Transaction Detail
EFFECT OF THE NATURAL BIOPOLYM
For Month Ending: April 30, 2016

Run Date: 05/05/2016

Acctg Date	Flex Code	UFID	CRIS	Transaction ID	Encumbrance ID	ID	Description Detail	Amount
Cost Center: 00125106 - EFFECT OF THE NATURAL BIOPOLYM~209~60770000 (Project~Fund~Department)								
04/13/2016	-	-	005206	PCard# UFLOR - TXN03410737	VCHR# UFLOR - 04922748	EMP# 06656944 - Schulmeister,Tessa M	TFS FISHERSCI ECOM CAT - acetone and HCl for the lab	242.42
04/13/2016	-	-	005206	PCard# UFLOR - TXN03412637	VCHR# UFLOR - 04923001	EMP# 04549943 - Messias Ciriaco Silva,Francine	DOLLAR-GENERAL #7308 - zip lock bags, aluminum foil,	24.00
04/19/2016	-	-	005206	PCard# UFLOR - TXN03418474	VCHR# UFLOR - 04927141	EMP# 06656944 - Schulmeister,Tessa M	TFS FISHERSCI ECOM CAT - drain hose for the lab	42.45
04/25/2016	-	-	005206	PCard# UFLOR - TXN03421518	VCHR# UFLOR - 04931113	EMP# 06656944 - Schulmeister,Tessa M	ALABAMA FLUID SYSTEM TEC - female quick connects for the	170.57
Subtotal 731100 - LAB SUPPLIES								$5,179.68
731220 ANIMAL FEED								
04/25/2016	-	-	005206	VCHR# UFLOR - P0463581	-	INVOICE# 91712197	Furst McNess Co - Bagged Calcium Carbonate	71.18
Subtotal 731220 - ANIMAL FEED								$71.18
	-	-						
Subtotal Other Operating Expenses								$14,250.86
00125106 - EFFECT OF THE NATURAL BIOPOLYM~209~60770000 (Project~Fund~Department)								$15,983.79

Title: Effects of the natural biopolymer chitosan on performance of growing cattle

Final Report

Principal Investigator: Drs. Nicolas DiLorenzo, Cliff Lamb, and Jose Dubeux, North Florida Research and Education Center

Relevance to Florida Cattle Industry: Future markets show a decline in cattle prices relative to those of previous years. It will be necessary for Florida producers to add value to their calves and one of the most effective strategies is to increase feed efficiency. This study evaluates the effects of chitosan on the performance of growing beef cattle consuming a high-forage diet. The cost of an average backgrounding diet or winter feeding can be as high as $120-140 per ton or more, depending upon the cost of the roughage source and supplemental feed. By increasing the digestibility of rations, beef producers in the state of Florida can potentially save $13 – 14 per head over a 90 day feeding period. At approximately 700,000 growing steers and heifers per year in Florida, this translates into $9.1 million in feed savings.

INTRODUCTION

Chitosan (N-acetyl-*D*-glucosamine polymer) is a natural biopolymer formed from the deacetylation of chitin. Chitin, the second most abundant organic compound on earth, can be found in the cell walls of lower plants and the exoskeletons of some arthropods and crustaceans (e.g., crab and shrimp). Chitosan has been studied for various applications in food preservation and medicine due to its antimicrobial actions (Cuero, 1999; Shahidi et al., 1999). In the U.S., chitosan has been deemed "generally recognized as safe (GRAS)" status, which ultimately opens the way for chitosan to be used as an alternative to antibiotics. Chitosan should not be considered a single compound, but rather a series of compounds with differing levels of deacetylation and other physic-chemical characteristics (Goiri et al., 2009a). Chitosan, as an in vivo CH_4 inhibitor, is a novel product for ruminants; however, there have been studies with monogastrics (i.e., poultry and swine) showing it can alter protein fermentation in the lower gastrointestinal tract (O'Shea et al., 2011; Han et al., 2013).

