

Feeding efficiency of growing bulls from the main Italian dual-purpose cattle breeds

Experiment 1: Fiume Veneto (PN)

Experiment 2: Gressan (AO)

Table 1. Ingredients, chemical composition, and nutritive values of the rations fed to the growing bulls.

	Experiment 1	Experiment 2
<i>Ingredient, % of DM</i>		
Ground corn	28.2	32.3
Barley	5.8	-
Wheat bran	5.8	12.9
Soybean meal	1.9	11.3
Sunflower and rapeseed meals	14.6	-
Dried beet pulp	5.8	6.5
Corn silage	27.2	-
Wheat straw	8.7	-
Meadow hay	-	30.6
Mineral and vitamin mix ^{1,2}	1.9	6.5
<i>Chemical composition</i>		
DM (%)	61.75	89.97
NDF (%DM)	37.05	30.84
CP (%DM)	13.45	14.08
Ash (%DM)	6.05	9.19
<i>Nutritive values ³</i>		
UFV (UF/kgDM)	0.96	0.94
PDIE (g/kgDM)	96.98	103.82
PDIN (g/kgDM)	91.07	97.57

DM=dry matter, NDF=neutral detergent fiber, CP=crude protein, UFV=forage unit for maintenance and growth, PDIE=protein digestible in the intestine which can be produced from the available energy, PDIN= protein digestible in the intestine which can be produced from the available N.

¹ Per kg of supplement mix (Fiume Veneto): vitamin A, 100,000 IU; vitamin D₃, 12,000 IU; vitamin E, 450 mg; choline chloride, 1000 mg; FeCO₃, 1076 mg; KI, 39 mg; Ca(IO₃)₂, 21.6 mg; Mn₂O₃, 1161 mg; CuSO₄·5H₂O, 275 mg; ZnO, 620 mg; ZnSO₄, 2055 mg; Na₂SeO₃, 3.1 mg; Sacch. Cerevisiae MUCL 39885, 120 *10⁹ CFU; Sacch. Cerevisiae MUCL 39885, 120 *10⁹ CFU.

