Rumen fluid metabolites influenced by endophyte-infected tall fescue seed and red clover isoflavones in beef steers

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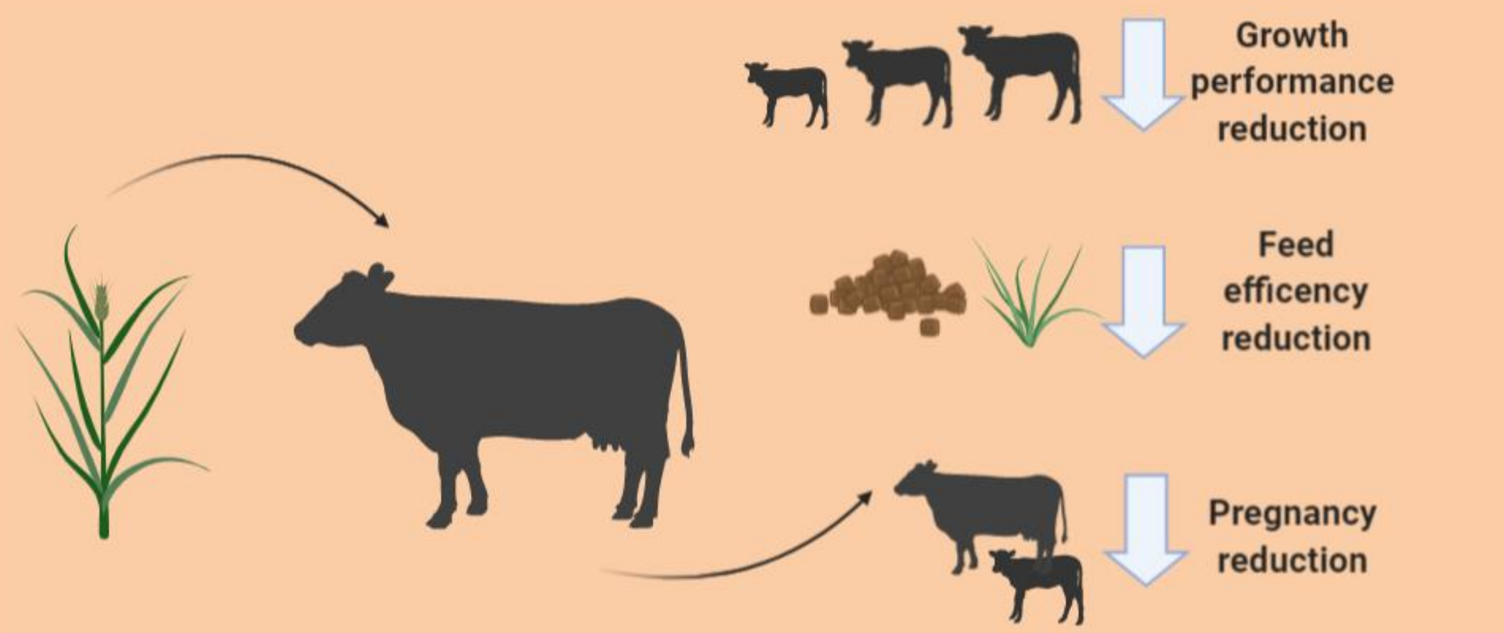
Introduction

- Substantial financial losses to the beef industry due to the negative effects of fescue toxicosis



- Reproduction, growth, and feed efficiency are severely affected[1]
- Researches have demonstrated that the negative effects of fescue toxicosis may be mitigated by supplementation of red clover isoflavones[2]

Methodology

<u>Animals:</u>

- 36 Angus steers weighing 250±20 kg[3]

<u>Treatments:</u>

- 21-day trial feeding isoflavones (943 mg) daily via bolus per animal
- Diet supplemented with or without fescue seed (0.011 mg×kg of body weight^{-1}×d^{-1})[4]
- Blocked on DRD2 genotype and treatments assigned in a 2 x 2 factorial arrangement
  - Two types of fescue seed (E+ or E-) and
  - Isoflavone treatment (Promensil or none)

