

Final Technical Report
FCEB Project #15

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August 15, 2024
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Title: Addressing labor shortage: Use of intake limiters to design free-choice supplementation programs

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1. Specific aims:

Livestock operation's cost of production could be significantly impacted by supplementation, through an increase not only in feed purchasing, but also labor and time involved in feed delivery. Recognizing the importance of protein supplementation to improve animal performance, and the cost and uncertainty of farm labor, this project aims to diminish the feeding labor using self-feeding technologies. This research is aligned with FCA research priorities #5: "Herd nutrition". The objective is to evaluate different additives with potential as intake limiters when added to protein supplements and select the most promising one to be used in a large field study to test self-feeding and free-choice access to both ensiled forages and protein supplements.

Specific objectives are:

- To determine inclusion levels of stock salt, tannins, and Fermenten (Church & Dwight, Princeton, NJ) to be used as protein supplement intake limiters
- To compare effectiveness of the three limiters at the inclusion rate selected for each, on a self-feeding sorghum silage system with free-choice access to a protein supplement
- To evaluate the economic impact of potential labor savings with these self-feeding technologies when the cost of the intake limiter is included

2. Significance

Cattle production is the most important agricultural industry in the United States, accounting for the largest share of total cash receipts for agricultural commodities (USDA-ERS, 2022), Florida is ranked in the 10th position for beef cows' inventory (USDA-NASS, 2021). It is mostly a cow-calf state, generating around 800,000 calves annually, where most of the males are shipped to other states to be finished and processed. Finding qualified labor force is becoming increasingly difficult in beef cattle production (and agriculture in general), challenging the future and productivity of

cattle operations. Labor shortage is causing a great concern for several industries along the United States, and US farms and livestock operations employed 11% fewer workers on 2021 than on 2020 (USDA-ERS, 2022). This is a result of many factors, including migration to urban areas and a declining interest in agricultural employment. In response, implementing technologies to increase production capacity and decrease the demand of labor is needed.

Supplementation to meet nutrient requirements is a major portion of the activities in a livestock operation, requiring much labor and time in feed delivery, loading, and unloading. To avoid overconsumption of expensive feedstuffs, and to address labor shortage issues, novel self-feeding technologies should be a research priority. An intake limiter allows cattle free-choice access to feed while also controlling consumption. Limiting the intake of supplements has been an objective of the livestock industry for years, and supplements have been developed with physical or chemical barriers such as blocks or liquids. However, large variation on individual consumption and a high incidence of animals that do not consume had been reported (Bowman and Sowell, 1997).

Daily salt requirement is less than 0.06 lb/animal/day, however voluntary intake can exceed their needs. There is a limit to salt intake, and Rasby (2011) showed that daily voluntary intake of salt was approximately 0.1 lb salt/100 lb BW for most classes of cattle. Including stock salt in supplements has been proved to limit feed intake (Kunkle et al., 2011) and it was more effective when compared with anionic salts and calcium hydroxide (Schauer et al., 2004). A disadvantage of stock salt as a limiter is the high variability from animal to animal and between operations (Reuter et al., 2017). This variation may be due to the quality of the drinking water for cattle and forage type and availability.

Fermenten (Church & Dwight Co., Inc., Princeton, NJ, USA), is an available commercial byproduct of lysine production, used to feed cattle as a source of ruminally degradable amino acids peptides and non-protein N (NPN, Cooke et al., 2009). Thus, an increase in forage intake on cattle feed low quality forage diets may be expected when feeding this product. Several years ago, while doing research with this byproduct at NFMREC, we noticed a rejection by cattle when Fermenten was included in the diet of backgrounding cattle, even though it was included at very low concentrations (Garcia-Ascolani et al., 2016). These findings gave us the idea of trying this byproduct now as an intake limiter when mixed in with cottonseed meal or any other protein source. This new use as an intake limiter of such byproduct, has not been tested until now.