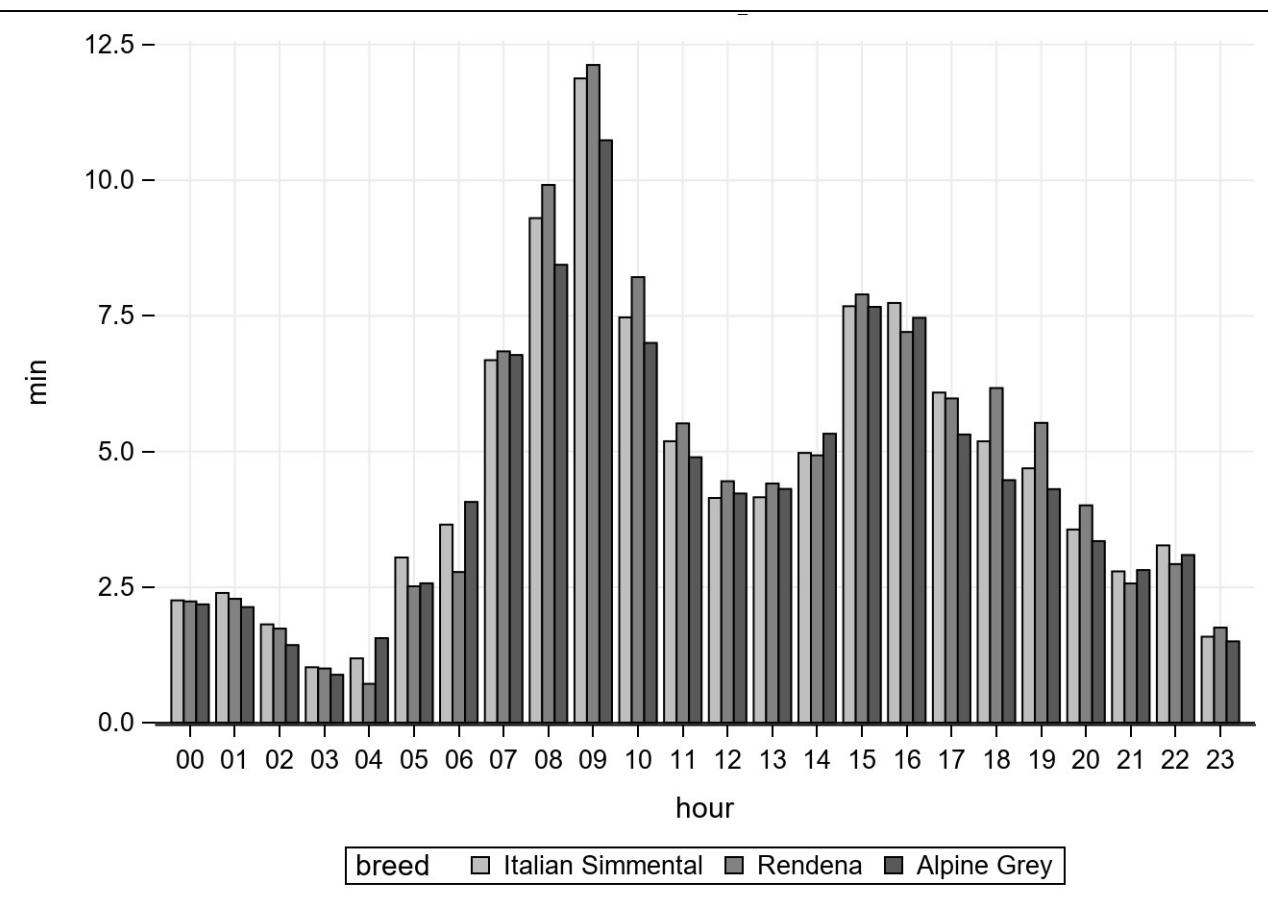
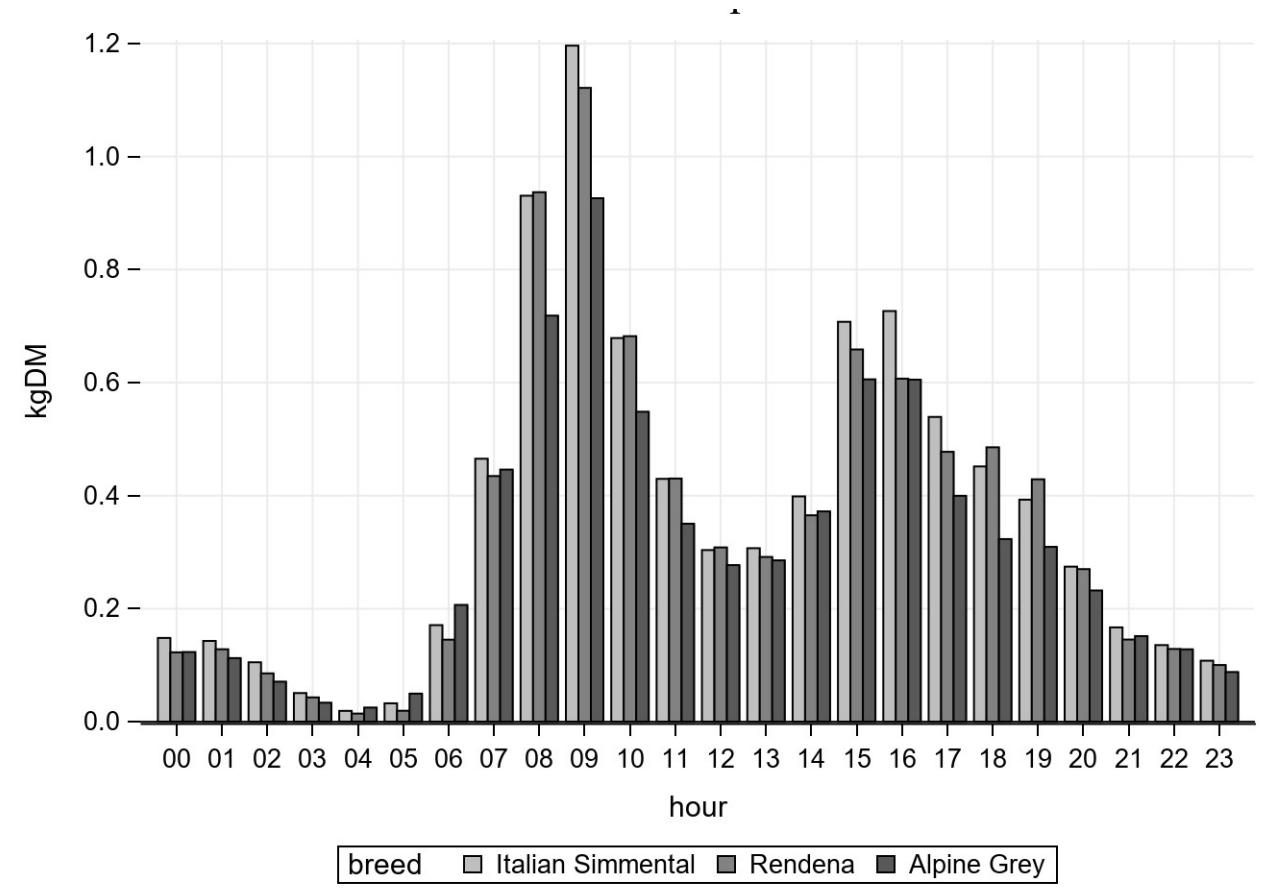
² Per kg of supplement mix (Gressan): vitamin A, 250,000 IU; vitamin D₃, 25,000 IU; vitamin E, 2000 mg; vitamin B1 100 mg; nicotinic acid 10,000 mg; Ca(IO₃)₂, 30.0 mg; Mn₂O₃, 1800 mg; CuSO₄·5H₂O, 600 mg; ZnO, 4350 mg; Selenomethionine 2250 mg, Sacch. Cerevisiae CNCM I-1077 15*10⁹ CFU.

