

Supplementary material

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Associations between the rumen microbiota and carcass merit and meat quality in beef cattle

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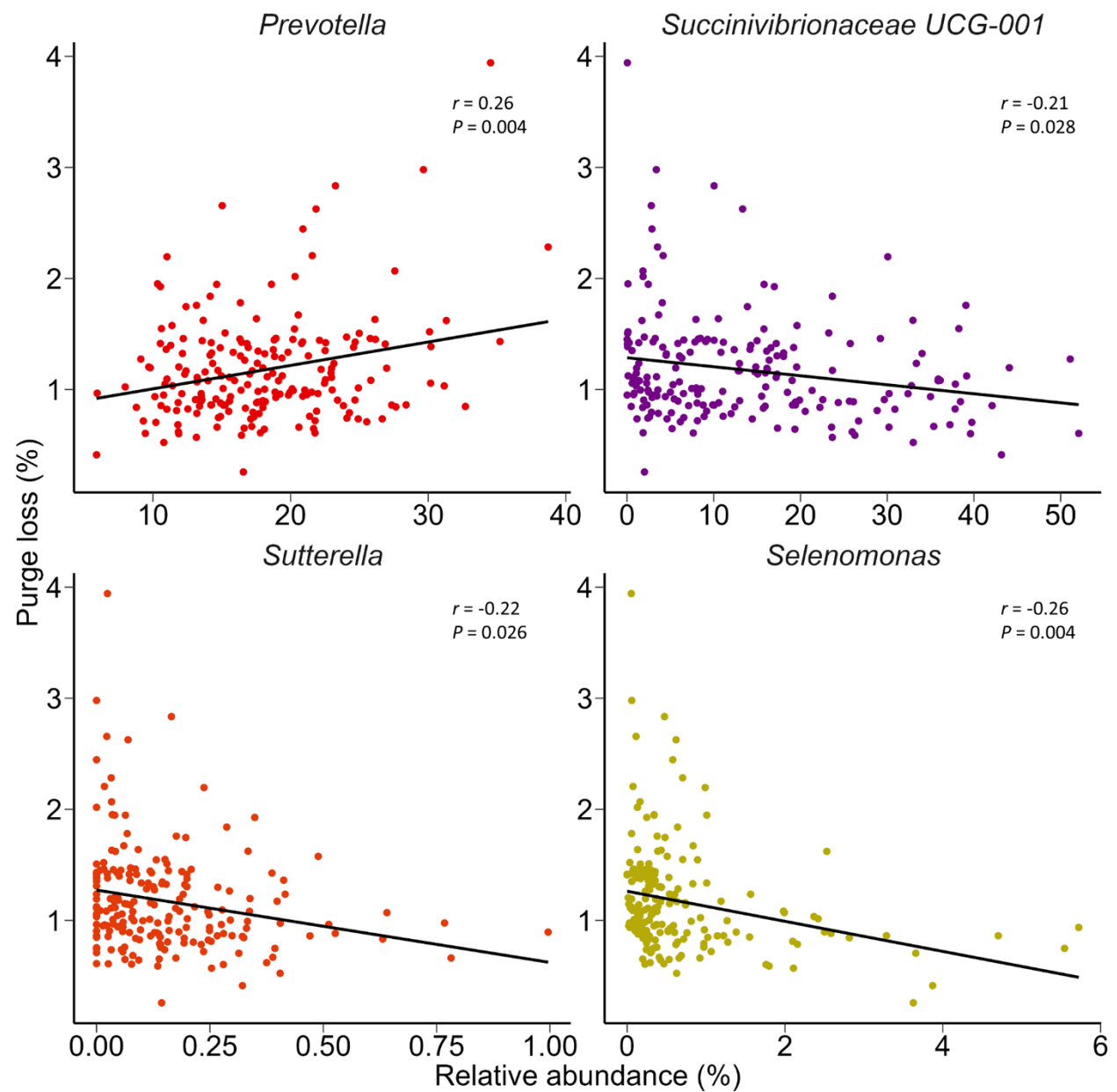
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