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The production of acetate, propionate and butyrate in the rumen of sheep: fitting models to ¹⁴C- or ¹³C-labelled tracer data to determine synthesis rates and interconversions

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A SAAM31  ***** Three-compartment VFA Kinetic Model *****
C          Re-analysis of data from Leng and Leonard (1963)
C Expts. [3 x i/r continuous infusions of tracer VFA, ie Ac, Pr, Bu]
2          10
H PAR
C Infusion rates [0.5 uCi/min=18.5kBq/min; converted to kBq/day, +/-
5%]
  P(1)=27936
  P(5)=27936
  P(9)=25344
C Model structure
C L(i,j) starting values (and +/- limits) in 'turnovers per day'
  L(2,1)   .4           .1           1
  L(1,2)   .5           .1           1
  L(3,1)  1.5           .1           10
  L(1,3)  11            .11          50
  L(3,2)   .2           .1           10
  L(2,3)   1            .1           10
  L(0,1)   8.6          1            50
  L(0,2)   13           1            25
  L(0,3)   20           1            50
C Model for tracer Pr infusion
  L(5,4)=L(2,1)
  L(4,5)=L(1,2)
  L(6,4)=L(3,1)
  L(4,6)=L(1,3)
  L(6,5)=L(3,2)
  L(5,6)=L(2,3)
C Model for tracer Bu infusion
  L(8,7)=L(2,1)
  L(7,8)=L(1,2)
  L(9,7)=L(3,1)
  L(7,9)=L(1,3)
  L(9,8)=L(3,2)
  L(8,9)=L(2,3)
C Equate 3 sub-model parameters
  L(0,4)=L(0,1)
  L(0,5)=L(0,2)
  L(0,6)=L(0,3)
  L(0,7)=L(0,1)
  L(0,8)=L(0,2)
  L(0,9)=L(0,3)
C Estimated compartment sizes (g C)
  P(21)   1.0E+01      1.0E+00      1.5E+01
  P(22)   3.1E+00      1.0E+00      6.0E+00
  P(23)   2.0E+00      1.0E+00      6.0E+00
H DAT
C If extra information is available, compartment sizes ...
C and other parameters can be constrained, with FSD weighting, in
'110'
110
  P(21)           10.1           .51

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P(22)                3.4                .17
P(23)                2.0                .10
C Set infusion rates for Expt 1, Expt 2, Expt (kBq/day)
X UF(1)=P(1)
X UF(5)=P(5)
X UF(9)=P(9)
C *****
C Calculate SA (kBq/gC); where P(21)=M(1), P(22)=M(2), P(23)=M(3)
X G(1)=F(1)/P(21)
x G(2)=F(2)/P(22)
X G(3)=F(3)/p(23)
X G(4)=F(4)/P(21)
x G(5)=F(5)/P(22)
X G(6)=F(6)/p(23)
X G(7)=F(7)/P(21)
x G(8)=F(8)/P(22)
X G(9)=F(9)/p(23)
H DAT
C ***** Expt 1 (Ac infn) *****
C Tracer infusion into C1=acetate; original units, min and uCi/mol
C Convert uCi/mol to kBq/gC; (uCi*37)/(mol*24)=1.5417; (min/1440)=days
C FSD defined by confidence in the experimental data
101g(1)      /1440      *1.5417      FSD=.15
C Expt 1. SA in Compartment 1 (Ac-SA) during tracer-Ac infusion
      30      28.500
      60      71.957
      90      108.07
      120     101.86
      135     116.82
      150     110.61
      165     110.89
      180     124.72
      195     121.34
      210     123.88
      225     135.73
      240     130.93
C Generate fitted data points to give a smoother plot
101G(1)
      0
2      .001      300
C Expt 1. Pr-SA response to tracer-Ac infusion
102G(2)      /1440      *1.0278      FSD=.25
      60      2.285
      90      4.571
      120     5.333
      135     6.603
      150     8.126
      165     7.365
      180     8.126
      195     9.142
      210     9.396
      225     8.888

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	240	9.012	
102G(2)	0		
2	.001		300
C Expt 1. Bu-SA response to tracer-Ac infusion			
103G(3)	/1440	*.7708	FSD=.2
	60	13.15	
	90	27.92	
	120	30.88	
	135	41.62	
	150	35.98	
	165	52.90	
	180	44.84	
	195	50.75	
	210	54.24	
	225	55.04	
	240	59.88	
103G(3)	0		
2	.001		300
C ***** Expt 2 (Pr infn) *****			
C Ac-SA response to tracer-Pr infusion			
104G(4)	/1440	*1.5417	FSD=.25
	30	0.10	
	60	1.50	
	90	2.697	
	120	1.312	
	150	2.083	
	180	3.468	
	195	3.468	
	210	3.468	
	225	4.853	
	240	5.80	
104G(4)	0		
2	.001		300
C Propionate (host)			
105G(5)	/1440	*1.0278	FSD=.15
	60	221.7	
	90	324.8	
	150	399.7	
	180	416.6	
	210	436.4	
	225	439.2	
	240	439.2	
105G(5)	/1440	*1.0278	FSD=0.5
	120	425.1	
105G(5)	0		
2	.001		300
C Bu-SA response during tracer-Pr infusion			
106G(6)	/1440	*.7708	FSD=.25

60	1.412
120	7.062
150	7.062
180	7.062
210	9.887
225	7.062
240	11.29

106G(6)

0		300
2	.001	

C *****Expt 3 Bu infn) *****

C Ac-SA response during tracer-Bu infusion

107G(7)	/1440	*1.5417	FSD=.25
	30	10.05	
	60	13.23	
	90	11.0	
	120	19.39	
	150	24.93	
	180	29.09	
	195	30.47	
	210	42.94	
	225	42.94	
	240	44.33	

107G(7)

0		300
2	.001	

C Pr-SA response during tracer-Bu infusion

108G(8)	/1440	*1.0278	FSD=.25
	30	5	
	60	7.083	
	90	7.697	
	120	8.312	
	150	11.08	
	180	12.46	
	195	12.46	
	210	12.46	
	225	13.85	
	240	13.23	

108G(8)

0		300
2	.001	

C Bu-SA response during tracer-Bu infusion

109G(9)	/1440	*.7708	WT=0
	60	240.28	
	90	338.03	
	120	393.45	
109G(9)	/1440	*.7708	FSD=0.10
	30	215.57	
	150	475.41	
	180	511.20	
	195	510.82	
	210	525.06	

	225	524.11
	240	525.52
109G(9)	0	
2	.001	300
C	*****	