

Association between alterations in plasma metabolome profiles and laminitis in intensively finished Holstein bulls: a randomized controlled study

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SUPPLEMENTARY MATERIAL

Table S1. Significantly different metabolites between bulls fed a high energy and protein (HEP) or a low energy and protein (LEP) diet, and all results of measured serum biochemistry. SM = sphingomyelin, PC = phosphatidylcholine, aa = diacyl, ae = acyl-alkyl.

	HEP	LEP	units	p-value
Arginine	195.0 ± 6.7	175.3 ± 6.3	µmol/L	< 0.05
Asparagine	38.9 ± 2.2	32.2 ± 1.4	µmol/L	< 0.05
Isoleucine	136.8 ± 5.8	103.0 ± 5.1	µmol/L	< 0.001
Leucine	164.8 ± 9.7	113.0 ± 6.1	µmol/L	< 0.001
Lysine	142.5 ± 8.3	107.4 ± 4.8	µmol/L	< 0.01
Ornithine	60.3 ± 2.5	47.6 ± 1.7	µmol/L	< 0.001
Phenylalanine	55.8 ± 2.9	45.1 ± 1.7	µmol/L	< 0.01
Threonine	75.0 ± 5.4	52.6 ± 1.9	µmol/L	< 0.001
Tryptophan	54.0 ± 3.1	46.1 ± 1.9	µmol/L	< 0.05
Tyrosine	68.2 ± 3.2	58.2 ± 1.9	µmol/L	< 0.05
Valine	259.3 ± 11.5	199.3 ± 7.7	µmol/L	< 0.001
Acetyloronithine	2.3 ± 0.2	3.8 ± 0.3	µmol/L	< 0.001
Creatinine	67.4 ± 3.8	83.0 ± 2.2	µmol/L	< 0.01
Trans-4-Hydroxyproline	28.1 ± 1.0	32.3 ± 1.4	µmol/L	< 0.05
lyso PC a C14:0	4.4 ± 0.1	4.1 ± 0.1	µmol/L	< 0.05
lyso PC a C16:0	17.9 ± 0.9	14.2 ± 0.6	µmol/L	< 0.01
lyso PC a C18:2	14.0 ± 0.7	10.5 ± 0.4	µmol/L	< 0.001
SM (OH) C14:1	7.4 ± 0.3	10.6 ± 0.6	µmol/L	< 0.001
SM (OH) C16:1	6.2 ± 0.3	8.2 ± 0.5	µmol/L	< 0.001
SM (OH) C22:2	4.2 ± 0.2	5.4 ± 0.3	µmol/L	< 0.01
SM C18:0	9.6 ± 0.5	11.7 ± 0.6	µmol/L	< 0.05
SM C18:1	4.0 ± 0.2	4.8 ± 0.2	µmol/L	< 0.05
SM C24:0	18.2 ± 1.2	31.7 ± 1.6	µmol/L	< 0.001
SM C26:0	0.28 ± 0.02	0.36 ± 0.03	µmol/L	< 0.05
C3	0.36 ± 0.02	0.46 ± 0.04	µmol/L	< 0.05
C3-OH	0.02 ± 0.00	0.02 ± 0.00	µmol/L	< 0.05
C5-M-DC	0.03 ± 0.00	0.03 ± 0.00	µmol/L	< 0.01