³ Values predicted according to the INRA, 2018

Table 2. Descriptive statistics, performance, feed efficiency, predicted emissions and feeding behavior of growing bulls from Italian dual-purpose breeds in Experiment 1.

	Italian dual-purpose breeds			RMSE
	Italian Simmental	Rendena	Alpine Grey	
n.	495	69	76	-
<i>BW and age</i>				
Initial age (d)	281.1	283.4	281.1	10.57
Initial BW (kg)	369.4 ^A	349.2 ^B	324.1 ^C	42.02
Final age (d)	326.9	328.1	327.2	10.53
Final BW (kg)	456.6 ^A	433.4 ^B	397.4 ^C	44.09
BW ^{0.75} (kg)	91.5 ^A	87.8 ^B	82.7 ^C	7.12
<i>Performance</i>				
ADG (g/d)	1549 ^A	1606 ^A	1317 ^B	231.1
ADG (%BW)	0.38 ^B	0.41 ^A	0.37 ^B	0.052
DMI (kgDM/d)	10.20 ^A	9.57 ^B	8.71 ^C	0.749
DMI (%BW)	2.49	2.47	2.44	0.174
F:G (kgDM/kg)	6.76 ^A	6.16 ^B	6.89 ^A	1.083
RFI (kgDM/d)	0.09 ^A	-0.33 ^B	-0.36 ^B	0.655
<i>Emissions</i>				
CH ₄ (g/d)	220.5 ^A	206.9 ^B	188.3 ^C	16.18
NU (g/d)	98.3 ^A	90.3 ^B	82.1 ^C	8.27
NF (g/d)	59.9 ^A	56.8 ^B	53.5 ^C	3.24
<i>Feeding behavior</i>				
FEn (number/d)	50.24 ^A	44.92 ^B	51.76 ^A	14.579
FT (min/d)	110.44	117.65	112.64	25.209
FEd (min/visit)	2.50	2.92	2.49	1.137
DMI per visit (kgDM/visit)	0.23 ^A	0.23 ^A	0.19 ^B	0.067
FR (gDM/min)	98.23 ^A	86.47 ^B	83.05 ^B	21.742
MEn (number/d)	8.68 ^B	7.71 ^B	11.42 ^A	4.467
MEt (min/d)	6.72	6.71	7.42	4.771
MEd (min/visit)	0.84	0.92	0.74	0.561

