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Willow (Salix spp) tannin-rich tree fodder: The potential to reduce methane and improve productivity of grazing beef cattle

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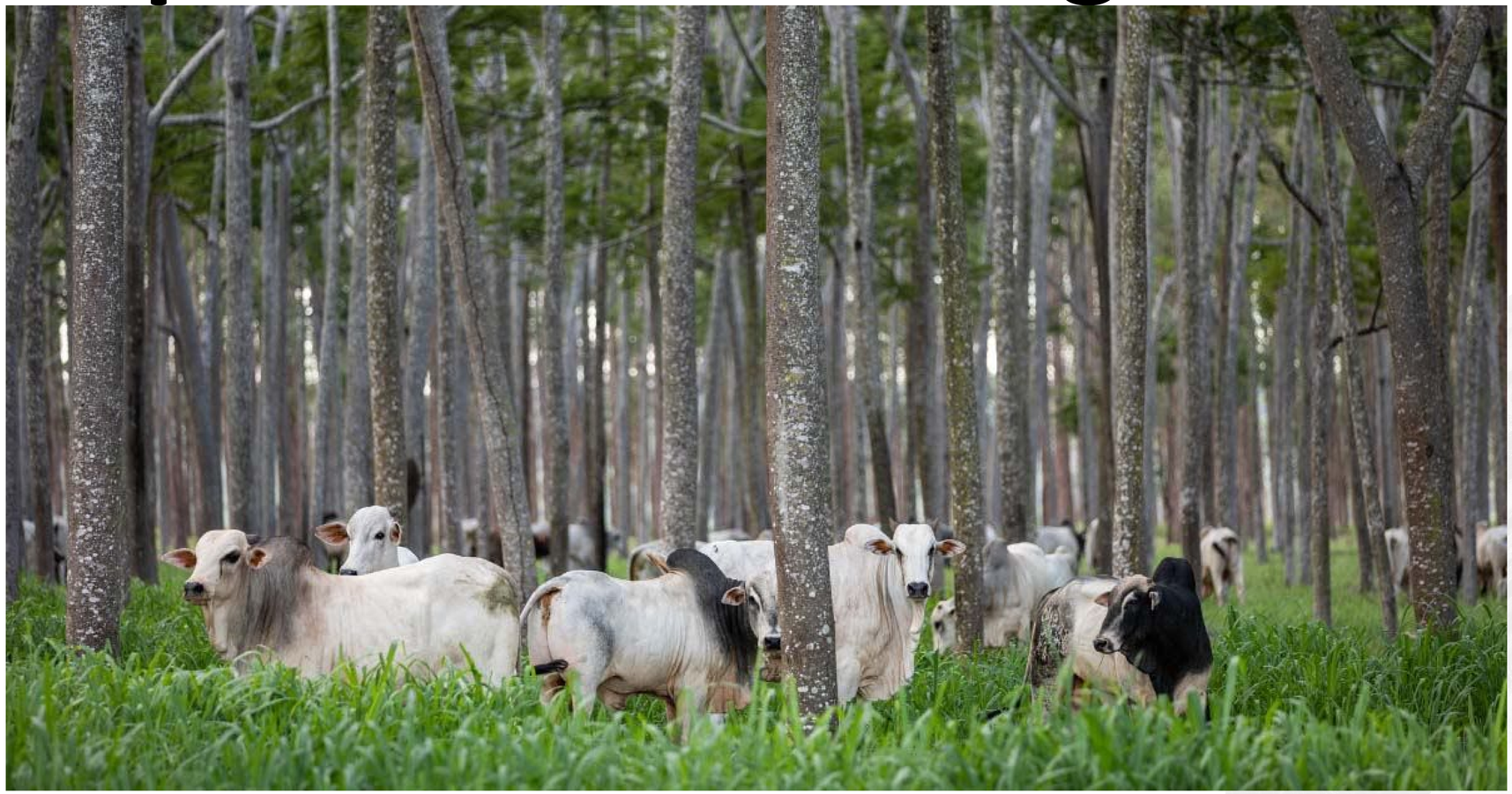
Silvopasture – Growing Interest?



Willow

Salix (spp)

Contains

Condensed Tannins

Willow (Salix spp) – Potential for Ruminant Nutrition?

Feeding Value
- Increased nitrogen use (reduced rumen proteolysis

Environmental Impact
- Decreased emission CH_4, NH_3
- Biodiversity

Condensed tannins in Willow

Product Quality
- Increased PUFA content
- Increased antioxidants

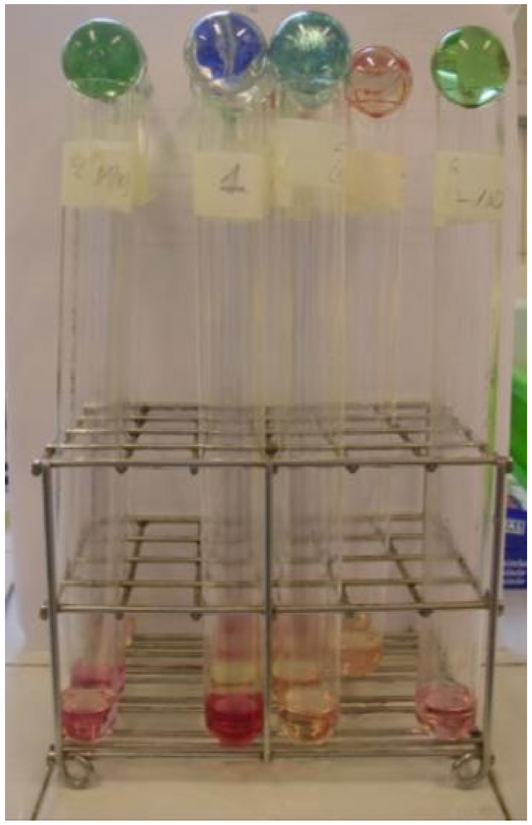
Animal Health
Decreased risk:
- Acidosis, Bloat, Parasitism

Objectives

- Explore if beef cattle would graze Willow Fodder in a grazing system
- Quantify the effect of Willow Fodder on performance and methane emissions
- Explore the impact of Willow Fodder on Faecal Metabolome

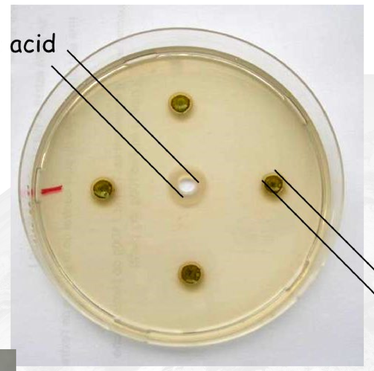
Materials & Methods

HCl-BUTANOL (Colorimetric assay)