<u>Sample Collection and Analysis:</u>

- Rumen content collected on final day of 21-day trial
- Rumen metabolites analyzed on UHPLC-MS
- Statistical analysis by MIXED procedure in SAS 9.4

Results

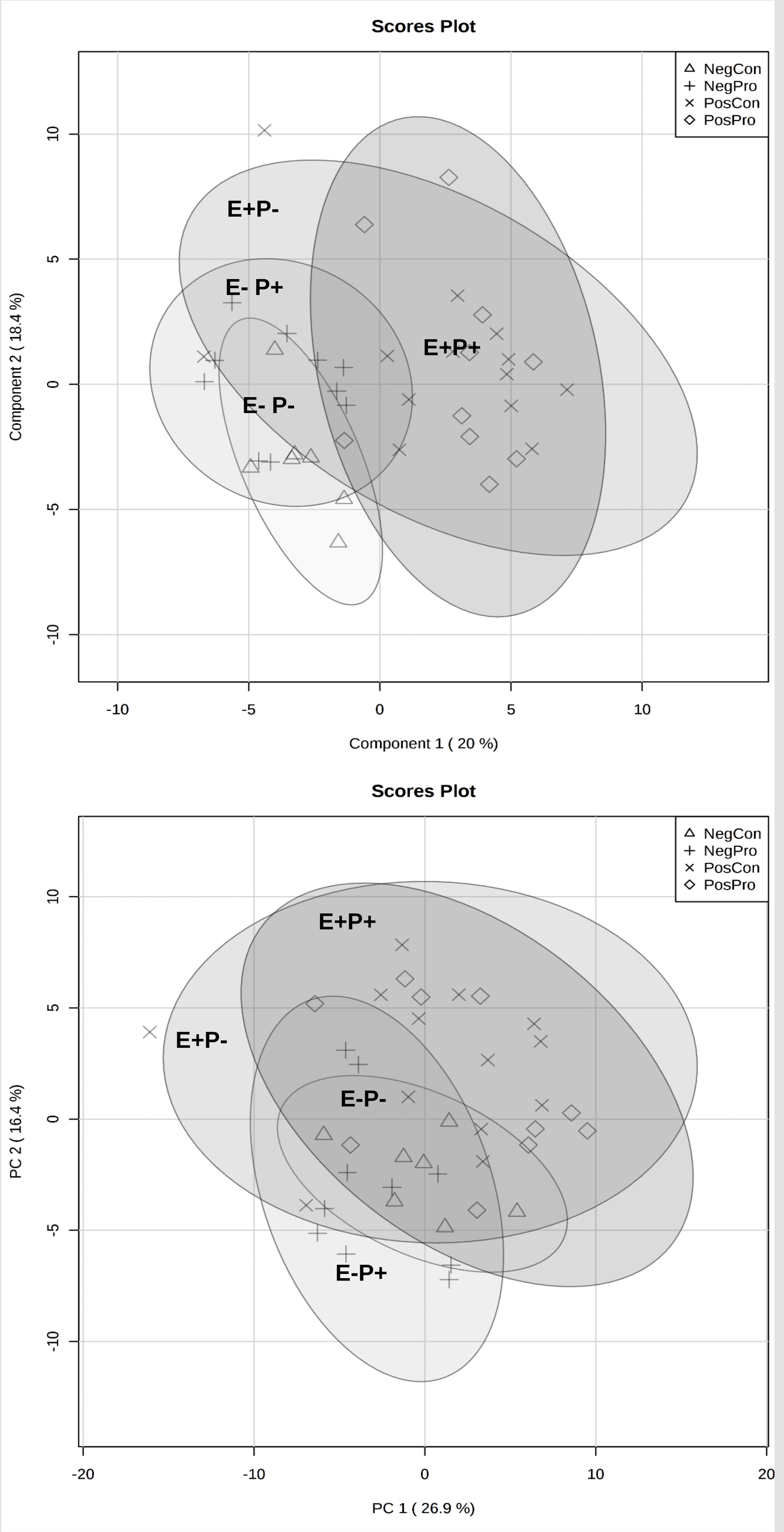


Figure 1. Principal components analysis of the rumen fluid metabolome by all treatment combinations

▲	endophyte-free w/o red clover isoflavone
+	endophyte-free w/ red clover isoflavones
x	endophyte-infected w/o red clover isoflavones
◆	endophyte-infected w/ red clover isoflavones.

