INTRAMUSCULAR FAT AND FATTY ACID COMPOSITION OF THREE COMMERCIAL LEG CUTS FROM FARMED RED DEER IN NEW ZEALAND

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Abstract – Twenty one stags were used to evaluate the fat content and fatty acid composition of intramuscular fat from three commercial leg cuts (Knuckle, Silverside, Topside). All cuts were very lean (close to 1% fat), but Topside had a higher fat percentage than Knuckle and Silverside. Despite the lower fat content, Knuckle showed higher percentage of saturated fatty acids and lower percentage of polyunsaturated fatty acids than the Silverside and Topside which had a more similar fatty acid profile. Although Silverside had higher PUFA:SFA ratio and Knuckle had lower *n*-6:*n*-3 ratio than the other two cuts, all cuts had both fatty acid ratios within dietary recommendations for a healthy diet. Topside had higher mg/100 g of CLA and EPA+DHA than Silverside and especially Knuckle. All cuts showed lower fat levels, lower CLA percentages and higher EPA+DHA percentages than previously reported leg cuts from beef and sheep.

Key Words – stags, conjugated linoleic acid, omega-3.

I. INTRODUCTION (10 lines)

Consumer trends indicate increasing demands for healthier meat and meat products with reduced level of fat, cholesterol, and improved composition of fatty acid profile [1]. Venison is regarded a lean meat with very low muscle lipid content and increased levels of polyunsaturated fatty acids. Most studies conducted with red deer looked at the fat content and composition of the loin or tenderloin and limited data are available from leg cuts. The objective of this study was to evaluate the fat content and fatty acid composition of three commercial leg cuts from grazing red deer farmed in New Zealand.

II. MATERIALS AND METHODS

Twenty one red deer (*Cervus elaphus*) stags (carcass weight 64.3±5.4) were used to evaluate the fat content and fatty acid composition of intramuscular fat from three commercial leg cuts. Lipids were extracted and methylated in a one step process according to [2]. Fatty acid methyl esters were analyzed using a GC-FID Shimadzu GC2010 with a RTX 2330 column (105 meters length, 0.25 mm i.d., and 0.20 μm film thickness). Data were analyzed using linear mixed effects modelling where the cut effect was examined using 'within' animal variation. All analyses were carried out using the R software version 3.3.3 (R Core Team, 2017).

III. RESULTS AND DISCUSSION

The fat content and fatty acid composition of the three commercial leg cuts are shown in Table 1. Results confirm the very low lipid content of venison. Intramuscular fat values were higher than those reported for loins from stags, but similar to those reported for loins from hinds farmed in New Zealand (0.63 and 1.12 %, respectively, [3]). There were significant differences in the fat content and fatty acids composition among cuts. Topside had higher fat percentage than Knuckle and Silverside which did not differ. Knuckle showed higher saturated fat with lower percentages of PUFA, including *n*-6, *n*-3 and the three long-chain *n*-3 fatty acids (LC-PUFA: EPA, DPA and DHA) than both Silverside and Topside. However, all muscles showed PUFA:SFA and n-6:n-3 ratios within dietary recommendations for a healthy diet (PUFA:SFA >0.45 and *n*-6:*n*-3 ≤4.0, [4]). There were no differences in the percentage of CLA among cuts, except for a higher quantitative value for Topside than Knuckle and Silverside (2.93^{a}, 2.54^{b} and 2.52^{b} mg/100 g, respectively, $^{a,b}P<0.05$). The health benefits obtained by human consumption of meat lipids have been associated with absolute *n*-3 LC-PUFA, mainly EPA and DHA. Topside showed higher quantitative EPA+DHA values than Silverside which was higher than Knuckle (33.19^{a} vs. 30.54^{b} vs. 25.12^{c} mg/100 g, $^{a,b,c}P<0.05$). According to

the Australian nutrient reference standard [5], >22 and 44 mg/100 g meat serve, are a 'source' and 'good source' of EPA+DHA, corresponding the values from this study to a 'source' of these beneficial fatty acids (25 to 33 mg/100g). Percentage values for CLA in this study (around 0.25%) are lower than those reported for leg muscles from beef and sheep (around 0.74 and 2.46% respectively, [6]), while percentage values for EPA+DHA (around 3.0%) were much higher than those reported for beef and sheep farmed in New Zealand (around 0.69 and 0.95% respectively, [6]).

Table 1. Selected fatty acids (g/100 g total fatty acids) from Knuckle, Silverside and Topside cuts from red deer stags (Mean±SE).

	Cut			
%	Knuckle	Silverside	Topside	P
Total Lipid	1.08^{b}±0.20	1.11^{b}±0.21	1.21^{a}±0.18	0.0003
C14:0 (myristic acid)	2.67±0.44	2.54±0.49	2.51±0.39	0.1662
C16:0 (palmitic acid)	19.79^{a}±0.56	18.53^{b}±0.65	19.04^{b}±0.64	0.0014
C18:0 (stearic acid)	17.88^{a}±0.37	17.10^{b}±0.33	16.62^{c}±0.34	<.0001
C18:1 c9 (oleic acid)	13.12^{a}±0.51	12.22^{b}±0.52	12.88^{a}±0.55	0.0008
C18:1 t11 (trans vaccenic acid)	1.07^{a}±0.44	0.92^{b}±0.39	0.97^{b}±0.40	<.0001
C18:2 n-6 (linoleic acid)	14.00^{b}±0.64	15.15^{a}±0.60	14.86^{a}±0.72	0.0066
C18:3 n-3 (α-linolenic acid)	5.82±0.50	6.03±0.52	5.90±0.55	0.2865
CLA c9,t11 (conjugated linoleic acid)	0.25±0.26	0.24±0.21	0.26±0.21	0.2677
C20:4 n-6 (arachidonic acid)	3.07^{b}±0.40	3.44^{a}±0.40	3.21^{b}±0.43	0.0013
C20:5 n-3 (eicosapentaenoic acid, EPA)	2.07^{b}±0.32	2.49^{a}±0.36	2.51^{a}±0.38	<.0001
C22:5 n-3 (docosapentaenoic acid, DPA)	2.05^{b}±0.33	2.23^{a}±0.35	2.21^{a}±0.33	0.0222
C22:6 n-3 (docosahexaenoic acid, DHA)	0.54^{c}±0.17	0.63^{a}±0.20	0.58^{b}±0.20	0.0001
SFA	42.46^{a}±0.41	40.22^{b}±0.50	40.03^{b}±0.55	<.0001
MUFA	21.98^{ab}±0.68	21.70^{b}±0.65	22.77^{a}±0.67	0.0247
PUFA	28.89^{b}±0.87	31.23^{a}±0.91	30.71^{a}±0.99	0.0112
n-6	18.06^{b}±0.73	19.66^{a}±0.69	19.13^{a}±0.81	0.0054
n-3	10.58^{b}±0.62	11.48^{a}±0.67	11.32^{a}±0.70	0.0081
PUFA:SFA	1.73^{b}±0.20	1.75^{a}±0.20	1.71^{b}±0.19	0.0677
n-6:n-3	0.69^{b}±0.18	0.79^{a}±0.20	0.78^{a}±0.23	0.0007

^{a,b,c} Values within a row with different superscript letters differ (P<0.05).

IV. CONCLUSION

Although all evaluated leg cuts could be included as part of a healthy diet, there are cut differences and the Knuckle showed lower fat percentage, but a more saturated fatty acid profile with lower *n*-6, *n*-3 and EPA+DHA fatty acids than the Silverside and Topside.

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