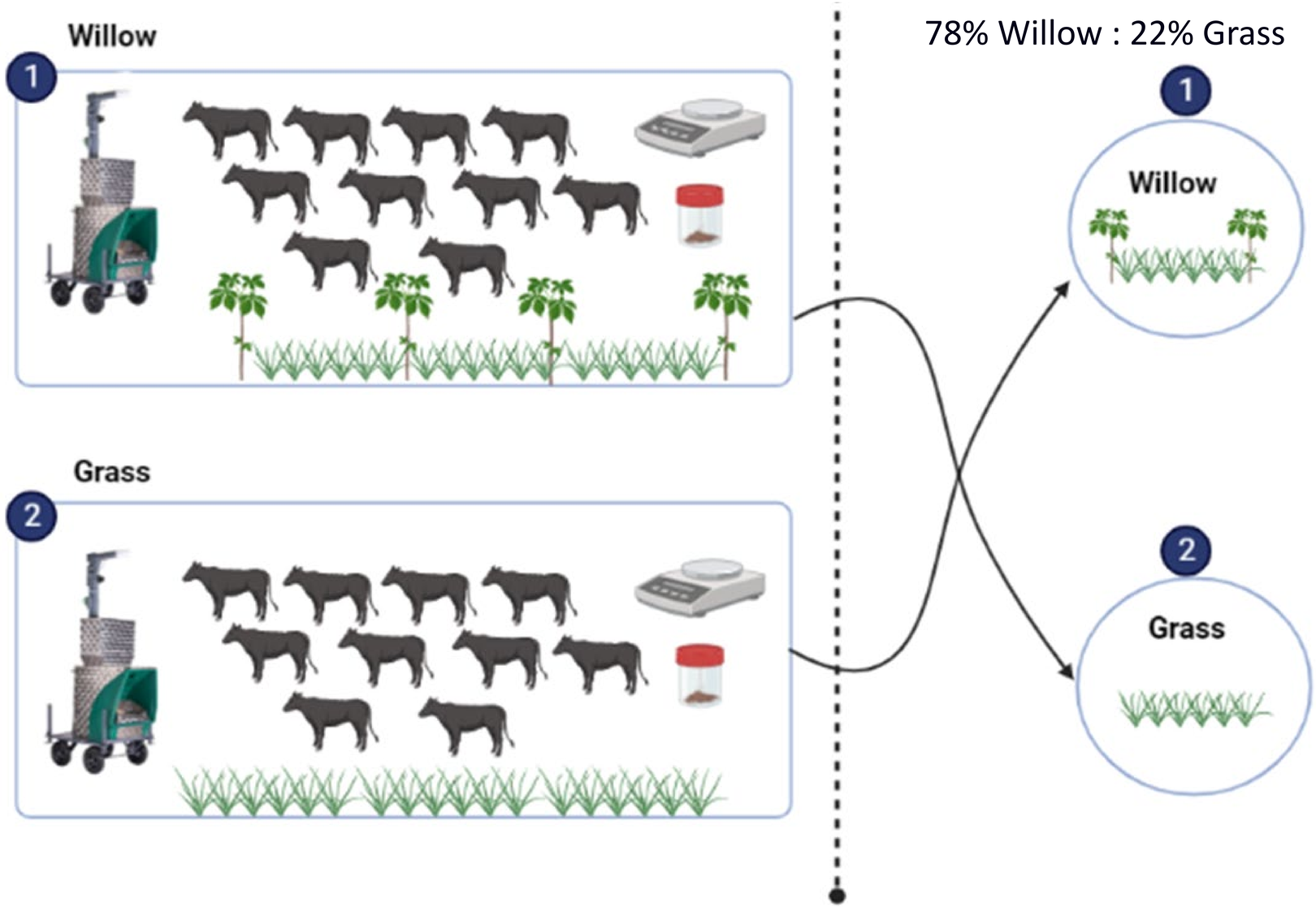
Structural Analysis (NMR Bruker)

Radial Diffusion Assay (Makkar et al. 2000)



Animal Trial

- Twenty growing beef steers were blocked into 2 subgroups (2x10)
- 2 (treatment) x 2 (period) Latin square design study.
- Gaseous exchange measured using GreenFeed
- Liveweight measured using water weigh scale
- Faeces Spot sampling and frozen
- Forage samples collected for analysis



Harvested February 2022

11th April 2022

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29th April 2022

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7th June 2022

Results

GRASS (perennial rye grass)

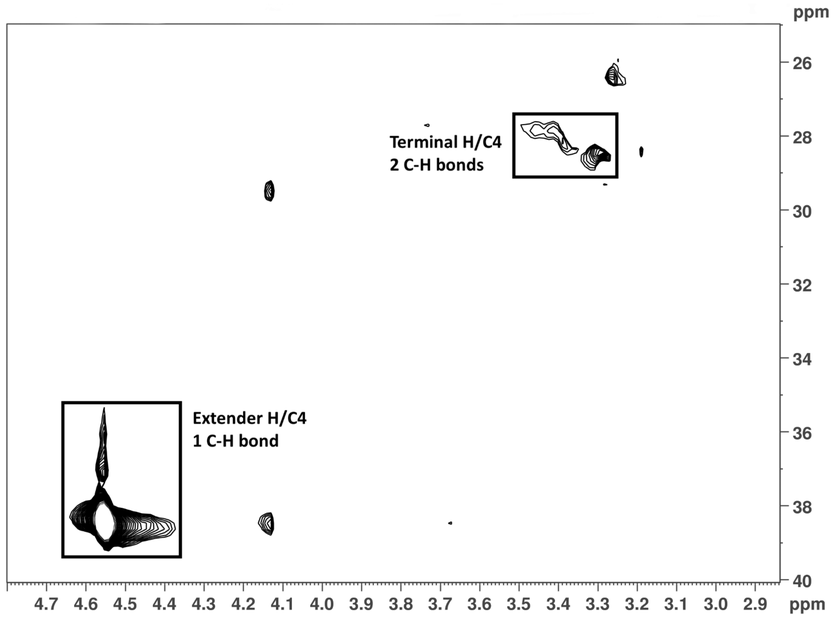
WILLOW (willow fodder grass mix)

P<0.001

GRASS (perennial rye grass)		WILLOW (willow fodder grass mix)	
24.0	DM (%)	27.0	↑
925.8	OM (g/kgDM)	925.7	
289.0	ADF (g/kgDM)	307.0	
563.0	NDF (g/kgDM)	376.0	↓
167.0	CP (g/kgDM)	159.0	
10.6	ME (g/kgDM)	9.1	↓
3.95	CT (g/kgDM)	43.9	↑