Our laboratory has recently investigated the effects of chitosan on nutrient digestibility and enteric CH_4 production (Henry et al., 2015a). Growing heifers were provided a high-roughage diet containing 64% peanut hulls and 36% concentrate (50:50 mixture of soybean hull pellets and corn gluten feed pellets). These heifers were subjected to one of three treatments: CTRL (0.0% chitosan), 0.5 (0.5% chitosan inclusion rate) and 1.0 (1.0% chitosan inclusion rate). Chitosan had no effect ($P = 0.65$) on enteric CH_4 production of growing heifers. When nutrient digestibility was evaluated, chitosan, at 1.0% of the diet DM, elevated DM and OM digestibility by 21 and 19%, respectively ($P \leq 0.05$; Figure 1). It was evident that the increases found in DM and OM digestibility were due to an increase ($P = 0.05$) in ADF digestibility and a tendency for an increase in NDF digestibility ($P = 0.08$). These results indicate that chitosan may have a beneficial effect on fiber digestibility, more specifically hemicellulose and cellulose.

Objective: To determine the effects of the natural biopolymer chitosan on growth performance indices and ruminal metabolism of growing beef cattle consuming a high-roughage diet.

Project Overview:

- Eight ruminally cannulated steers were used in a crossover design and 120 crossbred heifers were used in a completely randomized design
- Cannulated steers were fed either 0 or 80 g/d of chitosan via the ruminal cannula for 14 d during the adaptation period. Heifers were fed a TMR diet with chitosan included at 1% of the diet DM
- After the adaptation period, steers were sampled to measure ruminal fermentation parameters that may be indicative of improved performance, such as ammonia nitrogen and volatile fatty acid concentrations. Additionally ruminal fluid samples were taken to conduct a metagenomics analysis of the microbial populations in an attempt to elucidate a mode of action of chitosan on ruminal fermentation modification.

RESULTS

Table 1. Analyzed[1] chemical composition of Tifton 85 bermudagrass hay fed to cannulated steers, and backgrounding diet fed to growing heifers during the experiments.

Item	Hay	Backgrounding diet[2]
DM, %	91.2	84.4
OM, %	85.6	94.0
CP, %	13.0	12.5
NDF, %	71.5	57.5
ADF, %	40.6	46.9
TDN, %	56.0	52.0
Calcium, %	0.41	0.58
Phosphorus, %	0.29	0.28
Magnesium, %	0.32	0.20
Potassium, %	1.63	1.10
Sodium, %	0.09	0.15
Sulfur, %	0.49	0.25

[1]Analyzed by a commercial laboratory using a wet chemistry package (Dairy One, Ithaca, NY).

[2]Comprised of (DM basis): 51% peanut hulls, 22% corn gluten feed, 22% soybean hulls, 5% liquid supplements to provide vitamins and minerals.

Table 2. Effect of including 0 or 1% of chitosan in the diet DM on growth performance of heifers fed a backgrounding diet

Item	Control	1% Chitosan	SEM	*P*-value
DMI, lb/d	21.2	20.8	1.08	0.86
ADG, lb	0.57	0.82	0.185	0.074
G:F	0.022	0.032	0.0249	0.89

Table 3. Effect of including 0 or 1% of chitosan in the diet DM on ruminal volatile fatty acid molar proportions measured every 3 h for 24 h in ruminally cannulated steers

Item	Control	1% Chitosan	SEM	*P*-value	
				Treatment	Treatment × time
VFA, mol/100 mol					
Acetate	75.3	75.1	0.28	0.76	0.03
Propionate	14.7	15.2	0.24	0.18	0.02
Isobutyrate	1.0	1.0	0.05	0.48	0.002
Butyrate	6.3	6.1	0.17	0.40	0.06
Isovalerate + 2 MB	1.5	1.4	0.05	0.03	0.03
Valerate	0.9	0.9	0.04	0.83	0.69
A:P	5.1	4.9	0.09	0.22	0.02
Total	93.9	97.8	4.20	0.52	0.07

Figure 1. Effect of feeding 0 or 80 g of chitosan/d on OM disappearance in the total tract of ruminally cannulated steers.

