

# Effect of endophyte-infected tall fescue seed and red clover isoflavones on the serum metabolites in beef steers

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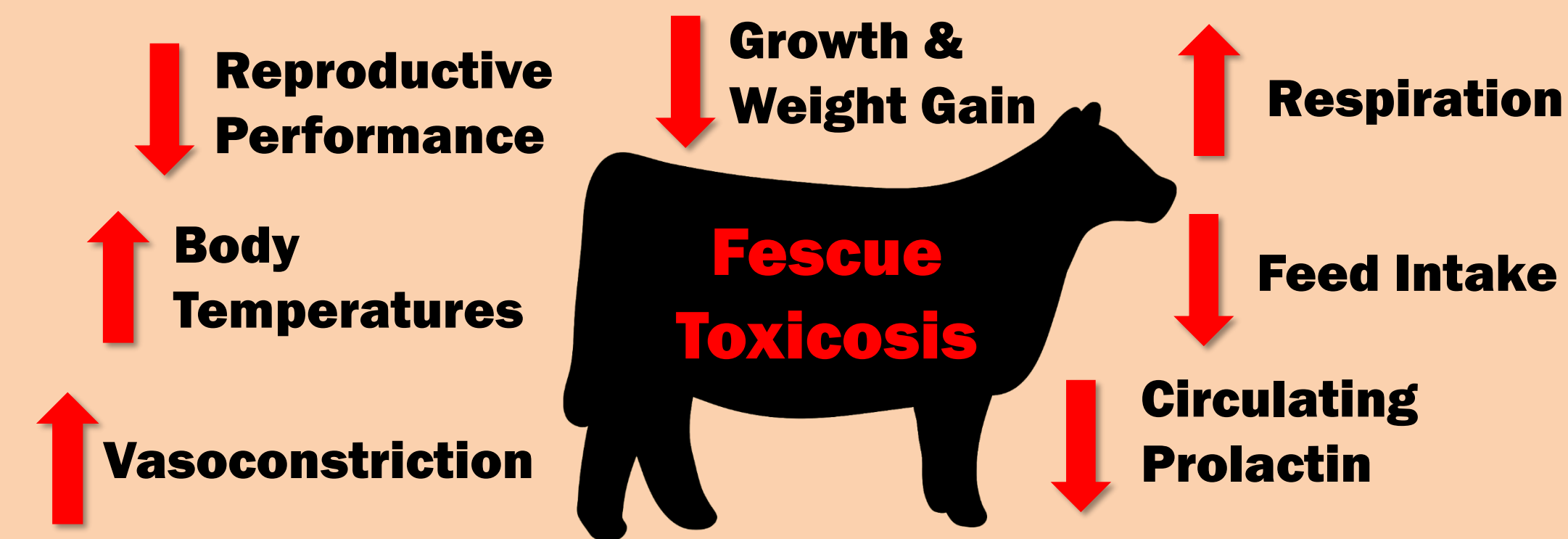
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## Introduction

- Fescue toxicosis costs the beef industry ~\$2 billion dollars annually due to the collection of systemic symptoms reducing overall animal performance<sup>1,2</sup>



- Consumption of isoflavones with endophyte-infected fescue may reduce the effects of fescue toxicosis by promoting vasodilation<sup>3</sup> and improving rumen fermentation<sup>4,5</sup>
- Circulating metabolites may provide insight into altered metabolic functions improving performance on endophyte infected tall fescue with administration of isoflavones

## Materials and Methods

**Animals:** 36 Angus steers

**Treatments:** 2 x 2 factorial arrangement

**Feed trial:**

- 21 day trial basal diet
- Total alkaloids targeted at minimum of 0.011 mg×kg of body weight<sup>-1</sup>×d<sup>-1</sup>
- 943 mg of isoflavones administered daily via bolus

**Sample Collection and Analysis:**

- Blood samples collected on day 21 for metabolite extraction from serum
- Metabolites analyzed by UHPLC-MS then Metabolomic Analysis & Visualization Engine program to identify metabolites
- Resulting metabolite data analyzed in MetaboAnalyst 4.0 and SAS 9.4