NMR – CT Structural Analysis

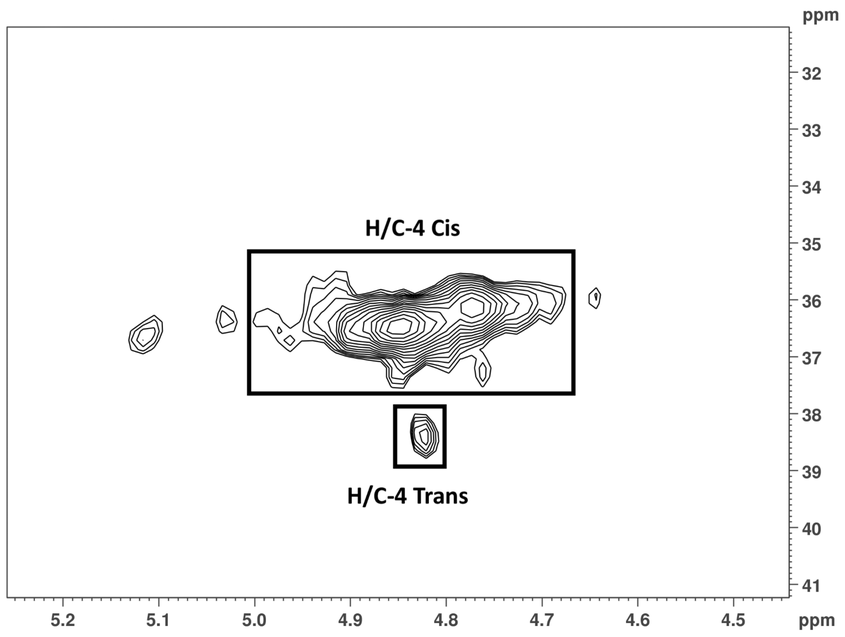
MDP = 7.2



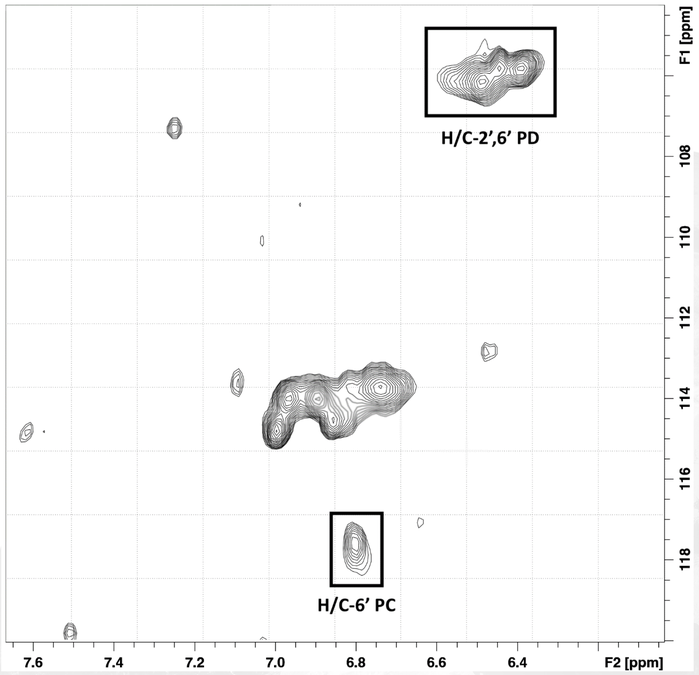
MDP correlate to decreases in CH_4

(Zeller et al., 2015)