Tannins are a group of high molecular weight polyphenolic compounds found in nature in many different families of plants, having a characteristic smell and astringent taste (Khanbabaee and Van Ree, 2001). Tannins have a positive effect on cattle when added in low doses, but at higher doses have a negative effect on feed intake (Smith et al., 1995). Landau et al. (2000) mentioned that tannins reduced meal size, making the intake more uniform throughout the day and related it to tannins astringency. Thus, tannins could be used as a potential supplement intake limiter, an approach that has also never been tested.

3. Approach

Phase 1:

The first phase will consist of three consecutive experiments to test each potential limiter separately. The study will be conducted at the University of Florida, North Florida Research and Education Center (NFREC) in Marianna, FL. Forty newly weaned Angus crossbreed steers (550 lb of BW, approx.) from the NFREC beef herd will be used for each experiment in a generalized randomized block design. Cattle will be allocated to concrete floored pens (1195 sq. feet) at the Feed Efficiency Facility (FEF), equipped with GrowSafe feed bunks to measure individual feed intake via radiofrequency identification. Each pen will have two GrowSafe bunks, one of them offering ad libitum sorghum silage and the other one containing cottonseed meal as a protein supplement only or with different doses of one of the three protein supplement intake limiters.

Experiment 1: Plain white stock salt coarsely ground will be used at different inclusion rates as a potential protein supplement intake limiter. Treatments will be: 1) Control (CTL) containing cottonseed meal only; and cottonseed meal plus 2) 3% salt (S3) 3) 5% of salt (S5) or 4) 10% of salt (S10).

Experiment 2: Fermenten (Church & Dwight, Princeton, NJ) will be evaluated in different inclusion rates as a potential protein supplement intake limiter. Treatments will be: 1) Control (CTL) containing cottonseed meal only; and cottonseed meal plus 2) 5% of Fermenten (F5) 3) 10% of Fermenten (F10) or 4) 20% of Fermenten (F20). Fermenten is a high-protein byproduct of lysine production.

Experiment 3: Growing heifers will be fed ad libitum amounts of sorghum Sudan silage with the following treatment: 1) Control (CTL) receiving sorghum Sudan silage ad libitum only; 2) Placebo (PCB), sorghum Sudan silage ad libitum plus cottonseed meal and corn grain (30:70) ad libitum without any intake limiter ; 3) sorghum Sudan silage ad libitum plus cottonseed meal and corn grain (30:70) ad libitum containing 10% of stock salt (SALT); or 4) sorghum Sudan silage ad libitum plus cottonseed meal and corn grain (30:70) ad libitum plus a commercially available intake limiter (RANGER).

Phase 2:

The study will be conducted at NFREC to test in large-scale field conditions the result found from the previous Phase. One hundred Angus crossbreed steers (750 lb of BW, approx.) from the NFREC beef herd will be used in a completely randomized design. Steers will be allocated to a paddock with a self-feeding sorghum silage bag (Fig. 1), allowing them to consume ad-libitum. Protein supplement will be delivered using the Super SmartFeed technology (C-Lock, Inc, Rapid City, SD). The Super SmartFeed (Fig. 2) is a portable and self-contained system designed to measure and control total daily feed delivery to individual feed animals while housed in a common area, based on RFID technology, it has four feed bunks that will be assigned one for each treatment. Treatments will be 1) Cottonseed meal



Figure 1: Self-feeding silage bag at NFREC, Marianna

as a protein supplement only (CTL) and cottonseed meal with the selected inclusion rate of feed intake limiter selected in the first phase 2) Salt (S) 3) Fermenten (F) 4) Tannins (T). Steers will be allowed to consume protein supplement based on the software-controlled delivery individually to each steer based on their assigned treatment. The study will consist in 14 d of adaptation period in which the animals will be allowed to eat self-feeding



Figure 2: Super SmartFeed machine at NFREC, Marianna.

sorghum silage ad libitum and cottonseed meal without intake limiters, followed by 56 days of performance data collection. On day 0 cattle will be randomly assigned to the treatments. Steers will be weighed in two consecutive days at the beginning (d -1 and 0) and at the end of the study (d 55 and 56). Interim unshrunk body will be recorded every 14 days. Individual daily feed intake of protein supplement will be recorded by the Super SmartFeed System.

