Rumen protozoal community structures of Jersey cows are not altered by 20 days of alternative forage consumption

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The objective of this study was to determine if supplementation of legume-based pastures with alternative forage crops would alter rumen volatile fatty acids and protozoal community structures in lactating Jersey cattle.

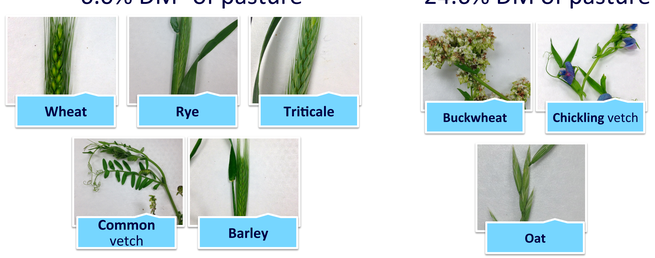
Background

- In the Northeastern United States, early spring and mid-late summer are periods of decreased pasture mass.
- The use of alternative forage crops (AFC) (e.g., small grains and legumes) is one potential solution to overcome this challenge.
- Rumen protozoa are anaerobic ciliates that ferment feedstuffs in concert with bacteria and fungi.
- *Diplodinium* spp. ingest starch granules, plant fragments, and prey on bacteria and other protozoa and could play an important role in AFC-fed animals.

Methods

- 16 Jersey dairy cows (8 cows grazing AFC, 8 control cows grazing mixed grasses/legumes) were co-housed at the University of New Hampshire Organic Research Farm.
- The diet comprised of a total mixed ration and pasture (60:40).
- The study consisted of two 21-d periods conducted in Spring (May 2015) and Summer (July 2015) when cows were grazing AFC or control pastures.
- Milk (4x) and rumen digesta samples (1x) were collected between days 19-21.
- The V3-V4 region of 18S rRNA gene was amplified and Illumina MiSeq (v.3) generated sequence reads.
- Volatile fatty acids (VFA) were analyzed via gas-liquid chromatography.

Figure 1: Alternative forage crops tested at each period.



[1]DM, dry matter

Results

Table 1: Composition of rumen VFA from lactating Jersey cows.

- Percentages of acetate, propionate, and butyrate did not vary in spring or summer periods.
- Cows consuming AFC had less ruminal isobutyrate than those on control pasture (*P*<0.01) (Table 1).

VFA (% of total)	Spring			Summer		
	Control	Treatment	SEM	Control	Treatment	SEM
Acetate	70.20	69.56	0.54	71.21	72.04	0.65
Propionate	16.21	16.49	0.35	15.62	15.57	0.36
Butyrate	11.10	11.29	0.30	10.96	10.43	0.23
Isobutyrate	0.99	0.96	0.05	0.98	0.80	0.03
Valerate	0.92	1.06	0.10	0.67	0.63	0.10
Isovalerate	0.57	0.66	0.86	0.56	0.54	0.12
Total VFA (mM)	70.38	78.20	4.27	71.91	78.20	5.19

Figure 2: Percent abundance of 18S rRNA gene sequence reads classified to rumen protozoal taxa during the spring and summer experimental periods in lactating Jersey cows.

- Abundance of protozoal taxa did not differ between treatment and control groups during spring and summer experiments (Figure 2).
- The genus *Entodinium* was more abundant in the summer period.

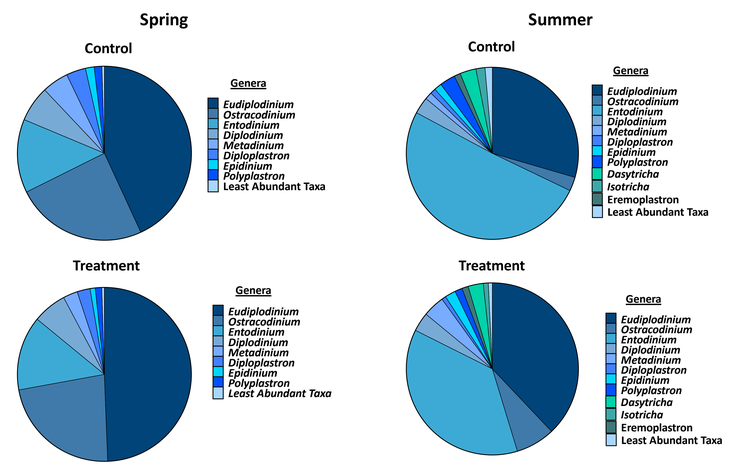
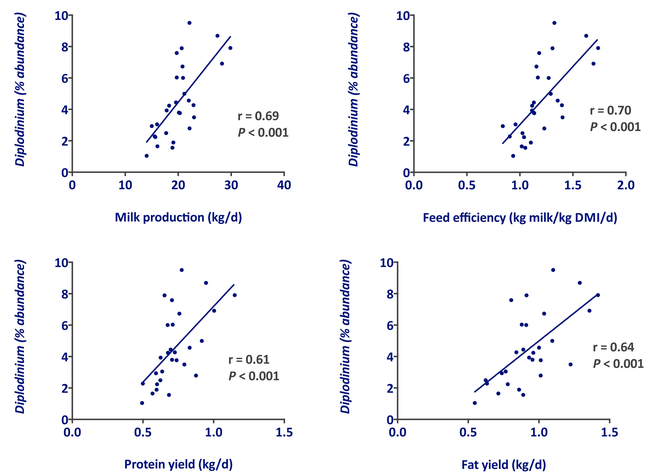


Figure 3: Pearson correlations between the protozoal genus *Diplodinium* and animal performance.

- The genus *Diplodinium* correlated with milk fat and protein yields, feed efficiency, and milk production (*P*<0.001) (Figure 3).
- The genus *Entodinium* was negatively correlated with milk production (r= -0.48, *P*<0.01).



Conclusion

- Abundances of major VFA and protozoal taxa were not altered by the addition of AFC.
- Protozoal taxa correlated with animal performance.
- The protozoal genera, *Eudiplodinium* and *Entodinium* were more abundant in SPR and SUM, respectively.

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