Cis/Trans: 97/3



PC/PD: 32/68

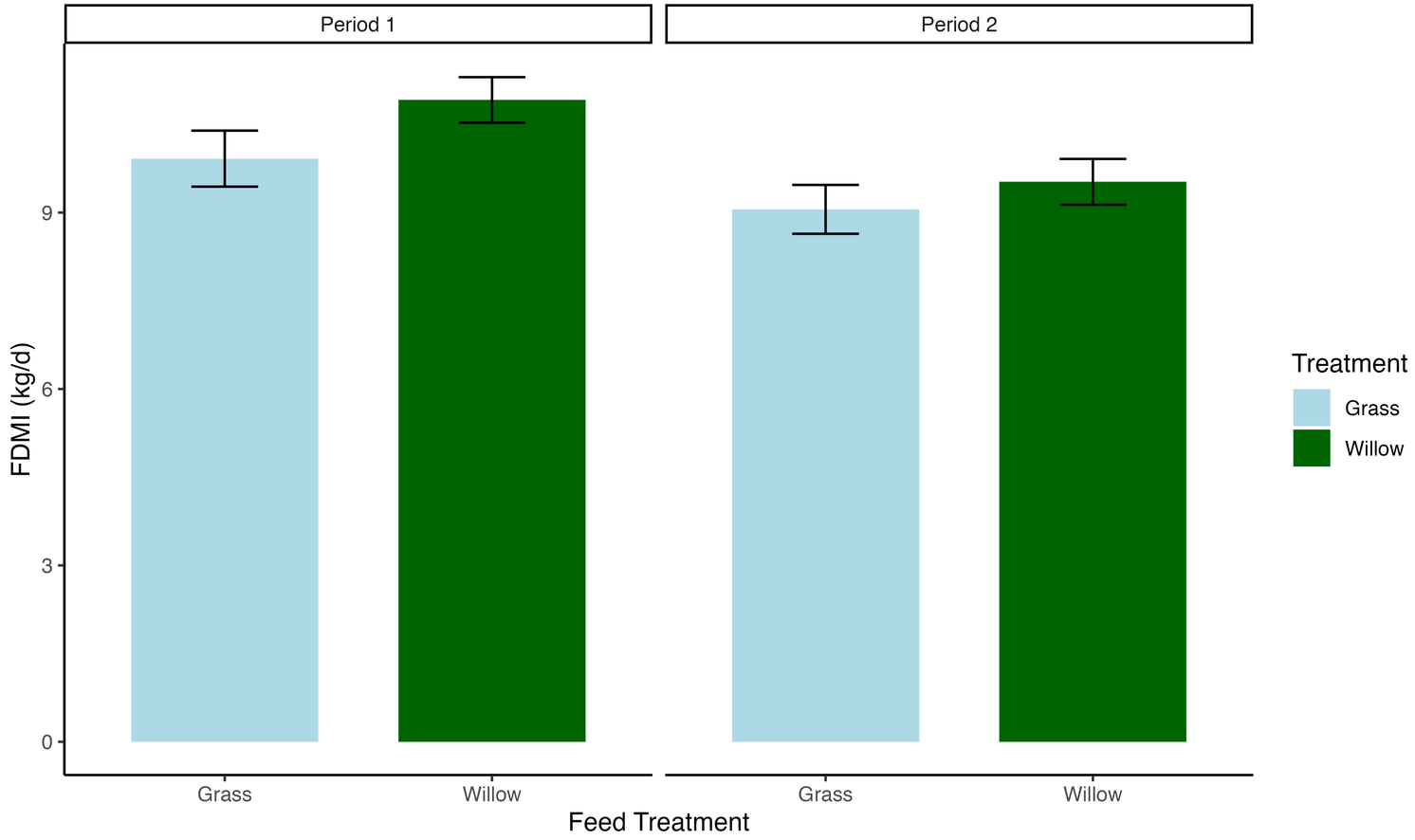


PD can impact feed intake

More hydrogen bonding sites

(Huyen et al., 2016)

Forage Dry Matter Intake (Kg/d)

