Effect of varying levels of hempseed meal supplementation on animal performance, rumen fermentation, and blood metabolites of growing meat goats

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Abstract

Hempseed meal (HSM) is a byproduct of hemp oil production and is high in crude protein, fiber, and fat making it a potential feedstuff for ruminants. The objective of this study was to evaluate the effect of HSM supplementation on growth performance, rumen fermentation and blood chemistry profile of growing meat goats. Forty castrated, Boer cross goats were randomly assigned to one of the four treatments (n=10): control, 10 %, 20 %, and 30 % HSM supplementation. Data that were collected over a period of a 60-day feeding trial were analyzed utilizing the mixed model analysis function of SYSTAT, version 13. The result revealed total live weight gain decreased with the increasing levels of HSM supplementation 10.75, 9.53, 8.48, and 7.80 kg, for 0, 10, 20, and 30 %, respectively. Average daily gain followed the same trend 0.179, 0.159, 0.141, and 0.13 kg, with a significant difference ($P < 0.05$) observed between the control and 30 % supplementation. Conversely, feed to gain ratio increased with the increasing levels of supplementation 9.0, 10.2, 11.9, 12.2, likewise a significant difference was observed ($P < 0.05$) between the control and 30 % supplementation. Acetic, propionic, butyric, valeric, iso-valeric, and iso-butyric acid concentrations as well as the total VFA concentration decreased significantly ($P < 0.05$) with the increasing level of supplementation. Acetic to propionic acid ratios increased with increasing level of supplementation 3.43, 4.36, 4.52, and 4.59, significant differences ($P < 0.05$) were observed between control-20 % and 30 % HSM group. Serum glucose concentration decreased with an increasing rate of HSM supplementation while BUN concentration increased with no significant differences. These findings provide new insights into the feeding value of HSM for meat goats, however, further research needs to be conducted to determine the optimal level of supplementation.

Introduction

For years all types of hemp (Cannabis Sativa L.) production have been illegal in most of the United States for fear of the level of THC that could potentially be stored or striking, visual similarity to marijuana. It was long believed that if producers were to grow industrial hemp, marijuana could easily be established within the industrial hemp Recent, legislative changes to the Farm Bill have resulted in a newfound interest in hemp production (Cherney and Small, 2016). Historically, hemp has been produced worldwide for centuries, as it can be grown in most climates, conditions, and provides several products: fiber and oilseeds (Johnson, 2018). Fiber is often high quality with a high strength to weight ratio, while seeds and oil are used to supply niche markets worldwide. There are two different methods for extracting the oil from ripe seeds: mechanical or solvent-based. After the oil is extracted, a residual meal is left behind that is high in crude protein and low in fat compared to the whole seed (Mustafa et al., 1998). With a possibility of increased production of Industrial Hemp in the Southeastern United States, it is important to find a use for the byproduct of oil production. It has consistently been shown that this byproduct has the potential to be an ideal feedstuff for ruminants as it is high in fiber and crude protein (Mustafa et al., 1998; Hessle et al., 2008; European Food Safety Authority, 2011). HSM on average contains 30-35% crude protein on a dry matter basis (Mustafa et al., 1998; Hessle et al., 2008). Hemp seed protein has a favorable amino acid profile, resisting ruminal degradation, and has a high availability in the small intestine (Gibb et al., 2005). Additionally, 80% of the fat found in the whole seeds is polyunsaturated fatty acids which could potentially serve as an energy source while improving animal health (Mustafa et al., 1998).

The objective of this study was to evaluate the effect of varying levels of HSM on the performance, blood metabolites, and rumen fermentation of growing meat goats.

(Sinning, 2020)

Methodology

- **Goats and Feed**
  - 40 Goats underwent a 60 Day feeding trial
  - Goats were fed twice daily feed offered and refused was documented to determine intake
  - Pellets consisted of: Hempseed Meal (varying rates), corn, timothy grass hay, soybean meal, molasses, meatmaker premix
  - Complete diets were pelleted
  - Feed analysis was completed on composite samples by Holmes Laboratory
- **Treatments and Sample Collection**
  - Treatments consisted of 0% (control), 10%, 20%, and 30% hempseed meal supplementation
  - Blood was collected on day 60 of the feeding period and serum chemistry profile analyzed
  - Rumen fluid was extracted of day 60 of the feeding period and was analyzed for volatile fatty acids
    - Acetic, Propionic, Butyric, Iso-butyric, Iso-Valeric, Valeric
- **Statistical Analysis**
  - All data was analyzed utilizing the mixed model analysis function of SYSTAT, Version 13
  - Significance level was set at $P \leq 0.05$

Results

- **Nutrient Composition**
  - Diets were balanced to be iso-nitrogenous; however, the last diet exceeded 19% (Table 1.)
  - As hempseed meal inclusion rate increased so did fiber and fat

