Nebraska Soybean Board
FINAL Research Report Form

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11/5/2018

Note: Submit this report no later than 90 days after the NSB-funded project officially terminates.
This post-project 90-day time-frame will allow the Lead PI time to complete any final data analysis and a final technical report, plus the drafting of any articles for submission to scientific journals. Note that this completed report will be provided to the curator of a national database of State, Region, and USA Soy checkoff funded projects.

Project # and Title: 18R-30-1/1 #1732: Benefits of Soy Based Amino Acids in Growing Cattle Diets

Principal Investigator: Andrea Watson

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Project Date (Including Extension): 10/01/2017 ***to*** 09/30/2018 ***(example: mm/dd/yyyy to mm/dd/yyyy)***

Total Budget for Project: $ 48,485.00

1. Briefly State the Rational for the Research:

SoyPass has been utilized in the dairy industry as a source of amino acids in the diet. Recent changes to the Beef Cattle Nutrient Requirements Model (2016) have led us to believe that SoyPass could also be beneficial in growing cattle diets as a source of lysine, frequently the first limiting amino acid in cattle diets. The lysine profile of soybeans is complementary to feedstuffs commonly used in cattle diets (primarily corn and distillers grains). We have gathered some supporting data with corn silage and corn residue based growing diets showing a response (increased weight gain) to bypass protein supplementation. Surprisingly, the benefits were observed at levels above the predicted requirement, leading us to believe that the response is due to meeting a specific amino acid deficiency (lysine). This trial was designed to supplement SoyPass as a concentrated form of lysine and determine the performance response by growing cattle.

2. Research Objectives (copy from project, but keep in a brief bullet format):

To evaluate the effects of rumen protected lysine, provided in the diet as SoyPass, on cattle growth and efficiency in order to increase efficiency when formulating rations. Specific objectives include:
1. Measure the performance response (weight gain and feed efficiency) of growing calves to inclusion of SoyPass in the diet.
2. Determine the optimal inclusion of SoyPass in diets fed to growing calves.
3. Improve our understanding of the lysine requirement of growing calves.
4. Increase N use efficiency when formulating diets for growing cattle.

3. General Approach Used and (if applicable) the Nebraska Test Locations:

Two groups of 60 growing steers (initial body weight 582 and 664 lb) were utilized to study the effects of replacing distillers grains plus solubles (DGS) with SoyPass in grass hay diets. The DGS was included at 20 or 35% of the diet, and SoyPass replaced 0, 30, or 60% of the DGS. Two separate groups of animals were utilized to observe the effect of stage of growth on metabolizable protein requirements. Steers were individually fed for 84 days at the University of Nebraska's Eastern Nebraska Research and Extension Center near Mead, NE.

Steers were limit-fed a common diet at 2% of BW for 5 d prior to weighing on 3 consecutive d to get both initial and final body weight. Steers were implanted on d 1, which increases growth and consequently, protein requirements. At the midpoint of the trial, a blood sample was collected and analyzed for blood urea nitrogen. Data collected included daily dry matter intake, daily body weight gain, and efficiency of weight gain as the ratio between feed intake and gain (F:G).

4. Describe: Deliverables & Significance Attained for Each Research Objective:

While SoyPass inclusion did not affect daily weight gain, steers consuming the greater amount of distillers grains plus solubles (DGS) did have improved weight gain, 2.49 vs 1.90 lbs per day, respectively. As SoyPass replaced the 35% DGS, intake increased linearly. As SoyPass replaced the 20% level of DGS, intake decreased. This led to changes in amount of feed per lb of weight gain (F:G). As SoyPass replaced DGS in the 35% treatment, F:G increased, but for the 20% level of DGS, as SoyPass replaced DGS, F:G was constant.

Blood urea nitrogen increased linearly as SoyPass replaced DGS in the 20% diet, which reflects the increased dietary CP and bypass protein content. Blood urea nitrogen was not affected by SoyPass substitution in the 35% diet, likely due to the animal's capacity to excrete urea being maximized under all 3 dietary conditions.

Performance results may be explained by both metabolizable protein and energy balance. In the 35% DGS diet, metabolizable protein was provided above requirements and likely supplied sufficient lysine. In the 20% DGS diet, F:G was not affected by SoyPass level, even though there is less energy in SoyPass compared to DGS. This suggests metabolizable lysine was limited in the 20% DGS diet, and was provided by the SoyPass.

4. Describe: Deliverables & Significance Attained for Each Research Objective (continued):

Overall, forage based growing diets formulated with low levels of DGS (<20%) may be deficient in metabolizable lysine, which can be corrected with the inclusion of SoyPass. Up to 60% of the DGS in these diets can be replaced with SoyPass. Lysine requirements of growing cattle are quite high, and are not always met with a corn or DGS based diet.

Non-enzymatically browned soybean meal (SoyPass) is an excellent source of protein for these calves, as approximately 75% of the protein is protected from degradation by microbes in the rumen and supplies essential amino acids directly to the animal.

