Ultrasonography and bacterial community of naturally occurring liver abscesses and non-abscessed livers in finishing Holstein steers

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Liver score for performance data	
Number	*Score definition*
0	Normal liver
1	S or A- inactive
2	A or A- active
3	A+ or A++

Liver Scoring System	
0	No abscess or scars
S	Inactive scar
A-	1 or 2 small abscess
A	1 or 2 large abscesses or several small abscesses
A+	Multiple large abscesses
A++	Multiple large abscesses + adhesions

Background & Objectives

Background

- Liver abscesses persist in feedlot cattle representing a financial burden to both pre- and post-mortem sectors of the beef industry.
- Severity has been previously identified as the driving force behind feeding performance reduction.
- Relatively little is known about development and resolution of abscesses and the associated timeline and subsequent impact on performance.
- Ultrasound methodology historically utilized to diagnose abscesses in live cattle but limitations to the technology exist
- Etiology of hepatic abscesses and healthy liver tissue could lead to further understanding of abscessation.

Objectives

1. Monitor onset, duration, and resolution of hepatic abscesses via ultrasonography, to quantify their impact on performance.
2. Investigate liver abscess severity classification and its impact on performance.
3. Examine the etiology of both healthy and abscessed livers and determine community differences between severity class.

Materials & Methods

Experimental Units

- Holstein steers (n = 56)
- Fed a 90% concentrate diet (NEm = 0.98 Mcal/lb, NEg = 0.67 Mcal/lb).
- Initial Body weight = 384±13.5 kg
- Final Body weight = 662±10.8 kg
- DOF = 188 days

Pre-mortem observations

- Liver ultrasound abscess detection (measured every 28 days)
- Modeled DMI, ADG and G:F

Post-mortem observations

- Liver abscess scores (prevalence and severity; liver scoring system)
- 16s rDNA sequencing of purulent material or tissue from abscessed & non-abscessed livers.

Statistical analysis

- *Performance*: Steers ranked within feedlot performance variables for 188 days on feed (DOF) and the final 48 DOF were compared with post-mortem liver score using the FREQ procedure of SAS
- *Ultrasound*: A contingency table for abscess detection by ultrasound versus harvest was used to evaluate ultrasound accuracy
- *Bacterial Etiology*: Continuous variables (α & β diversity) were analyzed using the MIXED procedure of SAS. Fixed effect of abscessation (severity) and response variables including bacterial relative abundance with alpha and beta diversity metrics

Results

- *Performance* data for 188 d on trial found ADG and G:F were not affected but DMI tended to be lower for unaffected livers *(P* = 0.051; Figure 1 a-c). In the last 48 d DMI and ADG were no affected by severity but those with healthy livers had greater numerical G:F *(P* = 0.098; Figure 2 a-c).
- *Ultrasound* accuracy found technician could evaluate approximately 66% correctly. Incorrect calls could be attributed to other limitation factors outlined in Table 1. However, technology did provide several individual timelines which researchers linked to performance data (Figure 3 a-f & 4).
- Non-abscessed and scarred livers had greater OTU richness and evenness while severely abscessed livers had greater dominance (P<0.001; Figure 5 a-c). Beta diversity test indicate that 0 and S classifications have different bacterial communities than A, A+ and A++ liver scores upon bootstrapping data (Figures 6). Patterns for 10 most dominate Phyla within severity class are displayed in Figure 7

Figures 1 & 2

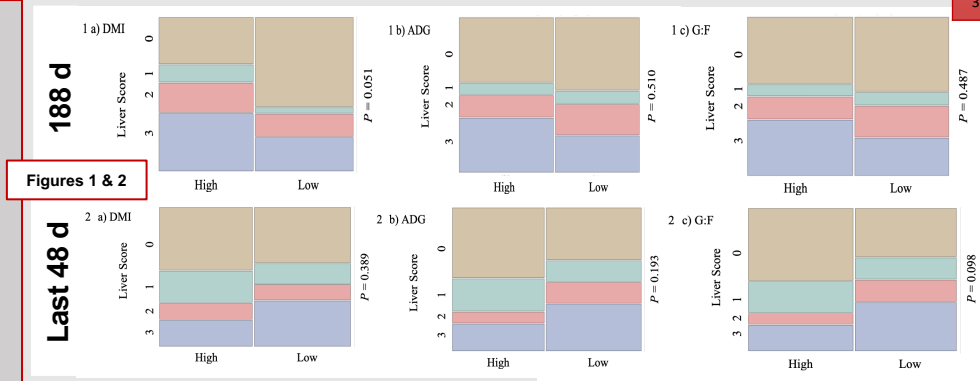


Table 1. Concordance and characteristics of liver abscess detection by Ultrasound and at harvest