An economic analysis of the self-feeding protein supplement using an intake limiter that allow ranchers to reduce labor vs. a traditional system with delivery of protein supplement 3 times/week will be performed.

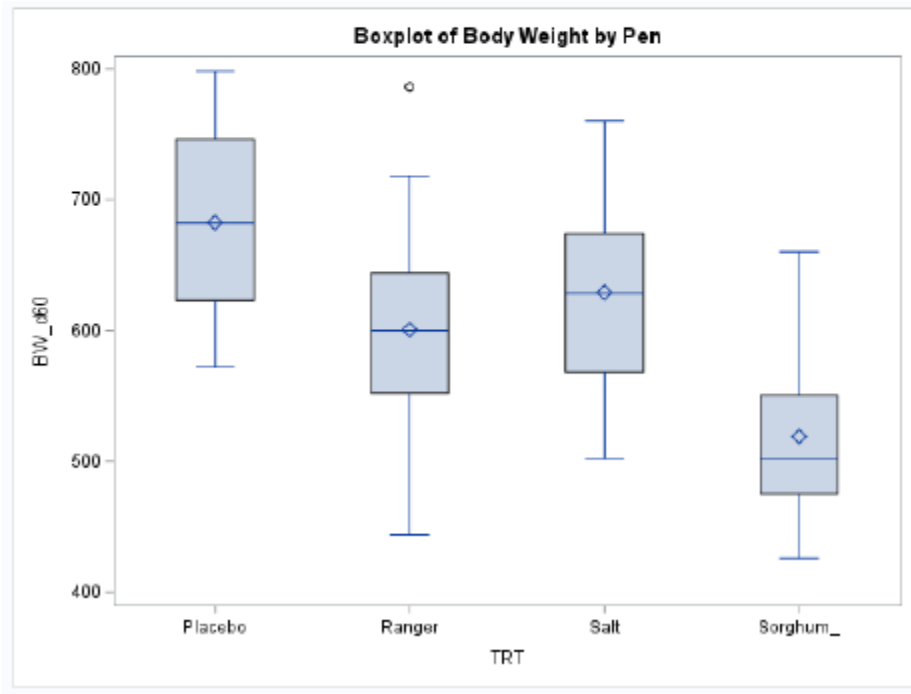
4. Anticipated outcomes and potential benefits

Developing cost-effective and free-choice supplementation programs should be a partial solution to labor shortage issues. One of the main outcomes of this study is to develop practical recommendations in terms of type of limiter and the particular amount to be mixed in with a protein source (e.g., cottonseed meal or DDGS) in order to achieve the desired supplement intake without daily delivery of it. An economic analysis will be made comparing traditional systems in Florida operations with these promising free-choice supplementation programs. With a gross wage rate of \$12.6/h for ranch help in southern U.S. (USDA), an estimated 4 h/day spent supplementing (highly variable), 90 days of supplementation, and 15,000 beef cattle ranching operations in Florida, savings in supplementation labor only (quite conservative amount, includes only one worker/operation) would be in the magnitude of \$68 million to the Florida cattle industry. Overall, the results of this project will provide technical and economical evidence on the best intake limiters to be implemented in Florida cattle operations to address labor shortage.

