Grazing toxic endophyte-infected tall fescue does not influence pancreatic or small intestinal digestive enzyme activities in beef steers

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Introduction

- Pancreatic and small intestinal digestive enzymes are responsive to changes in nutrient intake and tissue mass. (Kreikemeier et al., 1990; Swanson et al., 2002)
- Grazing toxic endophyte-infected tall fescue containing ergot alkaloids can lead to reductions in forage intake and body weight gain. (Strickland et al., 2011)
- Recent research in sheep has found that fetal pancreatic mass is decreased with maternal dietary intake of toxic endophyte-infected tall fescue during mid- to late-gestation. (Greene et al., 2019)
- Therefore, it could be possible that grazing toxic endophyte-infected tall fescue influences pancreatic digestive enzymes because of changes in tissue mass and dietary intake.
- Moreover, it is unknown if deficiencies in post-ruminal digestive enzymes could contribute to reduced gains among cattle grazing toxic endophyte-infected tall fescue.

Objectives

- The objective of this experiment was to determine the influence of toxic endophyte-infected tall fescue exposure on pancreatic and small intestinal digestive enzyme activities in beef steers.

Materials and Methods

Experimental design

- Twelve fescue-naïve beef steers [693 + 42.7 kg of body weight (BW)] were stratified by BW and randomly assigned within BW ranks to graze:
  1. Non-toxic endophyte-infected tall fescue (**NTE**, n = 6, 0.01 ± 0.009 mg ergovaline + ergovalinine/kg)
  2. Toxic endophyte-infected tall fescue (**TE**, n = 6, 0.50 ± 0.048 mg ergovaline + ergovalinine/kg)
- Steers grazed pastures for 84 d and were slaughtered in three groups for tissue collection.

Sample collection and analyses

- A 1-m segment of the small intestine was collected 5-m distal to the pyloric sphincter.
- Subsamples of the small intestinal mucosa and pancreas were collected, homogenized in saline, and assayed for protein concentration.
- Pancreatic (α-amylase and trypsin) and small intestinal (maltase, isomaltase, glucoamylase) digestive enzyme activities were assayed.
- One unit (U) of pancreatic digestive enzyme activity equals 1 µmol of p-nitrophenol for amylase or 1 µmol of p-nitroanilide produced per min.
- One unit (U) of small intestinal carbohydrase activity equals 1 µmol of glucose produced per min for glucoamylase and 0.5 µmol of glucose produced per min for maltase and isomaltase.
- Data are expressed as U/g tissue or U/g protein.
- Data were analyzed using the GLM procedure of SAS as a randomized complete block design for effects of treatment and slaughter group (blocking factor).

Table 1. Pancreatic and small intestinal digestive enzyme activities in jejunal mucosa of beef steers grazing toxic endophyte-infected (TE) or non-toxic endophyte-infected (NTE) tall fescue for 84 d.

	Treatment			
Item	NTE	TE	SEM[a]	*P*-value
BW at slaughter, kg	739	620	13.6	<0.001
Average daily gain, kg/d				
Pre-shrunk	0.750	-0.0317	0.152	0.006
Post-shrunk	0.282	-0.631	0.126	<0.001
Mucosal density, %	48.6	53.4	2.24	0.16
Jejunal intestinal protein, mg/g	111	117	4.43	0.36
Pancreatic protein, mg/g	159	148	6.17	0.22
α-Amylase				
U/g pancreas	302	240	32.3	0.21
U/g protein	1911	1603	199	0.30
Trypsin				
U/g pancreas	5.63	5.68	0.971	0.97
U/g protein	35.0	38.8	5.93	0.66
Glucoamylase				
U/g intestine	0.658	0.649	0.106	0.95
U/g protein	6.18	5.63	1.21	0.76
Isomaltase				
U/g intestine	0.407	0.557	0.141	0.47
U/g protein	3.82	4.94	1.45	0.60
Maltase				
U/g intestine	1.06	1.31	0.266	0.52
U/g protein	9.74	11.6	2.78	0.66

[a]Standard error of the mean (n = 6).

Results

- Steers grazing NTE pastures had a greater ($P < 0.001$) average daily gain (0.282 vs -0.631 kg/d) and final BW at slaughter (739 vs 620 kg) than steers grazing TE pastures.
- Small intestinal segment mass and mucosal density ($P \geq 0.16$) were not influenced by treatment.
- Grazing TE pasture did not influence ($P \geq 0.21$) pancreatic or small intestinal protein concentrations.
- Pancreatic α-amylase and trypsin activity per gram pancreas ($P \geq 0.21$) or per gram pancreatic protein ($P \geq 0.30$) were not influenced by fescue treatment.
- Small intestinal glucoamylase, isomaltase, and maltase activities did not differ between steers grazing NTE or TE pastures when expressed per gram of intestinal tissue ($P \geq 0.47$) or per gram of intestinal protein ($P \geq 0.60$).

Conclusions

- These data indicate that decreased gains observed in cattle consuming TE are not a result of decreased pancreatic or small intestinal digestive enzyme activities.
- More research is needed to understand how maternal exposure to TE influences offspring pancreatic and small intestinal mass and digestive enzyme activity.

Literature Cited

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