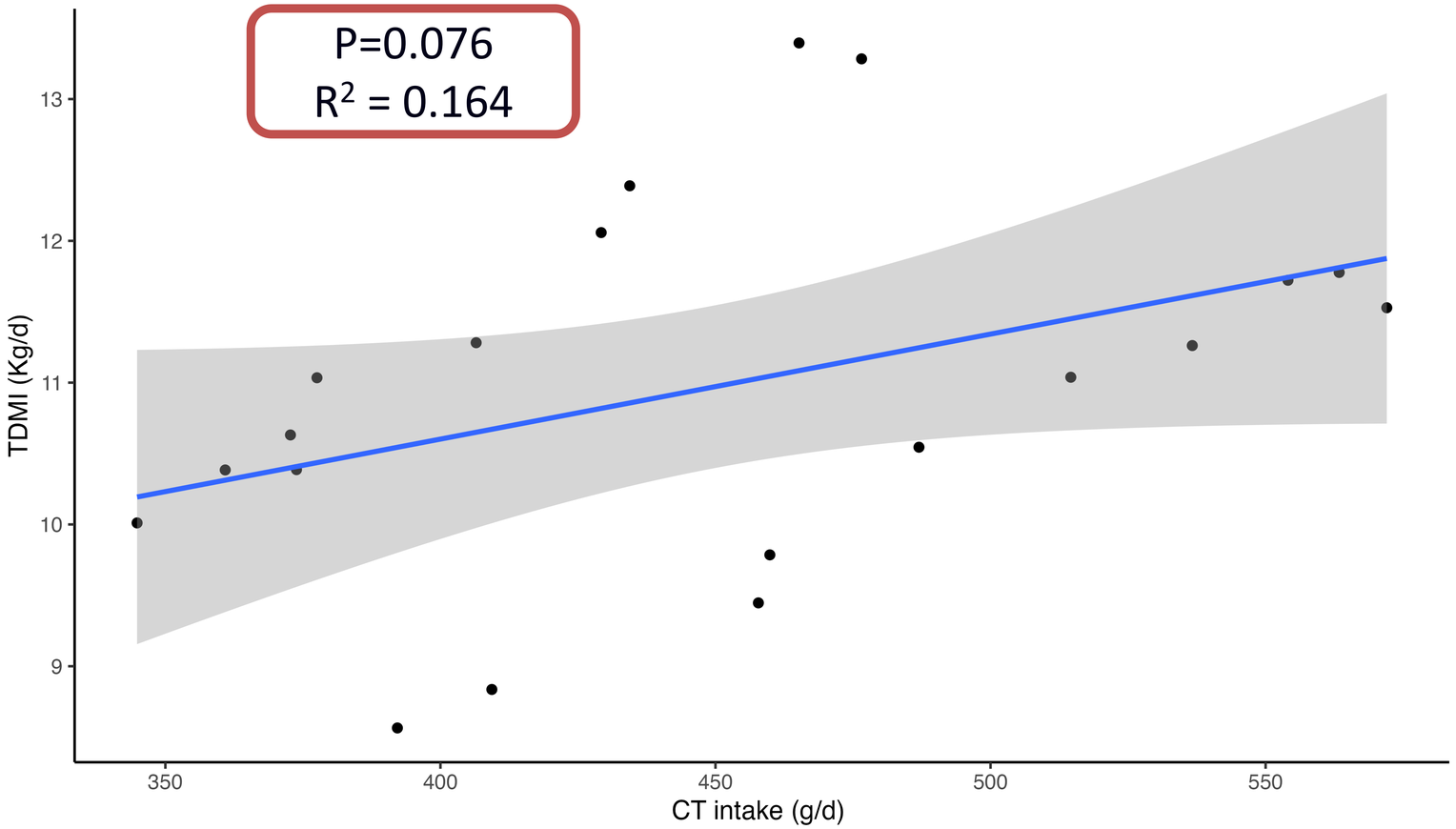


CT have the potential to reduce feed intake

Grass 9.46;
Willow 10.2
P=0.1

Treatment had no effect

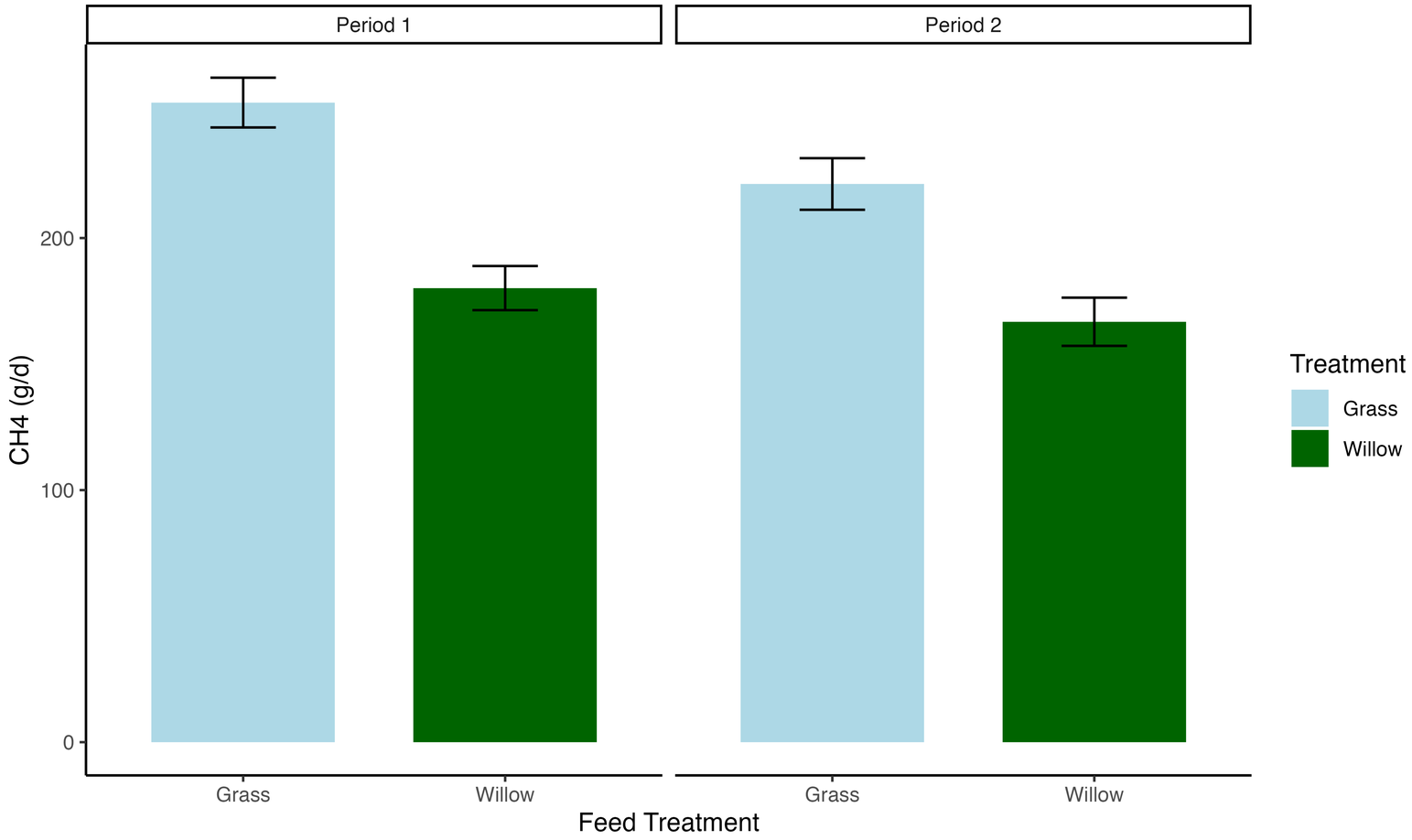
Willow – Relationship between CT intake and total DMI