5. Results

BW AT DAY 60

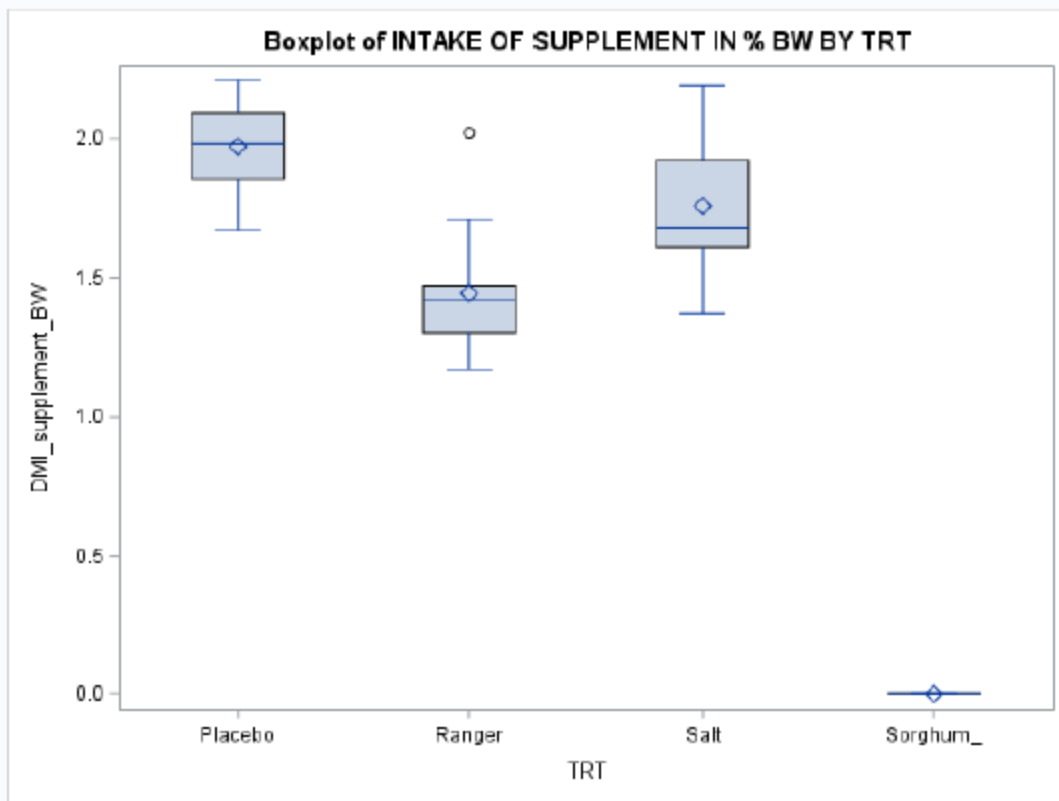
TRT	MEAN	SD	MIN	MAX
Placebo	682	69.7	572	798
Ranger	600	80.0	444	786
Salt	629	70.7	502	760
Sorghum_Silage	519	64.3	426	660