TRT		Seed Type	
		E-	E+
Isoflavone	P-	E- P-	E+ P-
	P+	E- P+	E+ P+

## Results

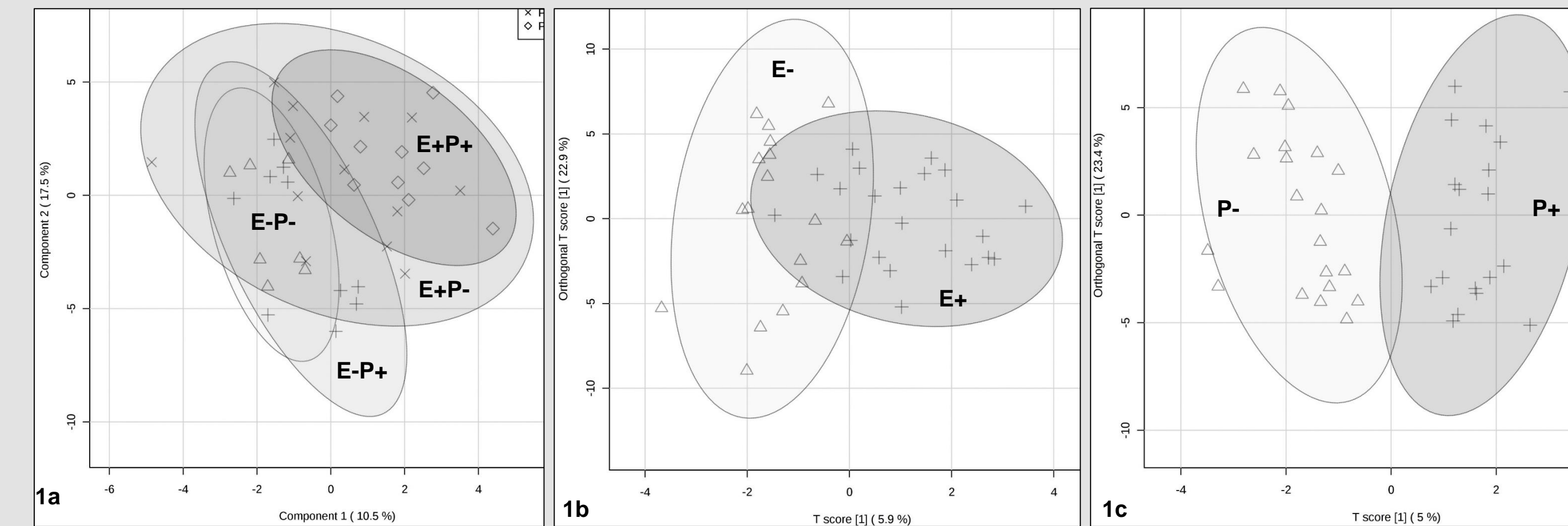


Figure 1. Orthogonal partial least squares discriminant analysis depicting global differences in serum metabolomes between seed type x isoflavone (a), seed type (b), and isoflavone (c) treatment groups.