Nutrient Analysis	Unit	Control	10%	20%	30%
Dry Matter	%	89.06	88.6	89.1	89.86
Crude Protein	%	19.18	19.91	19.25	20.39
Available Protien	%	18.51	19.13	18.34	19.42
Adjusted Protein	%	19.18	19.91	19.25	20.39
A.D.F. Protein	%	0.67	0.78	0.91	0.97
N.D.F. Protein	%	3.45	3.64	4.11	4.4
Soluble Protein	%	4.1	4.24	3.96	4.89
Protein Solubility	%	21.38	21.3	20.57	23.98
Ligin	%	3.34	4.77	6.21	7.02
Acid Detergent Fiber	%	21.06	24.67	28.96	30.97
Neutral Detergent Fiber	%	33.29	35.18	39.63	42.8
NFC	%	40.64	37.8	35.38	31.9
Crude Fat	%	3.19	3.32	4.22	4.5
TDN	%	71.2	69.2	64.7	62.79
NE1	Mcal/lb	0.736	0.714	0.664	0.643
NEm	Mcal/lb	0.758	0.729	0.664	0.636
NEg	Mcal/lb	0.481	0.456	0.397	0.372
Ash	%	7.02	7.01	7.09	6.79
Ligin Insoluble Ash	%	1.25	1.24	1.45	1.24
Calcium	%	0.95	0.92	0.88	0.82
Phosphorus	%	0.39	0.41	0.48	0.52
Magnesium	%	0.23	0.24	0.26	0.28
Potassium	%	1.43	1.29	1.29	1.24
Sulfur	%	0.22	0.22	0.22	0.22
Sodium	%	0.093	0.079	0.089	0.089
Copper	ppm	20	15	16	22
Manganese	ppm	64	75	82	91
Zinc	ppm	71	67	74	80
Iron	ppm	144	154	154	137

Table 1. Nutrient composition of the respective treatment diets fed to the growing meat goats

- **Volatile Fatty Acids**
  - With the increasing level of hempseed meal supplementation the concentration of major volatile fatty acids decreased (Figure 1)
  - A:P ratio increased with the increasing level of supplementation (Figure 2)
  - Total VFAS decreased with the increasing level of supplementation (Figure 3)

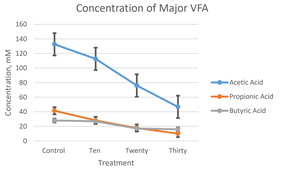

Figure 1. Concentration of major volatile fatty acids at the conclusion of the 60 day feeding period

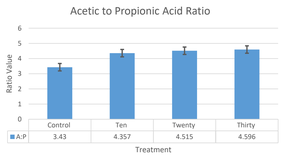

Figure 2. A:P ratio of the respective treatments at the conclusion of the 60 day feeding period

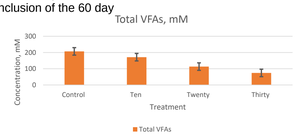

Figure 3. Total volatile fatty acids produced at the conclusion of the 60 day feeding period

Results cont.

- **Serum glucose and BUN concentration**
  - Glucose concentration followed and inconsistent trend
  - BUN concentration followed a more consistent trend with only a decrease between the control and 10% treatment
- **Animal Performance**
  - Final gain decreased with the increasing level of supplementation
  - Final ADG also decreased with the increasing level of supplementation
  - Feed: Gain increased with the increasing level of supplementation

Parameter:	Treatment				
Serum Chemistry:	Control	Ten	Twenty	Thirty	SEM
Glucose, mg/dL	73.3	55.4	63.2	62.64	7.825
BUN, mg/dL	24.9	20.6	26	29.20‡	2.707
Animal Performance:	-	-	-	-	-
Final Gain, kg	10.75	9.525	8.482	7.802†	0.955
Final ADG, kg	0.179	0.159	0.141	0.130†	0.016
Feed: Gain	9.002	10.179	11.855	12.173	0.997
Superscripts in rows: †- significantly different from control; ‡-significantly different from ten percent treatment					

Table 2. Serum glucose, BUN concentration, final gain, and final ADG for the 60 day feeding period

Conclusions

- Hempseed meal is relatively high in crude protein, fat, and fiber and could potentially be a great feedstuff for ruminants
- 30% treatment consumed less feed and consequently had less volatile fatty acids with a higher A:P ratio
- Final Gain and ADG decreased with the increasing level of supplementation
- Feed: gain increased with the increasing level of supplementation
- It appears that animal performance and rumen fermentation maybe sacrificed with the increasing level of supplementation
- In order to determine the maximum, appropriate inclusion rate, more work must be completed with varying rates of hempseed meal supplementation

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