g edible portion of South African lean lamb (A2) and the South African mutton (C2)

Nutrients analysed	Unit	Raw			Cooked		
		Lamb (A2) ¹	Mutton (C2)	Mutton ²	Lamb (A2) ¹	Mutton (C2)	Mutton ³
Proximate analysis							
Moisture	g	71.5	73.8	60.7	65.4	64.6	54.0
Protein (N x 6.25)	g	18.3	20.5	16.9	25.1	26.8	33.4
Fat	g	9.01	8.98	21.6	8.44	11.6	11.1
Ash	g	2.88	1.19	0.90	1.07	1.16	1.41
Food energy*	kJ	644	679	1087	745	889	978
Minerals							
Magnesium (Mg)	mg	20.1	22.2	22.0	21.7	22.8	31
Potassium (K)	mg	291	265	230	298	274	409
Sodium (Na)	mg	83.4	86.5	58.0	71.3	73.5	135
Zinc (Zn)	mg	2.25	3.66	3.33	1.72	4.25	5.93
Iron (Fe)	mg	3.17	2.84	1.60	3.32	3.26	4.76
Vitamins							
Thiamin (B ₁)	mg	0.10	0.04	0.12	0.04	0.02	0.06
Riboflavin (B ₂)	mg	0.09	0.04	0.22	0.05	0.07	0.30
Niacin (B ₃)	mg	1.47	4.96	6.10	1.42	2.99	6.52
Pyridoxine (B ₆)	mg	0.40	0.20	0.13	0.12	0.11	0.38
Cyanocobalamin (B ₁₂)	µg	3.54	2.37	2.40	0.93	0.10	4.44
Lipids							
Saturated fatty acids (SFA)*							
14:0	g	4.27	4.50	8.60	8.30	5.99	4.93
16:0	g	0.57	0.25	0.87	0.82	0.32	0.29
18:0	g	2.22	2.29	4.75	4.59	2.96	2.47
20:0	g	1.46	1.94	2.98	2.89	2.68	2.15
20:0	g	0.02	0.02	0	0	0.03	0.02
Monounsaturated fatty acids (MUFA)*							
16:1	g	3.62	3.77	8.59	8.66	0.48	4.36
18:1	g	0.19	0.15	0.63	0.62	0.19	0.21
18:1	g	3.43	3.62	7.96	8.04	0.29	4.15
Polyunsaturated fatty acids (PUFA)*							
18:2	g	0.27	0.22	1.24	1.21	0.28	0.40
18:2	g	0.27	0.22	1.24	1.21	0.28	0.40
Cholesterol	mg	62.8	50.3	72.0	87.8	62.5	109.0

*Calculated.

¹ Van Heerden *et al.* (2007).

² U.S. Department of Agriculture, Agricultural Research Service. 1998. USDA Nutrient Database for Standard Reference. Release 12. Mutton, raw.

³ U.S. Department of Agriculture, Agricultural Research Service. 2008. USDA National Nutrient Database for standard reference. Release 21. Mutton, cooked, roasted.

An increase in niacin concentration was recorded with an increase in age (from lamb to mutton), with the USDA data being higher than the South African values for both raw and cooked mutton. The USDA data

also report much higher riboflavin concentrations for both raw and cooked mutton than was recorded in South African mutton. Vitamin B₁₂ concentration seemed to decrease with age, with the USDA presenting higher values for vitamin B₁₂ than the South Africans, especially for cooked mutton. Although little difference is observed in the fatty acid profiles of South African lamb and mutton, significant differences are evident from Table 2 between the South African mutton fatty acid values (raw and cooked) and those from the USDA tables.

South African lamb and mutton of the measured classes provide a variety of valuable nutrients, but cooking changes the relative composition. The study contributes valuable data on the proximate chemical composition of lamb and mutton to assess the dietary intake of people.

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