C6:1	0.03 ± 0.00	0.04 ± 0.00	μmol/L	< 0.05
C12:1	0.11 ± 0.00	0.09 ± 0.01	μmol/L	< 0.01
C6 (C4:1 DC)	0.06 ± 0.00	0.08 ± 0.01	μmol/L	< 0.05
PC aa C30:2	0.1 ± 0.0	0.2 ± 0.2	μmol/L	< 0.01
PC aa C32:0	4.4 ± 0.2	5.1 ± 0.2	μmol/L	< 0.01
PC aa C32:1	4.6 ± 0.2	5.3 ± 0.2	μmol/L	< 0.05
PC aa C32:2	4.2 ± 0.3	6.0 ± 0.4	μmol/L	< 0.001
PC aa C34:2	109.7 ± 6.0	85.3 ± 3.7	μmol/L	< 0.01
PC aa C34:3	16.2 ± 1.0	23.7 ± 1.3	μmol/L	< 0.001
PC aa C36:0	4.1 ± 0.3	10.0 ± 1.0	μmol/L	< 0.001
PC aa C36:1	94.7 ± 4.2	133.4 ± 5.5	μmol/L	< 0.05
PC aa C36:3	57.2 ± 2.3	71.2 ± 11.7	μmol/L	< 0.01
PC aa C36:4	19.9 ± 1.1	23.9 ± 1.2	μmol/L	< 0.05
PC aa C36:5	4.2 ± 0.2	6.4 ± 0.4	μmol/L	< 0.001
PC aa C36:6	1.3 ± 0.1	1.9 ± 0.1	μmol/L	< 0.01
PC aa C38:0	1.5 ± 0.1	4.2 ± 0.3	μmol/L	< 0.001
PC aa C38:1	2.8 ± 0.2	9.7 ± 0.6	μmol/L	< 0.001
PC aa C38:3	28.2 ± 2.0	38.4 ± 2.0	μmol/L	< 0.01
PC aa C38:4	34.9 ± 30.6	44.4 ± 2.1	μmol/L	< 0.01
PC aa C38:5	11.5 ± 0.7	18.6 ± 1.3	μmol/L	< 0.001
PC aa C38:6	2.2 ± 0.1	3.4 ± 0.2	μmol/L	< 0.001
PC aa C40:1	0.2 ± 0.0	0.3 ± 0.0	μmol/L	< 0.001
PC aa C40:2	0.2 ± 0.0	0.5 ± 0.0	μmol/L	< 0.001
PC aa C40:3	2.4 ± 0.2	5.8 ± 0.5	μmol/L	< 0.001
PC aa C40:4	9.1 ± 0.8	18.9 ± 1.3	μmol/L	< 0.001
PC aa C40:5	13.3 ± 0.8	20.9 ± 1.2	μmol/L	< 0.001
PC aa C40:6	3.6 ± 0.3	6.3 ± 0.5	μmol/L	< 0.001
PC aa C42:0	0.06 ± 0.00	0.07 ± 0.00	μmol/L	< 0.001
PC aa C42:1	0.06 ± 0.00	0.09 ± 0.00	μmol/L	< 0.001
PC aa C42:2	0.09 ± 0.00	0.11 ± 0.00	μmol/L	< 0.001
PC aa C42:4	0.2 ± 0.0	0.3 ± 0.0	μmol/L	< 0.001
PC aa C42:5	0.6 ± 0.0	2.3 ± 0.2	μmol/L	< 0.001
PC aa C42:6	0.3 ± 0.0	1.1 ± 0.1	μmol/L	< 0.001
PC ae C30:0	0.37 ± 0.02	0.44 ± 0.01	μmol/L	< 0.05
PC ae C32:1	1.7 ± 0.1	2.1 ± 0.1	μmol/L	< 0.01
PC ae C34:0	1.9 ± 0.1	2.8 ± 0.1	μmol/L	< 0.001
PC ae C34:1	9.1 ± 0.4	12.8 ± 0.6	μmol/L	< 0.001
PC ae C34:2	12.2 ± 0.7	16.4 ± 0.8	μmol/L	< 0.001
PC ae C36:0	1.5 ± 0.1	2.8 ± 0.2	μmol/L	< 0.001
PC ae C36:1	11.9 ± 0.5	18.2 ± 0.9	μmol/L	< 0.001
PC ae C36:2	17.8 ± 0.8	20.8 ± 0.9	μmol/L	< 0.05
PC ae C36:3	6.8 ± 0.3	9.3 ± 0.5	μmol/L	< 0.001
PC ae C38:0	1.0 ± 0.1	2.1 ± 0.1	μmol/L	< 0.001
PC ae C38:1	1.6 ± 0.1	3.2 ± 0.2	μmol/L	< 0.001
PC ae C38:2	2.4 ± 0.1	3.6 ± 0.2	μmol/L	< 0.001
PC ae C38:3	2.7 ± 0.1	3.6 ± 0.2	μmol/L	< 0.001

PC ae C38:4	3.6 ± 0.2	5.1 ± 0.2	μmol/L	< 0.001
PC ae C38:5	2.7 ± 0.2	3.3 ± 0.2	μmol/L	< 0.05
PC ae C40:1	0.2 ± 0.0	0.4 ± 0.0	μmol/L	< 0.001
PC ae C40:2	0.7 ± 0.0	1.0 ± 0.0	μmol/L	< 0.001
PC ae C40:3	0.7 ± 0.0	0.9 ± 0.0	μmol/L	< 0.001
PC ae C40:4	0.9 ± 0.0	1.2 ± 0.1	μmol/L	< 0.001
PC ae C40:5	1.3 ± 0.1	2.0 ± 0.1	μmol/L	< 0.001
PC ae C40:6	0.7 ± 0.0	1.0 ± 0.0	μmol/L	< 0.01
PC ae C42:1	0.1 ± 0.0	0.2 ± 0.0	μmol/L	< 0.001
PC ae C42:2	0.15 ± 0.01	0.22 ± 0.01	μmol/L	< 0.001
PC ae C42:3	0.1 ± 0.0	0.2 ± 0.0	μmol/L	< 0.001
PC ae C42:4	0.1 ± 0.0	0.2 ± 0.0	μmol/L	< 0.001
PC ae C42:5	0.5 ± 0.0	0.7 ± 0.0	μmol/L	< 0.001
PC ae C44:3	0.07 ± 0.00	0.08 ± 0.00	μmol/L	< 0.001
PC ae C44:4	0.08 ± 0.00	0.1 ± 0.00	μmol/L	< 0.01
PC ae C44:5	0.07 ± 0.00	0.09 ± 0.00	μmol/L	< 0.001
PC ae C44:6	0.06 ± 0.00	0.07 ± 0.00	μmol/L	< 0.001
Insulin	3.1 ± 0.2	1.5 ± 0.2	μg/L	< 0.001
Glucose	4.1 ± 0.2	4.2 ± 0.1	mmol/L	0.794
L-Lactate	1.5 ± 0.3	2.2 ± 0.5	mmol/L	0.245
Urea	5.0 ± 0.1	2.8 ± 0.1	mmol/L	< 0.001
Creatinine	73.5 ± 2.2	86.9 ± 2.2	μmol/L	< 0.001
Total protein	69.9 ± 3.1	68.8 ± 0.4	g/L	0.201
Albumin	39.7 ± 0.4	39.3 ± 0.4	g/L	0.333
gamma Glutamyltransferase	16.1 ± 1.4	14.5 ± 1.0	U/L	0.27
Aspartate aminotransferase	86.8 ± 3.1	83.1 ± 2.1	U/L	0.328
Glutamate dehydrogenase	16.0 ± 2.3	10.1 ± 0.9	U/L	< 0.05
Creatine kinase	230.8 ± 50.2	176.6 ± 7.5	U/L	0.295
Phosphate	2.3 ± 0.0	2.2 ± 0.0	mmol/L	< 0.05
beta-Hydroxybutyrate	0.5 ± 0.0	0.4 ± 0.0	mmol/L	< 0.05
Non-esterified fatty acids	0.12 ± 0.01	0.12 ± 0.01	mmol/L	0.905