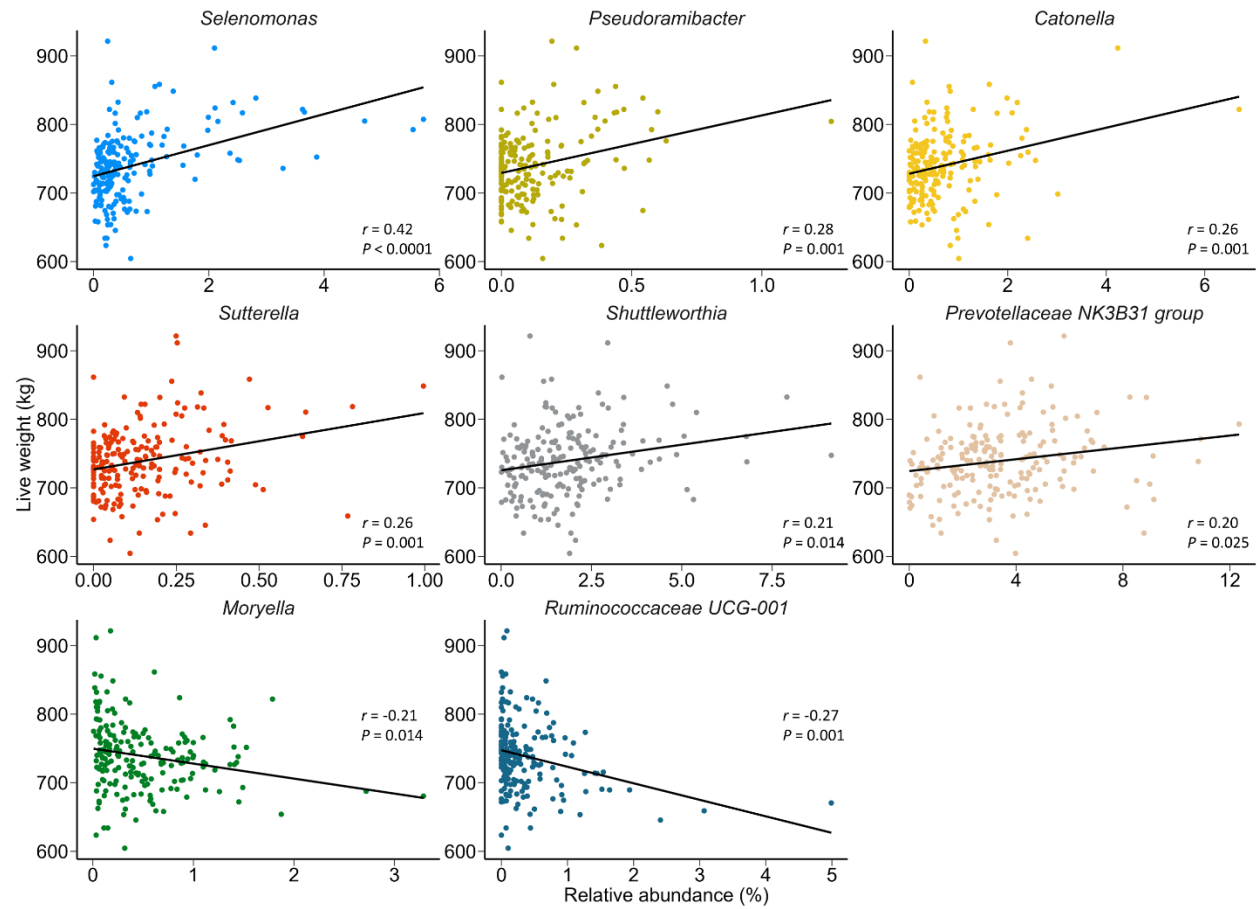
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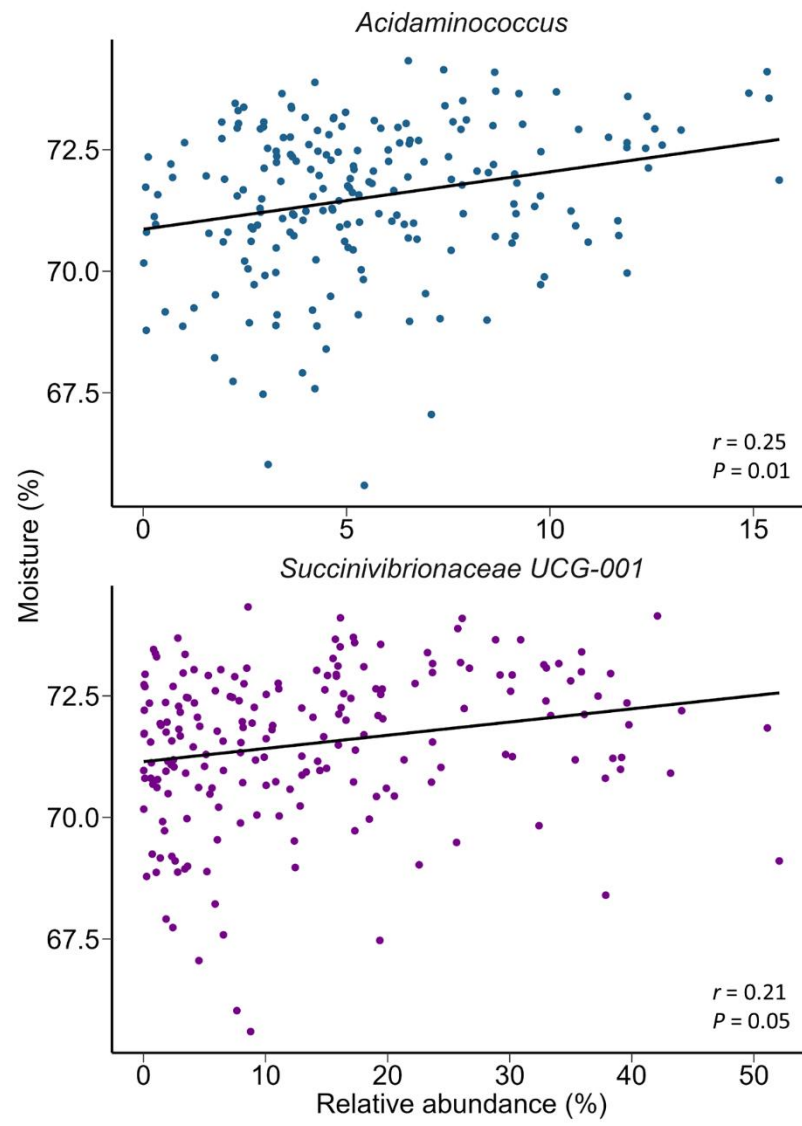
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Supplementary Figure S1. Scatter plot of the percent relative abundance of genera in the rumen vs. meat purge loss.