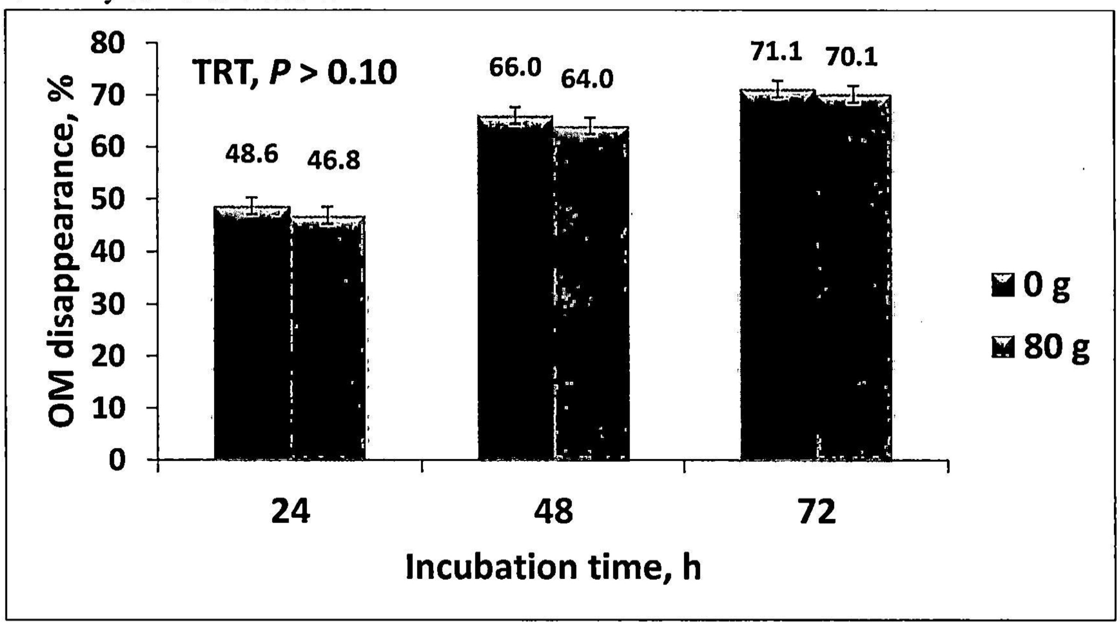


Figure 2. Effect of feeding 0 or 80 g of chitosan/d on ruminal pH measured every 3 h for a 24-h period in ruminally cannulated steers.