BW= body weight, BW^{0.75} = metabolic body weight, ADG= average daily gain, DMI=dry matter intake, F:G= feed to gain ratio, RFI=residual feed intake, CH₄= methane, NU=N urinary, NF= N faecal, FEn = number of feeding events, FT=feeding time, FEd = duration of feeding event, FR=feeding rate, MEn = number of missing events, MEt= time of missing events, MEd=missing event duration



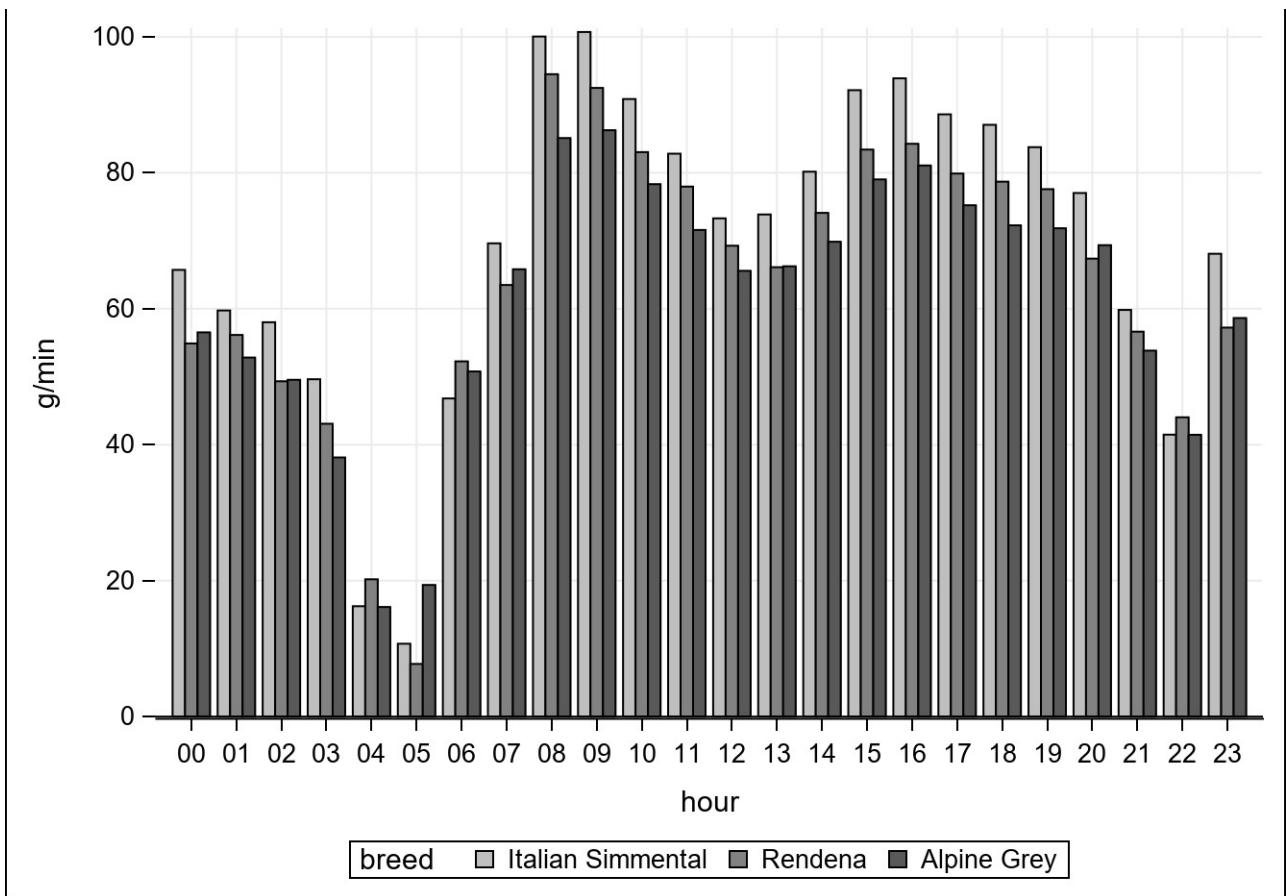


Figure 1. DM intake (a; kgDM/hour), Feeding time (b; min/hour) and Feeding rate (c; gDM/min/hour) of growing bulls from Italian dual-purpose breeds in Exp. 1.

Table 3: Pearson's correlations (*r* values) between performance traits and feeding behavior in Experiment 1.

Traits (unit)	DMI	RFI	F:G	FEn	DMI per visit	FR	FEd	MEn
<i>Performance</i>								
DMI (kgDM/d)								
RFI (kgDM/d)	0.69***							
F:G (kgDM/kg)	0.15***	0.38***						
<i>Feeding behaviour</i>								
FEn (number/d)	0.04	0.22***	0.01					
DMI per visit (kgDM/visit)	0.28***	0.03	0.04	-0.87***				
FR (gDM/min)	0.33***	0.24***	0.25***	0.36***	-0.20***			
FEd (min/visit)	-0.02	-0.14***	-0.13**	-0.77***	0.80***	-0.62***		
MEn (number/d)	-0.19***	0.08	-0.07	0.53***	-0.49***	-0.06	-0.30***	

DMI=dry matter intake, F:G= feed to gain ratio, RFI=residual feed intake, FEn = number of feeding events, FEd = duration of feeding event, FR=feeding rate, MEn = number of missing events.

*P<0.05; **P<0.01; ***P<0.001.