Supplementary Figure S2. Scatter plot of the percent relative abundance of genera in the rumen vs. the live weight of the cattle prior to slaughter.



Supplementary Figure S3. Scatter plot of the percent relative abundance of genera in the rumen vs. the moisture content of the meat.

Supplementary Table S1. Archaeal and bacteria genera in the rumen microbiota with an overall percent relative abundance of greater than 0.1%.

Genus	Relative abundance (%) $\pm$ SEM
<i>Prevotella</i>	17.98 $\pm$ 0.41
<i>Succinivibrionaceae</i> UCG-001	13.78 $\pm$ 0.87
<i>Succiniclasticum</i>	8.60 $\pm$ 0.52
<i>Acidaminococcus</i>	5.57 $\pm$ 0.24
<i>Lachnospiraceae</i> NK3A20 group	4.44 $\pm$ 0.15
<i>Prevotellaceae</i> NK3B31 group	3.41 $\pm$ 0.16
<i>Methanobrevibacter</i>	3.40 $\pm$ 0.13
[<i>Ruminococcus</i>] <i>gauvreauii</i> group	3.00 $\pm$ 0.12
<i>Acetitomaculum</i>	2.24 $\pm$ 0.18
<i>Succinivibrio</i>	2.09 $\pm$ 0.25
<i>Shuttleworthia</i>	1.83 $\pm$ 0.10
<i>Ruminococcus</i>	1.38 $\pm$ 0.08
<i>Dialister</i>	1.35 $\pm$ 0.08
<i>Oribacterium</i>	1.09 $\pm$ 0.06
<i>Rikenellaceae</i> RC9 gut group	1.01 $\pm$ 0.07
<i>Ruminococcaceae</i> NK4A214 group	0.97 $\pm$ 0.04
<i>Prevotellaceae</i> UCG-001	0.72 $\pm$ 0.07
<i>Christensenellaceae</i> R-7 group	0.67 $\pm$ 0.10
<i>Catonella</i>	0.66 $\pm$ 0.05
<i>Selenomonas</i>	0.65 $\pm$ 0.06
<i>Megasphaera</i>	0.63 $\pm$ 0.08

<i>Olsenella</i>	0.62 ± 0.05
<i>Moryella</i>	0.48 ± 0.03
<i>Syntrophococcus</i>	0.43 ± 0.02
<i>Ruminococcaceae</i> UCG-001	0.34 ± 0.04
[<i>Eubacterium</i>] <i>nodatum</i> group	0.33 ± 0.02
<i>Mogibacterium</i>	0.30 ± 0.01
<i>Mitsuokella</i>	0.29 ± 0.03
<i>Pyramidobacter</i>	0.26 ± 0.02
<i>Agathobacter</i>	0.23 ± 0.02
<i>Treponema</i>	0.23 ± 0.03
<i>Ruminococcaceae</i> UCG-002	0.15 ± 0.01
<i>Sutterella</i>	0.15 ± 0.01
<i>Coproccoccus</i>	0.14 ± 0.01
<i>Pseudoramibacter</i>	0.12 ± 0.01
[<i>Eubacterium</i>] <i>ruminantium</i> group	0.12 ± 0.01
<i>Ruminococcaceae</i> UCG-005	0.11 ± 0.02
<i>Lachnospiraceae</i> XPB1014 group	0.11 ± 0.01

Supplementary Table S2. Correlations between carcass merit/quality attributes and bacterial genera. Only those correlations with a Benjamini-Hochberg corrected *P* value of < 0.10 are included.