CT inclusions above 2-3% on a DM basis have been shown to be rejected by grazing ruminants
(Silanikove et al., 2001)

WILLOW
Average CT inclusion **4.3% DM**

Methane Production (g/d)



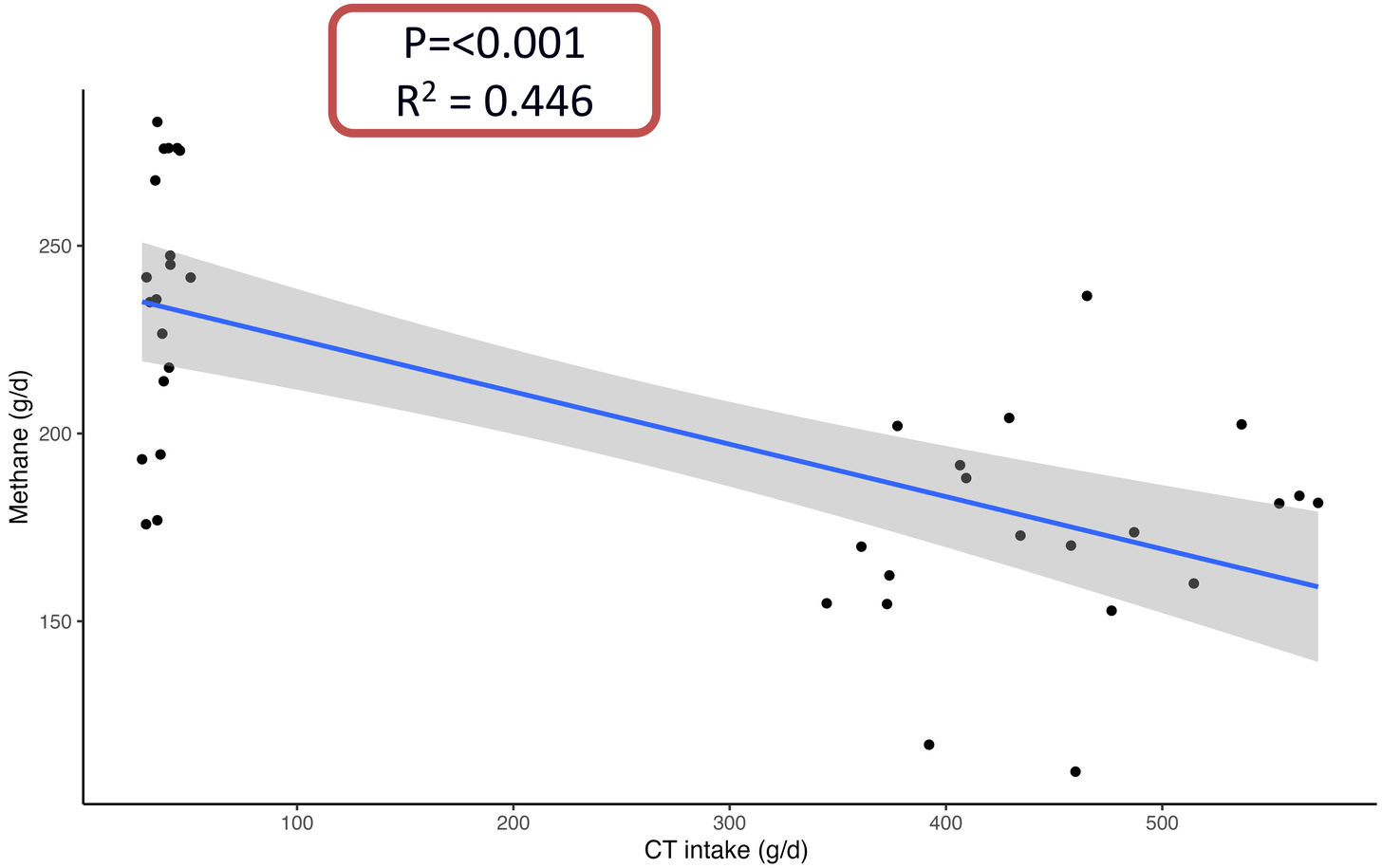
Grass (237g/d) vs Willow (173g/d)