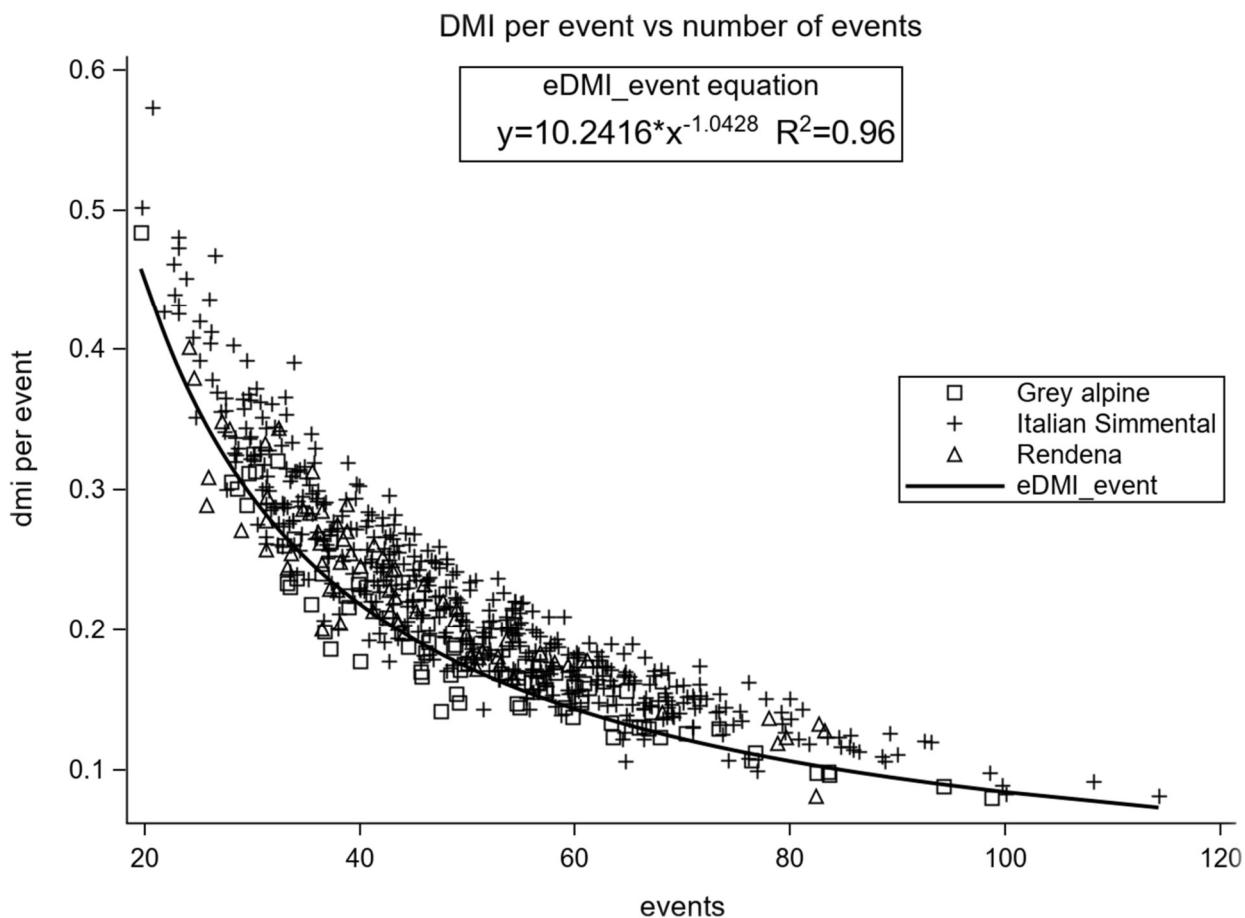


Figure 2. Plot of the daily average DMI per event (y) and the daily average number of events (x) of each bull (i=160) during the RFI period in Exp. 1 and interpolation of the data with a nonlinear model ($Y_i = A \cdot x_i^{-b}$).

Table 4. Descriptive statistics, performance, feed efficiency, predicted emissions and measure of activity of growing bulls from Valdostana strains in Experiment 2.

	Valdostana strain		
	Red Pied	Black Pied and Chestnut	RMSE
n.	151	99	-
<i>BW and age</i>			
Initial age (d)	203.3	205.3	13.23
Initial BW (kg)	179.9	180.7	32.10
Final age (d)	263.5	265.7	13.85
Final BW (kg)	229.3	234.7	40.31
$BW^{0.75}$ (kg)	54.0	54.5	7.05
<i>Performance</i>			
ADG (g/d)	816	887	215.1
ADG (%BW)	0.40 ^B	0.43 ^A	0.095
cDMI (kgDM/d)	4.10 ^B	4.28 ^A	0.300
cDMI (%BW)	2.06 ^B	2.12 ^A	0.187
F:G (kgDM/kg)	6.19	5.47	3.121
RCI (kgDM/d)	-0.01 ^B	0.13 ^A	0.302
<i>Emissions</i>			
CH ₄ (g/d)	88.6 ^B	92.4 ^A	6.47
NU (g/d)	68.0 ^B	70.4 ^A	3.94
NF (g/d)	37.0 ^B	37.9 ^A	1.54
<i>Behaviour</i>			
Activity (min/d)	825.5 ^A	766.4 ^B	126.57

BW= body weight, $BW^{0.75}$ = metabolic body weight, ADG= average daily gain, cDMI= concentrate dry matter intake, F:G= feed to gain ratio, RCI=residual concentrate intake, CH₄= methane, NU=N urinary, NF= N faecal.