Table 1. Rumen fluid metabolites that significantly differed by seed type

Metabolite	Seed Type		*P* Value
	E+	E-	
Dihydroxybenzoate	$5.90×10^7 ± 5.35×10^6$	$8.43×10^7 ± 6.26×10^6$	0.05
Adenine	$2.30×10^7 ± 1.13×10^7$	$6.84×10^7 ± 1.32×10^7$	0.02
CMP	$9.17×10^5 ± 7.64×10^5$	$3.17×10^6 ± 8.95×10^5$	0.04
Deoxyuridine	$8.04×10^5 ± 2.71×10^5$	$1.74×10^6 ± 3.18×10^5$	0.02
Glutamate	$7.18×10^7 ± 2.17×10^7$	$1.57×10^8 ± 2.54×10^7$	0.05
Guanosine	$3.00×10^5 ± 1.44×10^5$	$8.63×10^5 ± 1.69×10^5$	0.05
Homoserine/threonine	$1.02×10^7 ± 8.90×10^5$	$6.65×10^6 ± 7.60×10^5$	0.05
Hypoxanthine	$4.40×10^7 ± 1.66×10^7$	$1.17×10^8 ± 1.94×10^7$	0.01
Uracil	$5.76×10^7 ± 1.19×10^7$	$1.08×10^8 ± 1.39×10^7$	0.02
Xanthine	$1.79×10^8 ± 4.34×10^7$	$3.48×10^8 ± 5.09×10^7$	0.01
Xylose	$3.63×10^6 ± 1.05×10^6$	$8.69×10^6 ± 1.23×10^6$	0.01

Table 2. Rumen fluid metabolic pathways impacted by seed type

Pathway Name	FDR
Purine metabolism	$7.16 × 10^{-4}$
beta-Alanine metabolism	$7.16 × 10^{-4}$
Pentose and glucuronate interconversions	$7.16 × 10^{-4}$
Ubiquinone and other terpenoid-quinone biosynthesis	$7.48 × 10^{-4}$
Pyrimidine metabolism	$7.48 × 10^{-4}$
Phenylalanine, tyrosine and tryptophan biosynthesis	$7.48 × 10^{-4}$
Aminoacyl-tRNA biosynthesis	$8.04 × 10^{-4}$
Phenylalanine metabolism	$8.04 × 10^{-4}$
Arginine and proline metabolism	$1.33 × 10^{-3}$
Porphyrin and chlorophyll metabolism	$1.36 × 10^{-3}$
Pentose phosphate pathway	$3.57 × 10^{-3}$
Glutathione metabolism	$3.57 × 10^{-3}$
Pantothenate and CoA biosynthesis	$3.89 × 10^{-3}$
Nitrogen metabolism	$4.74 × 10^{-3}$
Histidine metabolism	$4.80 × 10^{-3}$
Alanine, aspartate and glutamate metabolism	0.01
Arginine biosynthesis	0.01
Butanoate metabolism	0.01
Tyrosine metabolism	0.01
Glyoxylate and dicarboxylate metabolism	0.02
D-Glutamine and D-glutamate metabolism	0.03
Glycine, serine and threonine metabolism	0.04

Conclusions

- Rumen metabolome appears to be more affected by seed type
- A total of 11 rumen metabolites were affected by seed type
- Rumen metabolites are not affected for the interaction of isoflavone × fescue seed type
- Rumen metabolic pathways were not affected by isoflavones treatment

Acknowledgments

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