Organic Farming Research Foundation Project Report
Ron Rosmann - Feeding beef cattle to produce healthier and highly acceptable beef

(Note: These tables are derived from the full project report, with additional notations by E. Walz from a discussion with Roberto Sonon. These additional notations are provided to help describe the data, and any errors are unintentional and my own. Readers may refer to the original project report for the tables as they were submitted. –*EW*)

Table 4: Fatty acid composition of feeds, with notations

The fatty acid composition of the pooled samples of pasture grass, ground hay, and concentrate mixture are shown in Table 4. Linolenic acid (C18:3*n-3*) comprised the greatest percentage of the total fatty acids for pasture and hay forages, whereas linoleic acid (C18:2*n-6*) was the largest component among the fatty acids in the corn-based concentrate mix. Pasture forage had the highest ratio of omega-3 to omega-6 fatty acids, and this ratio was lowest for the concentrate mix. Atherogenic index was similar for pasture and hay forages, which were higher than that of the concentrate mix.

Table 4. Fatty acid composition of feeds.

	Fatty acid	Full name	Pasture	Hay	Concentrate mix
			----------g/100 g of fatty acids----------		
Most atherogenic fatty acids	C12:0	Lauric acid	0.79	0.83	nd
	C14:0	Myristic acid	1.07	1.38	0.04
	C14:1		0.10	0.27	nd
	C15:0		0.20	0.40	nd
	C16:0	Palmitic acid	19.27	18.99	11.61
	C16:1		0.53	0.80	0.08
	C17:0		0.21	0.35	0.08
	C18:0	Stearic acid	1.85	3.30	2.41
	C18:1	Monounsaturated oleic acid	4.97	6.64	25.59
	C18:2*n-6*	Linoleic acid (o-6)	25.45	27.06	55.95
	C18:3*n-3*	Linolenic acid (o-3)	43.88	36.75	3.71
	C20:0		0.46	0.82	0.29
	C20:1		0.12	0.14	0.01
	C20:2		0.08	0.07	nd
	C20:3*n-6*		0.20	0.22	nd
	C20:4*n-6*		0.03	0.05	nd
	C22:0		0.36	0.89	0.13
	C23:0		0.13	0.40	0.01
	C24:0		0.30	0.64	0.10
	n-3/n-6[1]		1.95	1.62	0.07
	AI[2]		0.32	0.35	0.14

[1]*n3/n6*=calculated as the sum of all omega-3 fatty acids divided by the sum of all omega-6 fatty acids.

[2]AI=atherogenic index calculated as the sum of C12:0+4*C14:0+C16:0 divided by the sum of all unsaturated fatty acids.

nd=not detected.

Notes:

C14: Myristic acid – is the most atherogenic of all fatty acids, having the greatest low density lipoprotein (LDL) or "bad" cholesterol.

Fatty acids C12 through C16 as a group are considered the most atherogenic fatty acids.

Acids containing ":0" in the name refer to a saturated fatty acid.

Acids containing :*n-6* are an omega-6 fatty acid.

Acids containing :*n-3* are an omega-3 fatty acid.

While fatty acids values are shown for feeds, CLA (conjugated linoleic acid) values are not, because CLA is synthesized in the tissue of the animal

Table 5. Fatty acid composition of the different beef parts

Presented in Table 5 is the fatty acid composition of the different beef parts. The monounsaturated oleic acid (C18:1) accounted for the greatest concentration of the fatty acids in all three beef parts. This fatty acid was followed by palmitic acid (C16:0) and stearic acid (18:0) in a descending order of percentage. Myristic acid (14:0), which is the most atherogenic of all fatty acids, was found to be highest in the adipose tissue. Consequently, AI of adipose tissue was observed to be higher than that of the steak and trim. Linoleic acid, an omega-6 fatty acid, was highest in the ribeye steaks and lowest in the adipose tissue. Docosapentaenoic acid (C22:5), an omega-3 fatty acid, was also highest in ribeye steaks and almost negligible in the adipose tissue. Within a beef part, most of the fatty acids did not differ significantly ($p>0.05$) between the two finishing systems. In all three beef parts, the omega-3 linolenic acid (C18:3) was significantly higher in parts from the pasture-finished cattle than in those from drylot-fed cattle. This result indicates that some of the C18:3*n-3* in the feed, which makes up about 44% of the total fatty acids of the pasture forage, was transferred effectively to animal tissues. On the other hand, C18:2*n-6* content of adipose tissue was significantly higher in parts from the drylot-finished cattle than in parts from pasture-fed cattle. A similar trend was observed for this fatty acid in the ribeye steak as the concentration of C18:2n-6 tended to be significantly greater ($p=0.053$) with drylot-finished cattle. The ratios of omega-3 to omega-6 fatty acids were significantly greater for pasture-fed cattle compared with ratios for drylot-finished cattle in all three beef parts.