Backgrounding or growing calves before entry into the feedlot is a large business in Nebraska. Diets fed during this time are typically forage based, but highly variable depending on available feed resources. Calves may be grown on grass pasture or hay, corn residue, corn silage, cover crops, or even straw based diets. Results from this trial are applicable in all of these scenarios, with N use efficiency optimized from a blend of DGS and SoyPass.

5. List where the Project Research Results/Findings were Publicized:

Results of this trial will be published in the 2019 Nebraska Beef Cattle Report, available November, 2018. We distribute approximately 1,800 hard copies of this publication in addition to having it available for free download on the www.beef.unl.edu website. The student that managed the trial will also be presenting results at the Midwest American Society of Animal Science meeting in March, 2019.

Note: The above boxes will automatically accomodate for your text inputs; HOWEVER, the Final Report comprised of the above listed items must be kept to THREE PAGES. A Technical Report of no more than TEN PAGES (preferably fewer) can be appended to this report.
Submit both reports as a single PDF with this file name format: #XXX > FINAL > Project Title > PI last name

Please email this completed form to the Agriculture Research Division (jmonaghan2@unl.edu) based on the reporting schedule given to you. If you have any questions, please call the ARD at 2-2045 or Victor Bohuslavsky at the Nebraska Soybean Board Office at (402) 432-5720.

Effects of Supplemental SoyPass in Forage-Based Diets Containing Distillers Grains on Performance of Growing Steers

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Summary with Implications

SoyPass was supplemented in two grass hay diets containing 20% or 35% wet distillers grains with solubles (WDGS) to analyze the effects on growing cattle performance. The SoyPass supplement replaced 0, 30, or 60% of dietary WDGS for a total of 6 treatments with a factorial design. Substituting SoyPass into the diet did not affect average daily gain (ADG) of calves; however, calves consuming the 35% WDGS diet gained 31% more than the 20% WDGS treatment calves. Dry matter intake (DMI) and feed to gain (F:G) increased linearly in the 35% WDGS diet with the inclusion of SoyPass. In the 20% WDGS diet, DMI and F:G were maximized when SoyPass replaced 30% of the WDGS and lowest when SoyPass replaced 60% of WDGS. Therefore, SoyPass can replace up to 60% of the WDGS in forage based diets containing 20% WDGS with no adverse effects on performance by appearing to supply needed lysine.

Introduction

Growing cattle require increased quality and quantity of metabolizable protein compared to older more mature animals in order to meet the animal's demand for amino acids used for muscle growth. Typically, diets formulated for growing cattle contain large amounts of forage and smaller amounts of grain and by-products. While forage CP can be high, the majority of that protein is rumen degradable protein, which is fermented to meet the requirements of the ruminal microbial population. In many cases, microbes cannot provide enough protein and more cannot be made as dietary energy limits production. Corn distillers grains (DGS) is often used as a bypass protein supplement as a large portion (63%) of its protein is not ruminally degraded and is available for utilization by the animal.

Methionine and lysine are two of the first-limiting amino acids in most growing cattle diets. Corn and its by-products contain large amounts of methionine but are lower in lysine. Conversely, soybean products contain low-levels of methionine but concentrated amounts of lysine. The purpose of this study was to replace DGS with SoyPass (a bypass soybean meal product) in a forage-based growing diet to evaluate response to bypass lysine for growing calves.

Table 1. Experimental diets

	Wet distillers grains with solubles (WDGS) supplement					
	20%			35%		
	SoyPass replacing WDGS, %					
Ingredient, %DM	0	30	60	0	30	60
Brome hay	77	77	77	62	62	62
Supplement[1]	3	3	3	3	3	3
WDGS	20	14	8	35	25	15
SoyPass	0	6	12	0	10	20
Nutrient						
CP, % DM	13	14	15	16	18	23
RUP, % of CP	31	36	41	43	48	53
Lysine, % DM	0.40	0.48	0.57	0.53	0.67	0.90

[1]Supplement formulated to provide 1.22% fine ground corn, 1.34% limestone, 0.08% tallow, 0.3% salt, 0.05% beef trace mineral, and 0.02% vitamins A-D-E on DM basis

Procedure

Two groups of 60 growing steers (initial BW 582 ± 30 lb and 664 ± 75 lb) were utilized to study the effects of replacing DGS with SoyPass (0%, 30%, or 60% of DGS) in grass hay diets containing 35% or 20% DGS (Table 1). The study was arranged as a 2 × 3 factorial design and the feeding period was 84 d. Two separate groups of animals were utilized to observe the effect of stage of growth on metabolizable protein requirements. Steers were individually fed to ensure ad libitum intakes utilizing the Calan gate system at the Eastern Nebraska Research and Extension Center (ENREC) located near Mead, NE.