Attribute	Correlation coefficient (r)	P-value
Live weight		
<i>Selenomonas</i>	0.4157	0.0000
<i>Pseudoramibacter</i>	0.2756	0.0014
<i>Catonella</i>	0.2618	0.0014
<i>Sutterella</i>	0.2611	0.0014
<i>Shuttleworthia</i>	0.2141	0.0143
<i>Prevotellaceae</i> NK3B31 group	0.1967	0.0249
<i>Mitsuokella</i>	0.1752	0.0479
<i>Succinivibrionaceae</i> UCG-001	0.1738	0.0479
[<i>Ruminococcus</i>] <i>gauvreauii</i> group	-0.1862	0.0350
<i>Moryella</i>	-0.2116	0.0143
<i>Ruminococcaceae</i> UCG-001	-0.2681	0.0014
Hot carcass weight		
<i>Selenomonas</i>	0.3983	0.0000
<i>Pseudoramibacter</i>	0.2690	0.0014
<i>Prevotellaceae</i> NK3B31 group	0.2176	0.0146
<i>Sutterella</i>	0.2176	0.0146
<i>Catonella</i>	0.2071	0.0201
<i>Oribacterium</i>	-0.1794	0.0514
[<i>Ruminococcus</i>] <i>gauvreauii</i> group	-0.1862	0.0441
<i>Ruminococcaceae</i> UCG-001	-0.2974	0.0003
Dressing weight (%)		
<i>Moryella</i>	0.2894	0.0012
<i>Prevotella</i>	0.2274	0.0107
<i>Christensenellaceae</i> R-7 group	0.2244	0.0107
<i>Mitsuokella</i>	-0.1893	0.0345
<i>Ruminococcaceae</i> UCG-001	-0.1940	0.0321
<i>Oribacterium</i>	-0.2067	0.0210
<i>Dialister</i>	-0.2273	0.0107
<i>Succinivibrionaceae</i> UCG-001	-0.2314	0.0107
Marbling		
<i>Acidaminococcus</i>	-0.2122	0.0945
Fat content		
<i>Moryella</i>	0.1955	0.0664
<i>Prevotella</i>	0.1877	0.0664
<i>Christensenellaceae</i> R-7 group	0.1757	0.0685
<i>Coprococcus</i>	0.1681	0.0724
<i>Lachnospiraceae</i> NK3A20 group	0.1680	0.0724

<i>Megasphaera</i>	-0.1575	0.0884
[<i>Ruminococcus</i>] <i>gauvreauii</i> group	-0.1635	0.0773
<i>Oribacterium</i>	-0.1767	0.0685
<i>Dialister</i>	-0.1845	0.0664
<i>Succinivibrionaceae</i> UCG-001	-0.2442	0.0091
<i>Acidaminococcus</i>	-0.2902	0.0011

Yield grade

<i>Prevotella</i>	0.2078	0.0800
<i>Pseudoramibacter</i>	0.2011	0.0800

Moisture (%)

<i>Acidaminococcus</i>	0.2529	0.0117
<i>Succinivibrionaceae</i> UCG-001	0.2122	0.0500

Purge loss

<i>Prevotella</i>	0.2586	0.0040
<i>Succinivibrionaceae</i> UCG-001	-0.2089	0.0277
<i>Sutterella</i>	-0.2159	0.0264
<i>Selenomonas</i>	-0.2589	0.0040

Supplementary Table S3. Carcass merit and meat quality traits of the carcasses with the 50 highest and 50 lowest marbling scores. *P* values are from the Mann–Whitney U test.

Attribute	High marbling	Low marbling	P-value
Live weight (kg)	739.2 ± 8.0	728.2 ± 7.4	0.79
Hot carcass weight (kg)	443.8 ± 5.3	426.0 ± 4.8	0.03
Hot dressing (%)	60.0 ± 0.2	58.5 ± 0.2	9.89E-06
Rib eye area (cm ²)	97.4 ± 1.6	98.9 ± 1.6	0.46
Marbling score	645.8 ± 9.7	406.8 ± 3.7	< 2.2E-16
Intramuscular fat content (%)	7.31 ± 0.26	3.32 ± 0.10	< 2.2e-16
Fat thickness (mm)	20.7 ± 0.9	15.2 ± 0.7	1.07E-05
Yield grade	3.2 ± 0.1	2.5 ± 0.1	1.32E-05
Retail cut yield (%)	48.4 ± 0.3	50.0 ± 0.3	4.13E-05
Moisture content	69.7 ± 0.2	72.8 ± 0.1	< 2.2e-16
Shearing	5.9 ± 0.2	6.24 ± 0.2	0.28
Purge loss	1.16 ± 0.07	1.22 ± 0.07	0.31