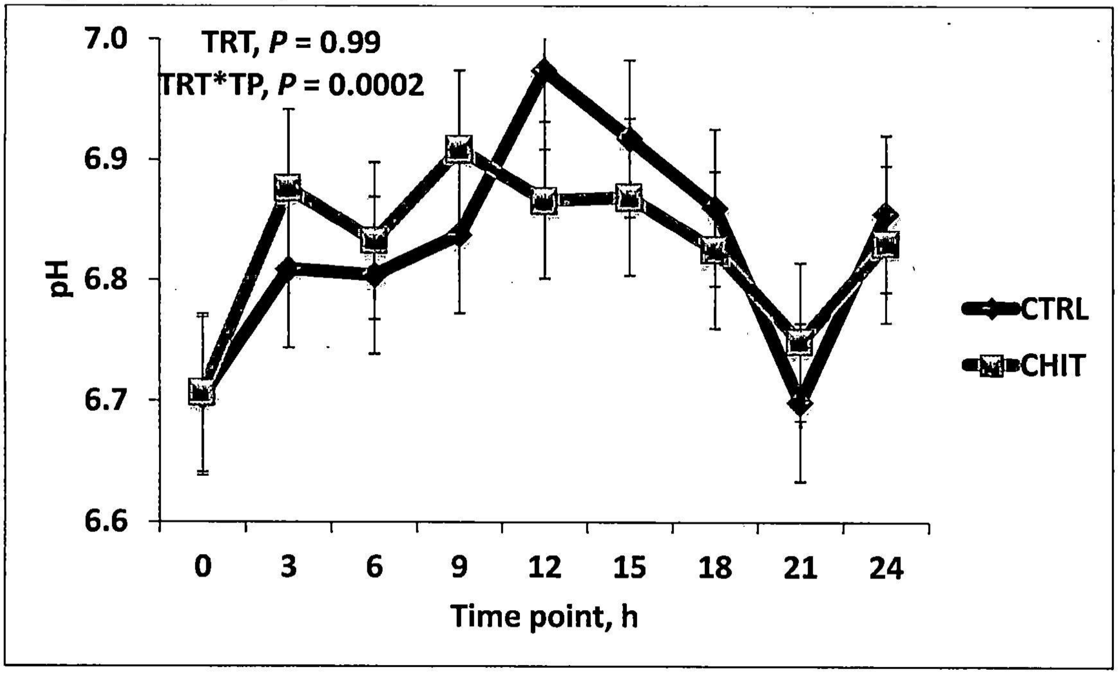


Figure 3. Effect of feeding 0 or 80 g of chitosan/d on ruminal ammonia-N concentrations measured every 3 h for a 24-h period in ruminally cannulated steers.