Steers were limit-fed a common diet containing 50% Sweet Bran (Cargill Corn Milling, Blair, NE) and 50% alfalfa hay at 2% of BW for 5 d followed by 3 d of weighing. The average of the 3-d weight served as initial BW and this procedure was replicated at the end of the study to measure ending BW. Additionally, all steers were implanted on d 1 with Synovex S (Zoetis, Parsippany, NJ). On d 43 for both groups of cattle, a blood sample was collected and analyzed for serum urea nitrogen for the first group and plasma urea nitrogen for the second group.

Performance results and blood urea nitrogen data were analyzed using the MIXED procedure of SAS. Initially, block of cattle, level of DGS, level of SoyPass supplement, and the interaction served as fixed effects in the model. Because there were no treatment × block interactions ($P \geq 0.10$), the interaction was removed from the final

Table 2. Performance of growing cattle on forage-based diets supplemented with SoyPass

	Wet distillers grains with solubles supplement									
	20%			35%						
	SoyPass replacing WDGS, %						SEM	*P*-value		
Item	0	30	60	0	30	60		Dist	SoyP	Int
IBW[1], lb	623	624	621	625	622	622	13	0.97	0.99	0.98
EBW[2], lb	787	778	781	836	830	829	14	<0.01	0.84	0.99
DMI, lb	17.7^{bc}	18.4^{ab}	16.9^{c}	17.8^{bc}	18.6^{ab}	19.7^{a}	0.47	0.01	0.30	0.01
ADG, lb	1.96	1.83	1.91	2.52	2.48	2.47	0.07	<0.01	0.49	0.76
F:G	9.1^{ab}	10.2^{a}	8.9^{bc}	7.0^{e}	7.4^{de}	8.0^{cd}	-	<0.01	0.17	0.03

[1]Initial body weight

[2]Ending body weight

[abcde]Means in a row with uncommon superscripts differ ($P \leq 0.05$)

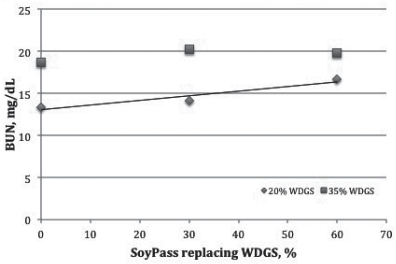

Figure 1. Blood urea nitrogen increased with increasing SoyPass in 20% distillers grains diets. SoyPass was supplemented to replace 0, 30, or 60% of distillers grains in grass hay diets formulated to contain 20 or 35% WDGS. Main effect of distillers grains inclusion ($P < 0.01$; SEM = 0.35), SoyPass inclusion ($P < 0.01$; SEM = 0.44), and the interaction ($P = 0.04$; SEM = 0.61).

analysis and data from both blocks of cattle were combined for analysis with block as a fixed effect. Additionally, where SoyPass × DGS interactions were detected, SoyPass inclusion was analyzed using covariate regression within DGS inclusion.

Results

There were no interactions detected for ADG between SoyPass supplementation and level of DGS in the diet ($P = 0.76$; Table 2). Additionally, SoyPass inclusion had no effect on ADG ($P = 0.49$). However, ADG was increased for steers consuming the 35% DGS diet compared to steers offered the 20% distillers ration (2.49 vs. 1.90 lb, respectively; $P < 0.01$).

A SoyPass × DGS interaction was detected ($P = 0.01$) for DMI. As SoyPass replaced DGS in the 35% diet, DMI increased linearly (linear $P = 0.01$). In the 20% DGS diet, DMI decreased as SoyPass replaced 60% of the DGS compared to 30% ($P = 0.02$). Therefore, there was also an interaction between SoyPass and DGS for F:G ($P = 0.03$) with a linear increase ($P = 0.01$) in F:G as SoyPass replaced DGS in the 35% treatment and a quadratic increase ($P = 0.02$) detected for the 20% WDGS treatment. On average, F:G was improved 20% for cattle consuming the 35% diet compared to 20% (7.5 vs. 9.4, $P < 0.01$).

Blood urea nitrogen increased linearly as SoyPass replaced distillers in the 20% diet ($P = 0.01$), which reflects the increased dietary CP and RUP content (Figure 1). Blood urea nitrogen was not affected by SoyPass substitution in the 35% diet, likely due to the animal's capacity to excrete urea being maximized under all 3 dietary conditions.

Performance results may be explained by both metabolizable protein and energy balance. In the 35% DGS diet, metabolizable protein was provided above requirements and may have supplied sufficient lysine. Likely because of the oil in DGS, DGS supplied more energy than the SoyPass. In the 20% DGS diet, F:G was not affected by SoyPass level, even though there is less energy in the SoyPass than in the distillers grains. This suggests metabolizable lysine may have been limiting with only DGS and the SoyPass supplied needed lysine.

Conclusion

Overall, forage-based growing diets formulated with low-levels of distillers grains (< 20%) may be deficient in metabolizable lysine, which could be corrected by the inclusion of SoyPass. Furthermore, cattle demonstrated increased performance when fed the 35% distillers diet compared to the 20% because both dietary energy and metabolizable protein balance were improved.

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