	Ultrasound/Harvest, n = 56			
	Concordant		Discordant	
	N/N	Y/Y	N/Y	Y/N
Count	23	14	19	0
Percent	41.1 %	25.0%	33.9%	0.00%
Total	66.10%		33.90%	
	Discordant Characteristics, n = 19			
	A-	A+	A++	Total
Active	5	3	2	10
Inactive	7	0	2	9
Total	12	3	4	19
	Discordant Active Infection Location, n = 10			
	A-	A+	A++	Total
Visceral	3	0	0	3
Lateral	2	0	0	2
Both	0	3	2	5
Total	5	3	2	10

Figure 5

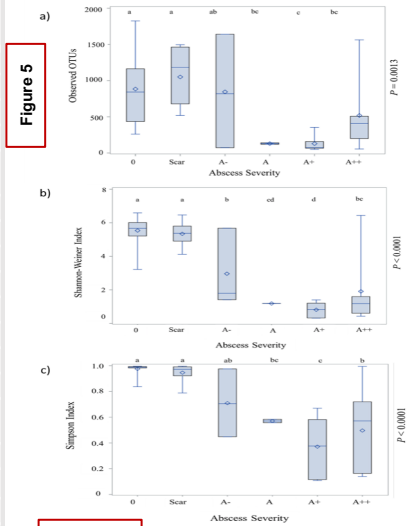


Figure 4

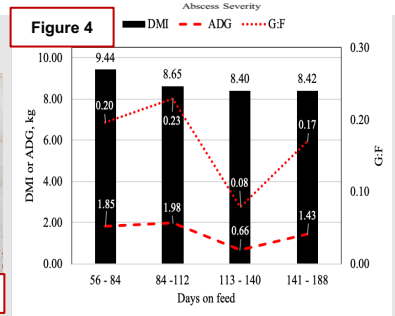


Figure 6

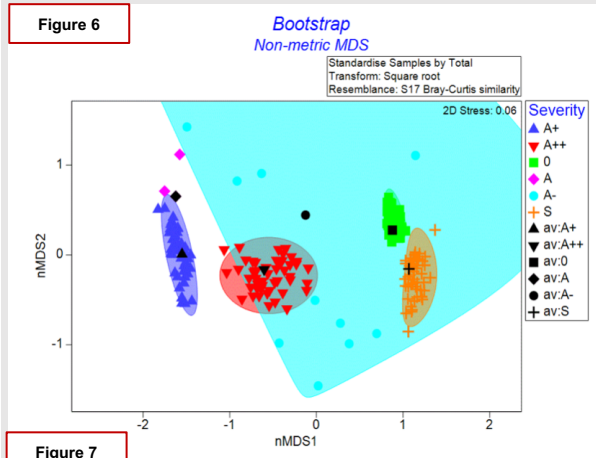


Figure 7

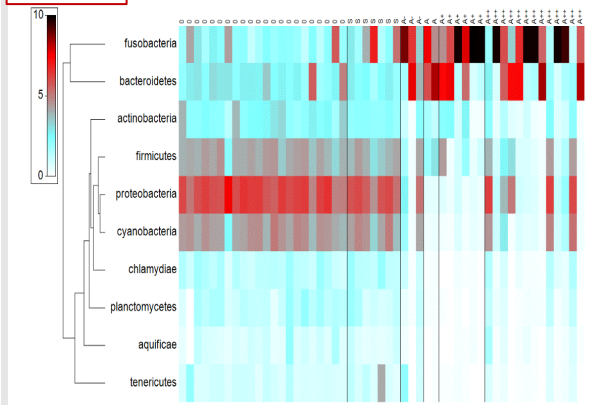
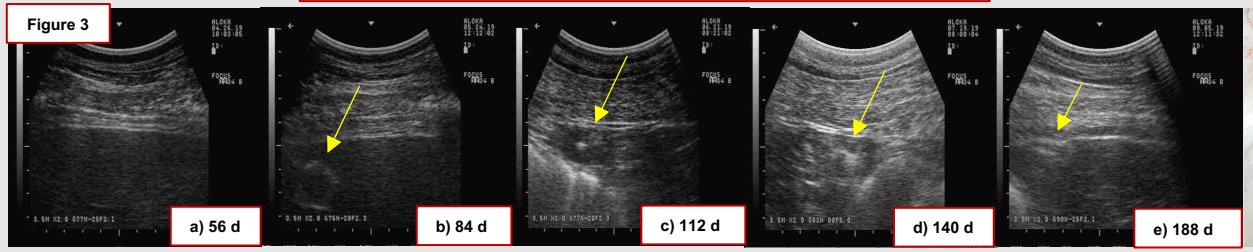


Figure 3



Conclusion

- Liver abscesses may not affect the entire feeding period.
- Ultrasonography may be useful in quantifying onset, duration and severity of liver abscess and its effect on cattle performance.
- Clear community separation was observed between liver severity classes.

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