P=<0.001

WILLOW
27% Methane reduction

Relationship between CT intake and Methane

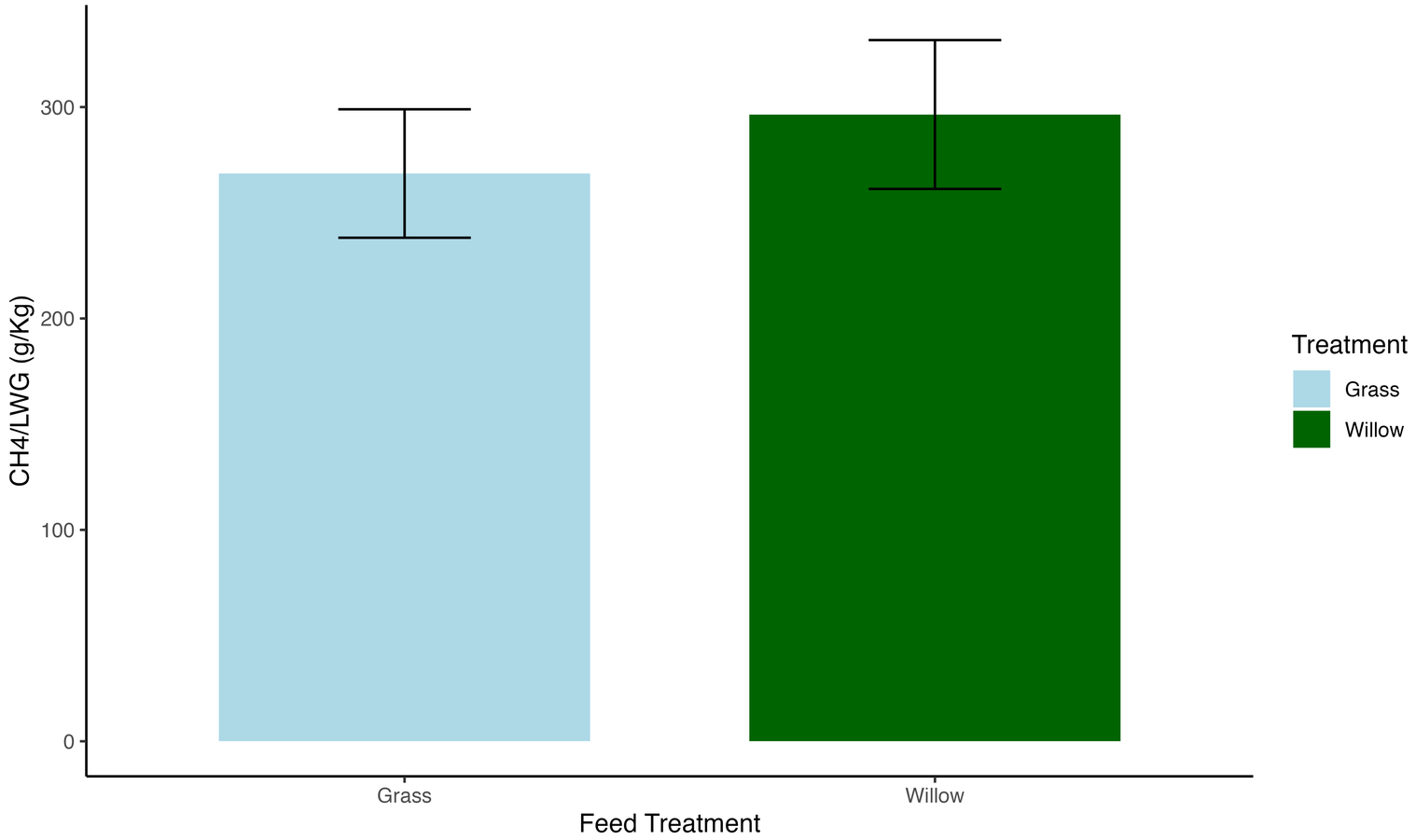
P=<0.001
R^2 = 0.446



How?
Direct Action
Indirect Action
(Tavendale et al., 2005)

H_2 production non-significant between treatments

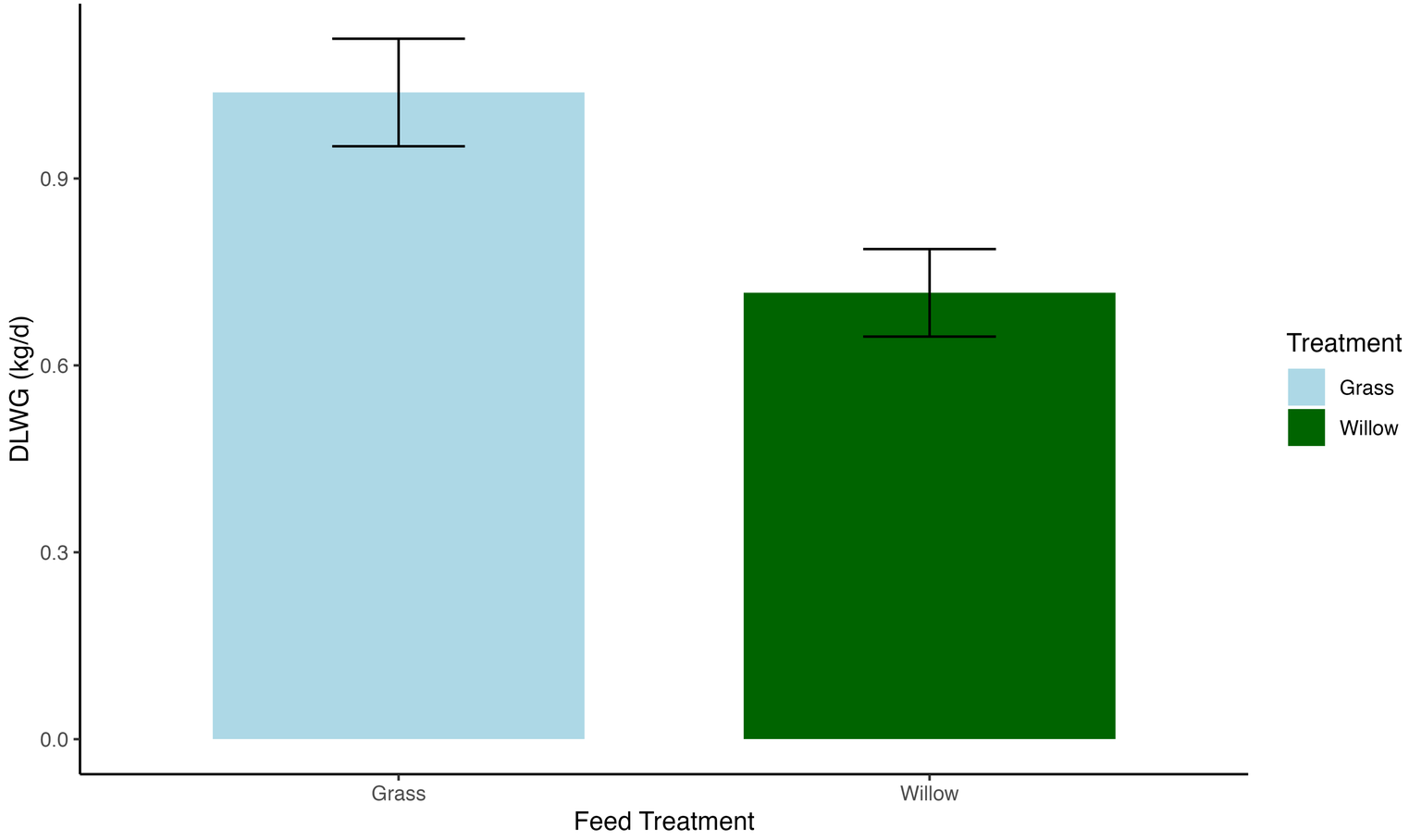
Methane Intensity (g/Kg)