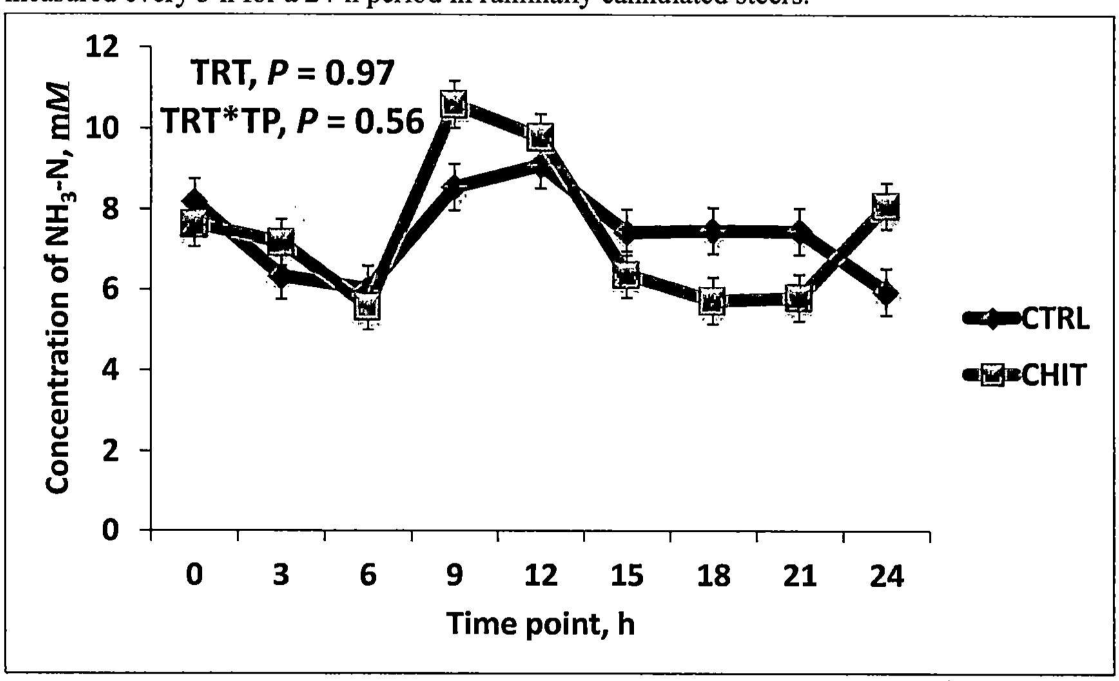
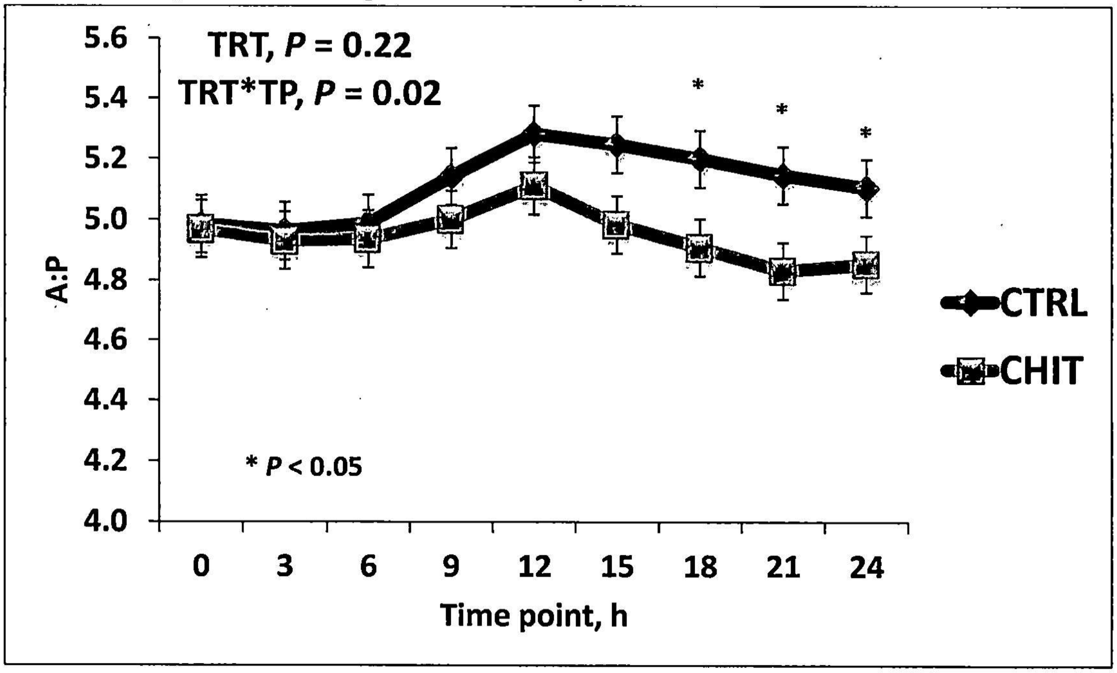


Figure 4. Effect of feeding 0 or 80 g of chitosan/d on ruminal acetate to propionate ratio measured every 3 h for a 24-h period in ruminally cannulated steers.



CONCLUSION

The inclusion of chitosan as a feed additive fed at 80 g/head/day or 1% of the diet DM in a backgrounding heifer diet, appear to have potential effects on ruminal digestion that lead to enhanced energy metabolism. In backgrounding heifers, a difference in ADG of 0.25 lb/d was obtained with the inclusion of chitosan relative to control heifers, however this was only a trend ($P = 0.07$) and was not statistically significant. The daily cost of chitosan feeding at current market prices and at the tested dose is of $0.4/hd/d. At current cattle prices the added weight gain with chitosan feeding does not cover the cost of the product, however if cattle prices increase slightly, chitosan feeding could become a very attractive alternative. Additionally, future research should focus on the mass production of chitosan at a lower cost than the actual one. Currently the lack of demand for this additive does not create any incentives for research to reduce production costs, however the potential exists in the case of further restrictions on the use of antimicrobials as growth promoters.

References

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