SUPPLEMENT INTAKE IN % BW

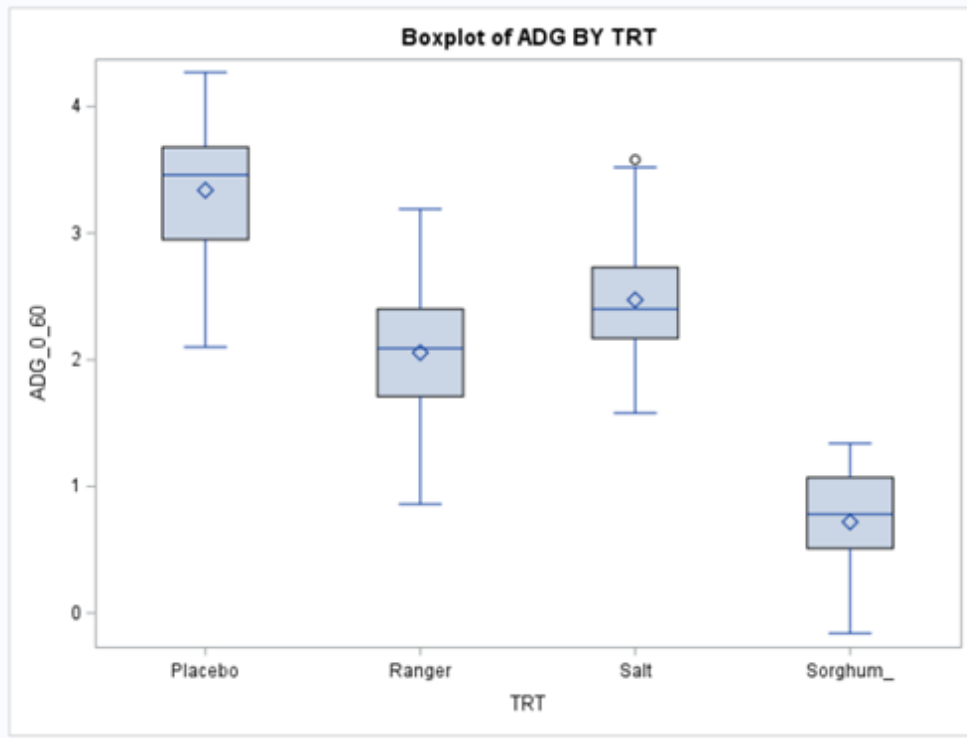
The MEANS Procedure

Analysis Variable : DMI_supplement_BW					
TRT	N Obs	Mean	Std Dev	Minimum	Maximum
Placebo	21	1.9705000	0.1479856	1.6700000	2.2100000
Ranger	21	1.4433333	0.1992820	1.1700000	2.0200000
Salt	21	1.7571429	0.2288043	1.3700000	2.1900000
Sorghum_	21	0	0	0	0



ADG AT DAY 60

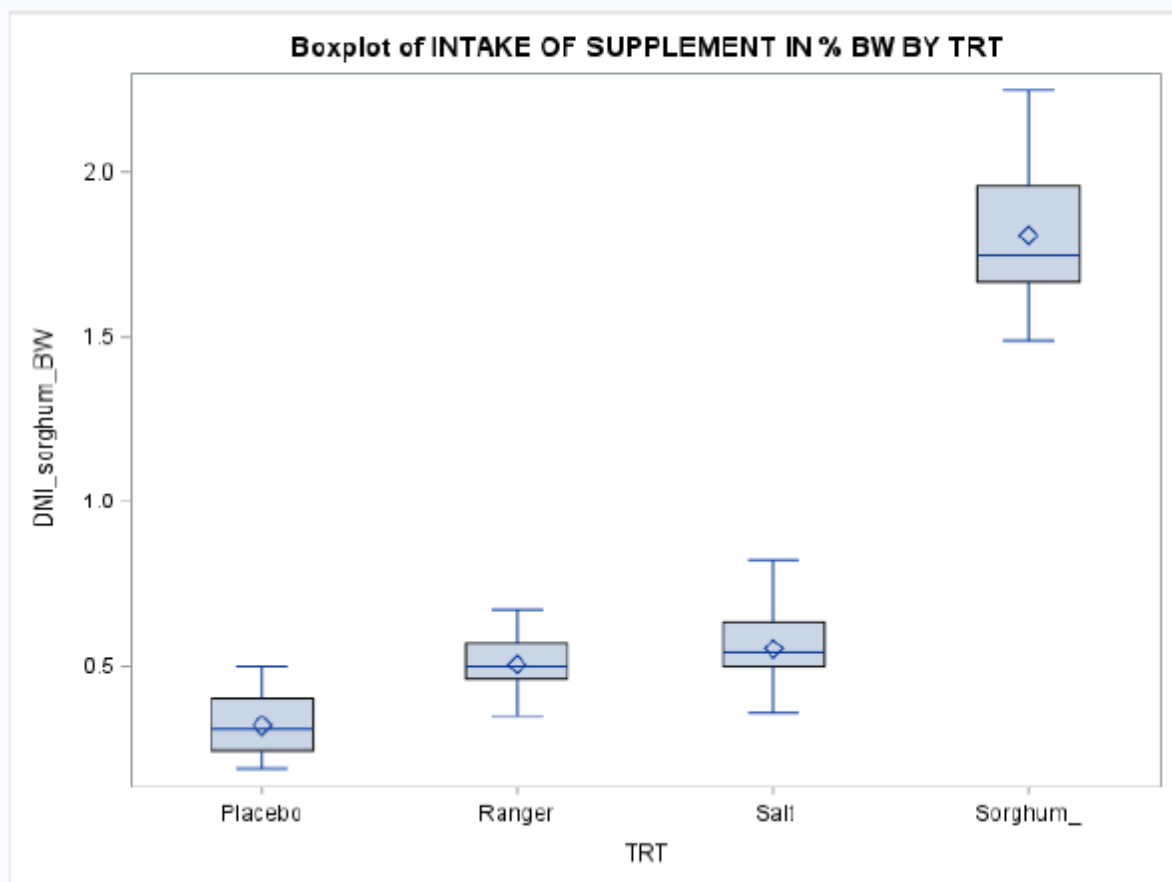
TRT	MEAN	SD	MIN	MAX
Placebo	3.34	0.5	2.1	4.27
Ranger	2.47	0.6	0.86	3.19
Salt	2.06	0.5	1.58	3.58
Sorghum_Silage	0.72	0.4	-0.16	1.34



