

Effects of feeding 60% dried corn distillers grains plus solubles or the equivalent sulfur as CaSO₄ on DNA structure and integrity in bull semen

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Introduction

One product from the ethanol industry that has been utilized in the beef cattle industry is dried corn distillers grains plus solubles because it is an excellent source of energy and protein. However, the percentage of sulfur in distiller's grains is elevated and can be detrimental to sperm motility and function (Bansal and Bilaspuri, 2011; Zhang et al., 2006). Previous reports have stated that elevated dietary sulfur influenced mineral and glutathione peroxidase concentrations which may result in increased oxidative damage to sperm cells (Kassetas et al., unpublished).

Oxidative damage by reactive oxygen species can be detrimental to sperm cells by possibly influencing sperm DNA structure and integrity. Furthermore, alterations to DNA structure and integrity may influence the ability for sperm to bind to the sperm oviductal reservoir which may influence fertilization (S. Suarez, 1998). Another factor that can influence fertilization and capacitation is insufficient Zn within the sperm cell (Kerns et al., 2018). Zinc is a crucial mineral for the successful completion of both of these processes.

Hypothesis

Dietary treatments used in this study would alter DNA structure and integrity in yearling Angus bull semen.

Objectives

To investigate the effects of feeding 60% dried corn distillers grains plus solubles or the equivalent sulfur as CaSO₄ on DNA structure and integrity in frozen/extended bull semen.

Figure 1. Sperm from Zn signature assay analyzed via flow cytometry. From left to right: signature 1, 2, 3, 4.

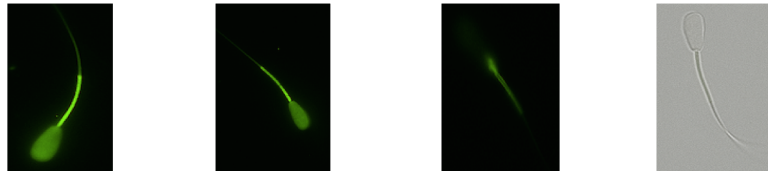


Table 1: Least squares means for DNA structure and integrity in bull semen.

Item, %	Treatment			SE	P-value
	CON	60DDGS	SULF		Trt
Sybr 14					
Live	35.4	26.5	33.1	3.9	0.26
Dead	58.4	68.0	61.0	4.3	0.29
Dying	6.1	5.4	5.7	0.7	0.80
PNA Assay					
Live intact	42.6	34.2	35.3	3.8	0.25
Oxidation Potential					
Live ROS negative	8.2	5.6	7.3	0.9	0.15
Live ROS positive	38.5	28.3	35.8	4.6	0.29
Dead ROS negative	50.9	64.2	54.5	4.9	0.15
Dead ROS positive	2.2	1.7	2.3	0.3	0.41
Mitochondrial Polarization					
Polarized	15.0	11.7	26.6	4.7	0.08
DNA Integrity Assay					
High Green	0.9	0.6	0.6	0.1	0.31
DFI ¹	5.7	4.6	4.7	0.4	0.19

¹ DFI = DNA fragmentation Index

Table 2: Least squares means for Zn signature assay.

Item	Treatment			SE	P- value
	CON	60DDGS	SULF		Trt
Sig 1	0.2 ^a	0.1 ^b	0.1 ^b	0.04	0.04
Sig 2	4.4	3.5	5.0	0.59	0.17
Sig 3 live	37.8	32.2	32.3	3.83	0.49
Sig 3 dead	2.3	1.6	2.2	0.27	0.11
Sig 4	0.6	0.3	0.3	0.11	0.12

^{a,b} means in a row not sharing a common subscript are different ($P \leq 0.05$).

Materials and Methods

- 36 half-sibling Angus bulls (256 ± 8 d; initial BW = 320 ± 2 kg) were assigned one of three treatments:
 - corn based diet containing 60% concentrate (CON, S=0.20%, n=12).
 - diet containing 60% DDGS as a replacement for corn (60DDGS, S=0.54% DM, n=12).
 - CON diet+ equivalent sulfur of DDGS in diet added as CaSO₄ (SULF, S=0.53%, n=12).
- Bulls were individually fed in Calan gates for 112 d and diets were adjusted every 14 d to target an ADG of 1.6 kg/d.
- Semen samples were extended and frozen at d 112. Samples were thawed and the Guava easyCyte 8HT Flow Cytometer was used to analyze:
 - acrosome/cell membrane integrity
 - mitochondrial energy potential
 - oxidation status
 - DNA integrity
 - zinc signature assay (Kerns et al., 2018)
- Data were analyzed using the MIXED procedures of SAS for effects of treatment.

Conclusion

- There was a tendency for SULF to have more polarized mitochondria compared with CON and 60DDGS.
- Differences were observed for sperm with a zinc signature of 1.
- Feeding DDGS at 60% of the diet does not appear to alter the sperm enough to influence sperm motility, morphology, or pubertal status.
- Other factors besides sulfur within DDGS may be influencing yearling bull reproduction.

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