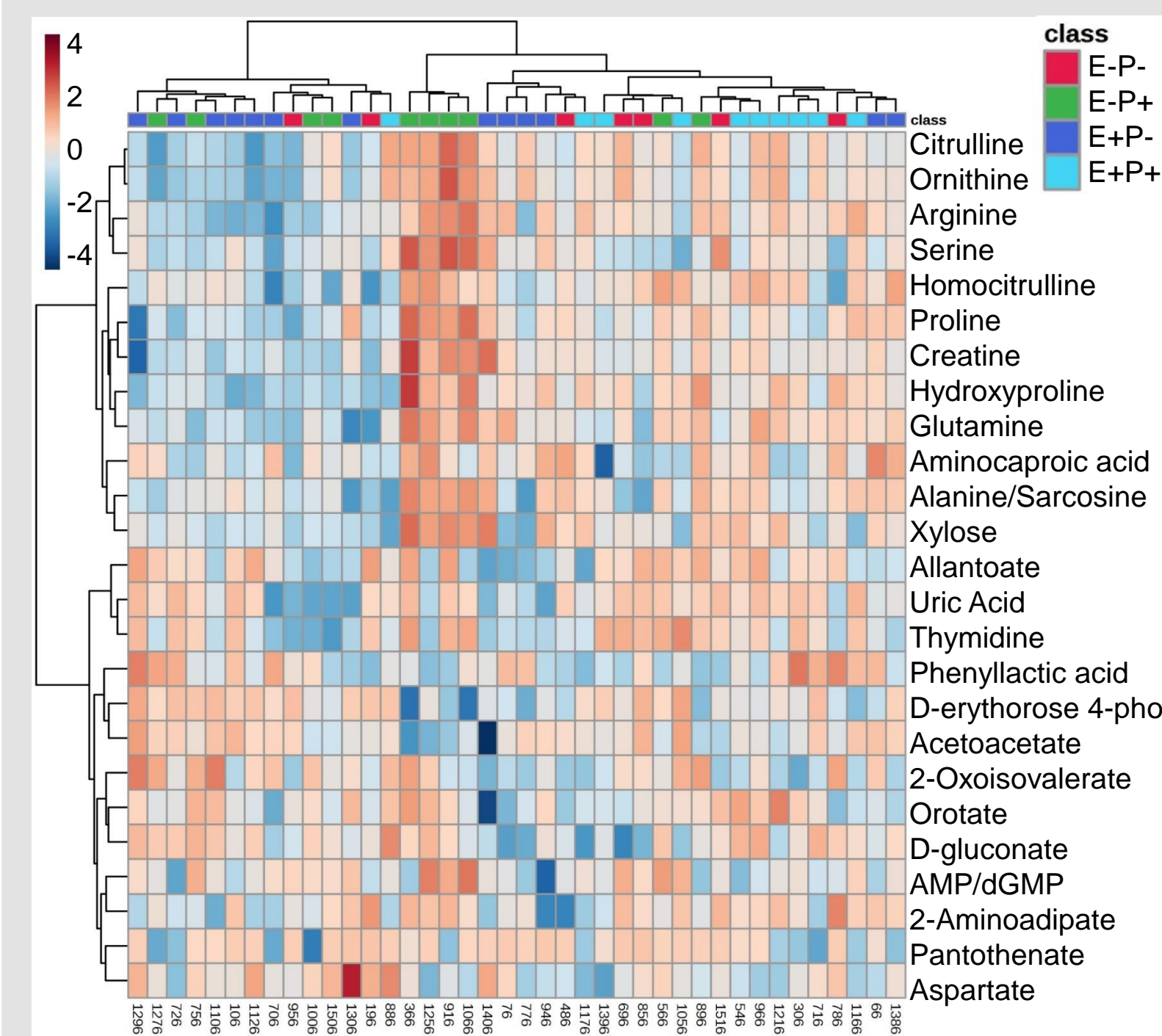


Figure 2. Heat map of the top 25 metabolites present in serum of steers indicated clustering by treatment groups.

Table 2. Mean ± SEM of metabolites differing in the serum of steers in response to isoflavone treatments based on rank data. No individual metabolites differed due to seed type or seed type x isoflavone ( $P > 0.05$ ). Significance based on FDR corrected  $P$  values.

Seed Type			
Pathway	FDR	Impact	$P$ Value
Glyoxylate and Dicarboxylate Metabolism	0.013	0.11	0.005
Arginine Biosynthesis	0.013	0.51	0.006
Alanine, Aspartate, and Glutamate Metabolism	0.015	0.73	0.007
Isoflavone Treatment			
Pathway	FDR	Impact	$P$ Value
Pyrimidine Metabolism	0.151	0.37	0.007
Arginine and Proline Metabolism	0.151	0.19	0.008

Table 1. Metabolic pathways affected by seed type or isoflavone treatment ( $P < 0.01$ ). Seed type affected 13 total pathways and isoflavones affected 8 total pathways ( $P < 0.05$ ).

Metabolite	Isoflavone Treatment		$P$ Value
	P+	P-	
Histidine	$8.50 \times 10^6 \pm 8.94 \times 10^5$	$1.05 \times 10^7 \pm 9.37 \times 10^5$	0.05
Cytidine	$1.51 \times 10^6 \pm 4.89 \times 10^5$	$2.67 \times 10^7 \pm 5.12 \times 10^5$	0.01
Pantothenate	$6.64 \times 10^6 \pm 1.84 \times 10^6$	$1.51 \times 10^7 \pm 1.93 \times 10^6$	0.01
Homocysteine	$1.47 \times 10^6 \pm 1.28 \times 10^5$	$2.02 \times 10^6 \pm 1.35 \times 10^5$	0.02
Allantoin	$1.94 \times 10^8 \pm 1.14 \times 10^7$	$2.37 \times 10^8 \pm 1.19 \times 10^7$	0.03
GABA	$9.68 \times 10^5 \pm 1.40 \times 10^5$	$1.41 \times 10^6 \pm 1.44 \times 10^5$	0.05
Methylhistidine	$8.35 \times 10^5 \pm 6.25 \times 10^4$	$1.04 \times 10^6 \pm 6.51 \times 10^4$	0.05

## Conclusions

- Isoflavone treatment was associated with differences in global serum metabolites and individual metabolite abundances
- Abundances of the top 25 metabolites differed among treatment groups
- Multiple amino acid biosynthesis and metabolic pathways were affected by seed type and isoflavone treatment
- Metabolism alterations by isoflavone supplementation that may improve animal performance during fescue toxicosis

## Acknowledgments

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