No difference in Methane Intensity

P=0.555

Daily Liveweight Gain (kg/d)

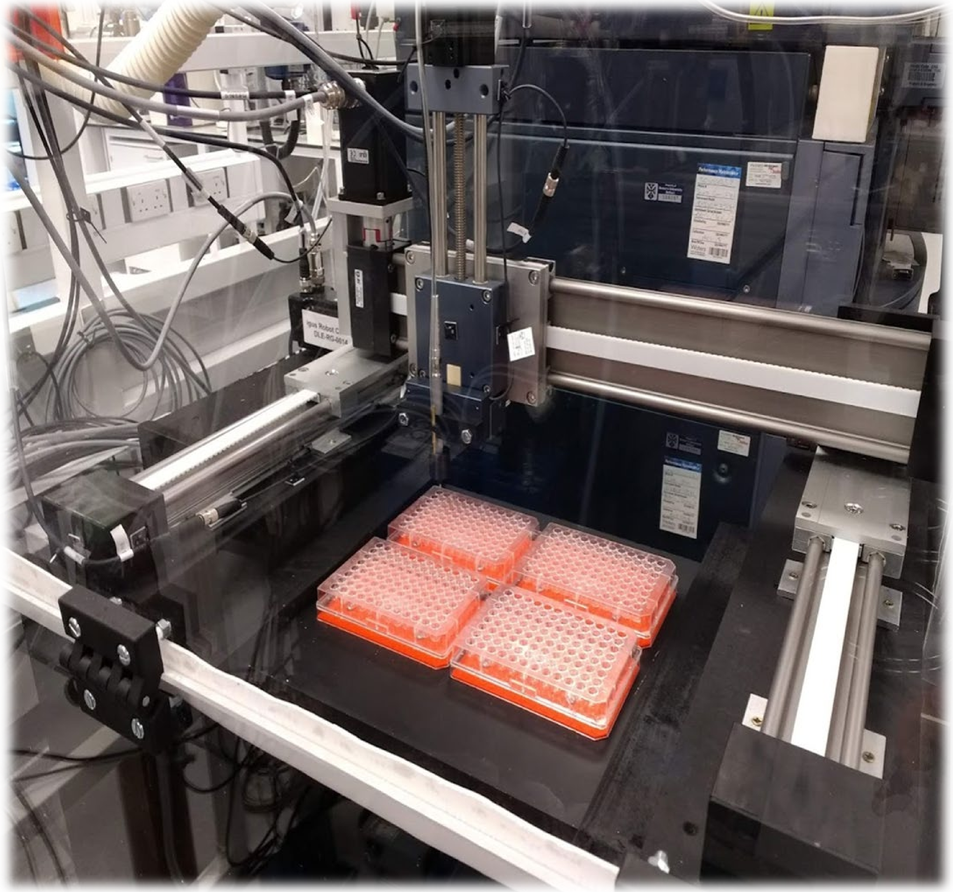


Grass: 1.04 vs **Willow:** 0.72

P<0.01

Willow 44% lower

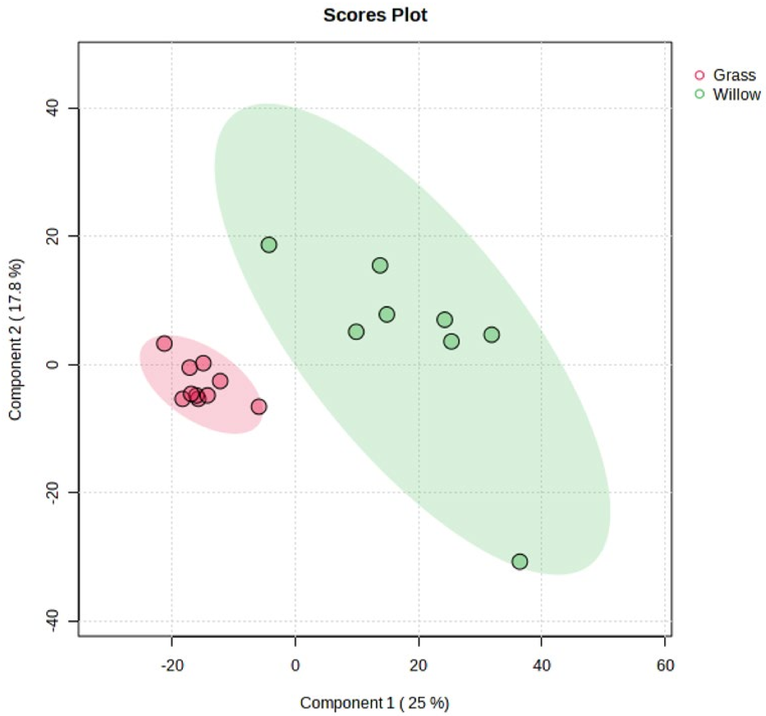
Fecal Metabolomics – LA REIMS



We wanted to see if there was an indication of a shift in Nitrogen excretion

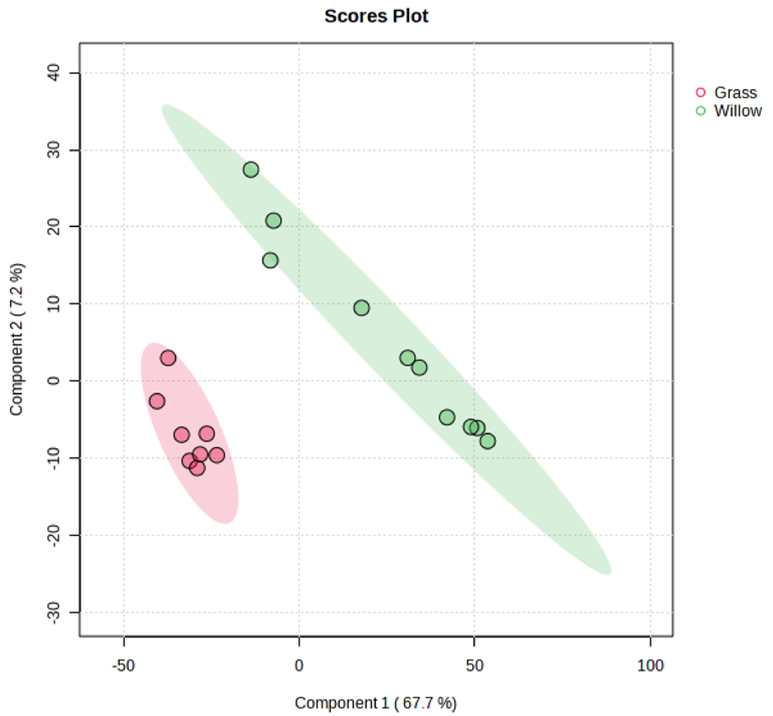
Fecal Metabolomics: Partial Least Square Discriminant Analysis (PLS-DA)

Timepoint 1



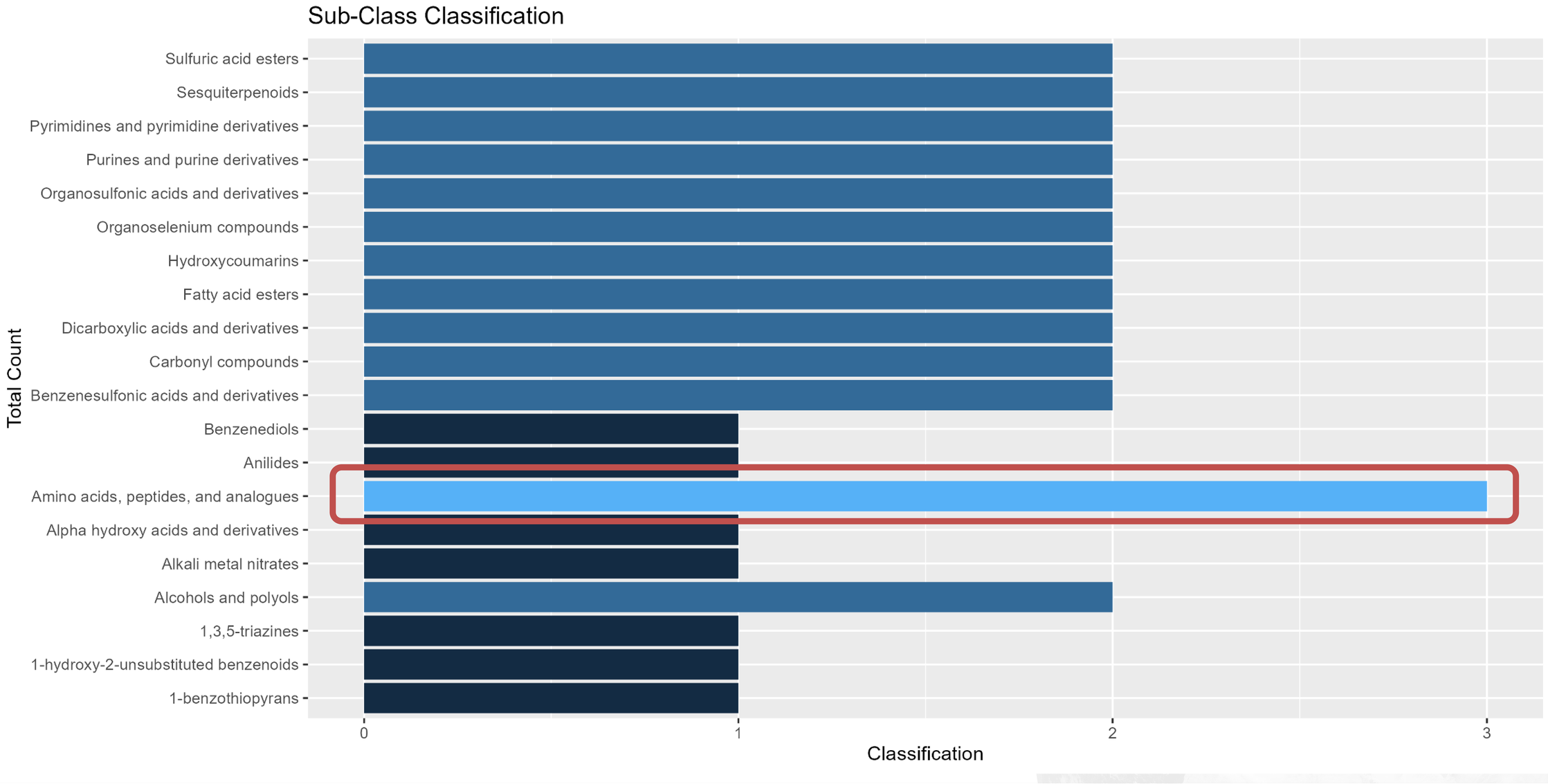
Grass

Timepoint 2



Willow

Amino acids, peptides and analogues



Conclusion and Implications

When willow herbage was not limiting, and cattle had easy access to it:

1. Cattle consumed similar amounts of feed and forage dry matter from willow than grass
2. Liveweight gain was lower when beef grazed willow than good quality grass
3. Methane production (g/d) is reduced by up to 27% but methane intensity (g/kg liveweight gain) is not affected by willow

- Potential use in low-input grazing beef with no access to good quality grass and methane reducing supplements
- Trade-off with liveweight gain rates, vs good quality grass, needs to be considered
- Variation in quality when rotationally grazed, needs to be considered
- Type of tannins should be accounted for when the aim is methane reduction

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Calculations Used

1. Heat Production (Brouwer, 1965)
2. Urinary Nitrogen excretion from total N intake (Angelidis et al., 2021
3. Energy required for liveweight gain (AFRC, 1993)
4. TMEI was calculated as the sum of 1 + 2
5. TDMI 4/ME of forage treatment