To investigate the effect of grass-based feeding practices on insulin sensitivity, adipose tissue inflammation and hepatic lipid composition in a transgenic mouse model

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Grass-based feeding practices can alter the fatty acid composition of beef to reduce saturated fatty acid (SFA) concentrations and increase polyunsaturated fatty acid (PUFA) concentrations, in particular, α-linolenic acid (ALA) and conjugated linoleic acid (CLA)[1]. The beneficial effect of chronic grass-fed red meat consumption on LC n-3 PUFA status in human has previously been characterised[2]. However, the *in vivo* mechanism is currently unknown. Therefore the aim of this study was to assess the impact of beef consumption from alternate feeding practices on insulin sensitivity, adipose tissue inflammation and hepatic lipid composition. ApoE.3L.CETP transgenic mice were fed either a GRASS (18 % beef protein, 30 % beef fat, derived from grass-fed beef) a CONC (18 % beef protein, 30 % beef fat, derived from concentrate-fed beef) or a GRASS-CASEIN (18 % casein, 30 % grass-fed beef fat) diet for 12 weeks. Following the dietary intervention, the metabolic phenotype was characterised using glucose tolerance tests (GTT) and insulin tolerance tests (ITT). Epididymal adipose tissue was harvested to isolate the stromal vascular fraction (SVF) cellular fraction which is enriched in immune cells and stimulated with 100ng/ml LPS for 18 hours, and hepatic lipid composition was characterised using a two-step microwave-assisted saponification and esterification process. Resultant adipose IL-6 secretion was measured by ELISA. Prism version 5 (GraphPad Software Inc.) was used for statistical analysis. One- and two-way ANOVA tested for differences between diets in the GTT, ITT, adipose cytokine secretion and hepatic fatty acid composition.

No difference in glucose tolerance, insulin sensitivity of adipose tissue inflammation was observed between the beef interventions. However, significant differences in hepatic fatty acid composition were observed following the dietary intervention, wherein PUFA concentrations were increased following the GRASS diets (Table 1). In conclusion, this work demonstrates the potential of grass-fed beef consumption to improve fatty acid status. Future perspectives include a chronic intervention with grass-fed beef.

Table 1. Fatty acid composition of livers following beef dietary intervention in transgenic mouse model

	GRASS (n = 7)		CONC (n = 8)		GRASS-CASEIN (n = 6)		
	Mean	SD	Mean	SD	Mean	SD	P*
C16:0 Palmitic Acid	18.39[a]	3.17	14.74[a]	3.97	27.92[b]	9.78	**0.002**
C16: 1 Palmitoleic Acid	6.59[a]	1.35	4.96[a]	2.03	13.17[b]	5.45	**0.001**
C18:0 Stearic Acid	3.26	0.17	2.97	0.29	3.1	0.29	0.119
C18:1 Oleic Acid	54.71[ab]	12.82	38.74[a]	12.87	75.34[b]	30.88	**0.01**
C18:2n-6 Linoleic Acid	8.38	1.3	6.17	1.98	6.52	3.77	0.214
C18:3n-3 Alpha Linolenic Acid	0.46[a]	0.09	0.22[b]	0.1	0.40[a]	0.16	**0.002**
C18:2c9t11 Conjugated Linoleic Acid	1.32[a]	0.19	0.31[b]	0.11	1.50[a]	0.45	**<0.001**
C18:2t10c12 Conjugated Linoleic Acid	0.04[a]	0.02	0.01[b]	0.01	0.06[a]	0.04	**0.004**
C20:4n-6 Arachidonic Acid	2.71[a]	0.39	3.06[a]	0.38	2.37[b]	0.21	**0.006**
C20:5n-3 Eicosapentaenoic Acid	0.40[a]	0.07	0.19[b]	0.04	0.25[b]	0.07	**<0.001**
C22:5n-3 Docosapentaenoic Acid	0.50[a]	0.06	0.26[b]	0.08	0.28[b]	0.09	**<0.001**
C22:6n-3 Docosahexaenoic Acid	3.10[a]	0.5	2.27[b]	0.34	2.42[b]	0.27	**0.002**

*A one way ANOVA was applied to test for differences between beef groups. [a,b] Indicates significant differences between beef dietary interventions (P < 0.05)

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2. McAfee AJ, McSorley EM, Cuskelly GJ *et al.* (2011) *Br J Nutr* **105** 80–89

Proceedings of the Nutrition Society