Table 5. Fatty acid composition of the different beef parts[1].

	Beef part					
	Ribeye steak		Trim		Adipose	
	Finishing system		Finishing system		Finishing system	
	Pasture	Drylot	Pasture	Drylot	Pasture	Drylot
Fatty acid	----------g/100 g of fatty acids----------					
C12:0	0.08	0.06	0.08	0.10	0.10	0.10
C14:0	2.95	2.61	3.12	3.16	4.27	4.22
C14:1	0.56	0.52	0.95	0.59	1.42	1.50
C15:0	0.41[a]	0.26[b]	0.52	0.46	0.59[a]	0.46[b]
C16:0	28.51	29.01	26.18	27.05	27.18	27.49
C16:1	3.56	3.34	4.48	3.33	5.64	5.17
C17:0	0.96[a]	0.78[b]	1.00	1.02	1.07	0.97
C18:0	15.96	14.94	15.28	18.65	13.52	12.96
C18:1	38.44	40.13	40.47	39.69	39.98	42.61
C18:2*n-6*	3.74	4.80	3.20	3.13	1.77[b]	2.26[a]
C18:3*n-3*	0.79[a]	0.61[b]	0.74[a]	0.54[b]	0.60[a]	0.46[b]
C20:0	0.09	0.08	0.09	0.11	0.09	0.09
C20:1	0.03	0.05	0.03	0.03	0.02	0.02
C20:2	0.03[b]	0.05[a]	0.04	0.04	0.02	0.02
C20:3*n-6*	0.29	0.40	0.22	0.18	0.07	0.08
C20:4*n-6*	0.87	1.20	0.65	0.36	0.06	0.05
C20:5*n-3*	nd	nd	nd	nd	0.03	nd
C22:5*n-3*	0.31	0.33	0.24	0.13	0.02	0.01
C24:0	0.15	0.15	0.11	0.03	nd	nd
n-3/n-6[2]	0.26[a]	0.15[b]	0.25[a]	0.19[b]	0.35[a]	0.19[b]
AI[3]	0.80	0.76	0.74	0.81	0.85	0.83
	n=9	n=7	n=8	n=7	n=9	n=7

[1]Means within a beef part and within a row with unlike superscripts differ (p .05).

[2]*n3/n6*=calculated as the sum of all omega-3 fatty acids divided by the sum of all omega-6 fatty acids.

[3]AI=atherogenic index calculated as the sum of C12:0+4*C14:0+C16:0 divided by the sum of all unsaturated fatty acids.

nd=not detected.

Table 6. Trans vaccenic acid and conjugated linoleic acid concentrations of the different beef parts

Table 6 shows the trans vaccenic acid (C18:*t11*) and CLA concentrations of the different beef parts. Among the four CLA isomers determined, *cis9 trans11* accounted for about 78% of the total CLA. Adipose tissue had the greatest amount of *cis9 trans11* CLA, which was followed in a decreasing order by the trim and ribeye steak. In all three beef parts, CLA concentrations were significantly greater from the pasture-finished cattle, having more than twice those from the drylot-finished cattle. These data are complemented by the higher concentration of trans vaccenic acid in parts from the pasture-fed cattle than in parts from the drylot-finished cattle; the differences were significant (p 0.05) for the ribeye steak and adipose tissue. Trans vaccenic acid is a precursor for CLA synthesis in animal tissues. Linolenic acid coming from pasture may have supplied the additional trans vaccenic acid produced during ruminal biodydrogenation.

Table 6. Trans vaccenic acid and conjugated linoleic acid concentrations of the different beef parts[1].

Beef part[2]	Finishing system	*c18:1t11*	C18:2 CLA isomers *c9, t11*	*t10, c12*	*c9, c11*	*t9, t11*	Total CLA
		----------g/100 g of fatty acids----------					
Ribeye steak	Pasture	1.70[a]	0.44[a]	0.02[a]	0.02	0.07[a]	0.56[a]
	Drylot	0.44[b]	0.17[b]	0.01[b]	nd	0.04[b]	0.22[b]
Trim	Pasture	1.68	0.61[a]	0.04[a]	0.03[a]	0.12[a]	0.81[a]
	Drylot	1.06	0.26[b]	0.02[b]	0.01[b]	0.07[b]	0.36[b]
Adipose	Pasture	2.39[a]	0.82[a]	0.05[a]	0.04[a]	0.16[a]	1.08[a]
	Drylot	1.09[b]	0.34[b]	0.02[b]	0.01[b]	0.07[b]	0.44[b]

[1]Means within a beef part within a column with unlike superscripts differ (p 0.05).

[2]n=9 for parts from pasture-fed cattle, except for trim where n=8; n=7 for parts from drylot-fed cattle.

nd=not detected.