SORGHUM INTAKE IN % BW

The MEANS Procedure

Analysis Variable : DMI_sorghum_BW					
TRT	N Obs	Mean	Std Dev	Minimum	Maximum
Placebo	21	0.3205000	0.0921940	0.1900000	0.5000000
Ranger	21	0.5033333	0.0901295	0.3500000	0.6700000
Salt	21	0.5514286	0.1277218	0.3600000	0.8200000
Sorghum_	21	1.8085714	0.2204832	1.4900000	2.2500000



6. Conclusions

Alternatives exist to reduce labor during the backgrounding period when supplementing protein and energy concentrates ad libitum. Without any intake limiter, a 70:30 corn:cottonseed meal concentrate supplement offered ad libitum was consumed at 1.97% of the body weight (BW) in heifers weighing 600 lb on average. With the inclusion of stock salt at 10% of the mix, the ad libitum intake of the concentrate was reduced to 1.76% of the BW. A commercial intake limiter was able to reduce ad libitum intake of the concentrate to 1.44%.

The ADG of heifers fed sorghum only (no concentrate supplement) was 0.72 lb/d which is suboptimal for developing heifers. With the inclusion of intake limiters, the ad libitum intake of sorghum was between 0.5 and 0.55% of the BW daily, but the ADG with limiters ranged from 2.1 to 2.5 lb/d. These rates of weight gain are almost optimal for heifer development. In conclusion, if the cost of supplement delivery can be reduced by the adoption of technologies like the ones researched here, optimal rates of growth can be achieved with reduced labor costs, likely greatly improving the cost of gain in backgrounding programs.

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Invoice Date: 08/14/2024
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 Principal Investigator: DiLorenzo, Nicolas
 Award Begin Date: 10/30/2023
 Award End Date: 07/31/2024

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Sponsor Award ID: 15
 Award Title: Addressing labor shortage: Use of intake
 limiters to design free-choice supplementation
 programs
 Award Amount: \$50,687.00

Invoice #	I000130472
UF Award #	AWD15834
Primary Project #	P0325274
Primary Department:	60770000
Current Invoice Amount:	\$42,614.65

Description	Current	Cumulative
Personnel - Salary	\$18,195.67	\$18,195.67
Personnel - Fringe Benefits	\$1,909.52	\$1,909.52
Tuition	\$5,384.76	\$5,384.76
Materials and Supplies	\$9,642.33	\$9,754.71
Contractual Services	\$0.00	\$76.00
Animal	\$2,437.25	\$9,444.80
Publication Costs	\$98.74	\$98.74
Other Expenses	\$15.83	\$26.23
Domestic Travel	\$366.57	\$366.57
Direct Cost	\$38,050.67	\$45,257.00
Facilities and Administrative Costs	\$4,563.98	\$5,430.00
Total	\$42,614.65	\$50,687.00

For billing questions, please call 352.392.1235
 Peterson, Nathan Kyle npeterson82@ufl.edu
 Please reference the UF Award Number and Invoice
 Number in all correspondence

By signing this report, I certify to the best of my knowledge and belief that the report is true, complete, and accurate, and the expenditures, disbursements and cash receipts are for the purposes and objectives set forth in the terms and conditions of the federal award. I am aware that any false, fictitious, or fraudulent information, or the omission of any material fact, may subject me to criminal, civil, or administrative penalties for fraud, false statements, false claims or otherwise. (U.S Code Title 18, Section 1001 and Title 31, Sections 3729-3730 and 3801-3812).

Nathan Peterson

 Certifying Official

Payment History	
Cumulative Invoices:	\$50,687.00
Payments Received:	\$8,072.35
Outstanding Balance:	\$42,614.65
Note: Outstanding balance includes current invoice amount	