

FERRAMENTAS DE PESQUISA PARA OTIMIZAÇÃO DA UTILIZAÇÃO DE ALIMENTOS



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29 de Julho, 2021

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University of Florida

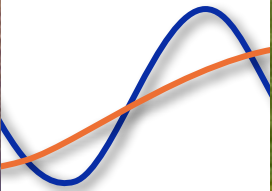
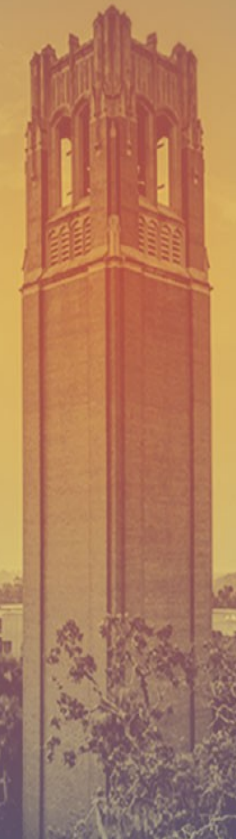
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Selz-Pralle Aftershock 3918 – 35.457,32 kg (116 kg/d)

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© Lea Jordan
Clybil Fisher Photography



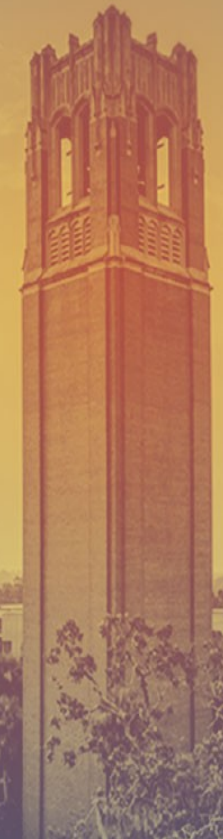
Schaff Angus Valley America 8018 – \$1.51 M

UF

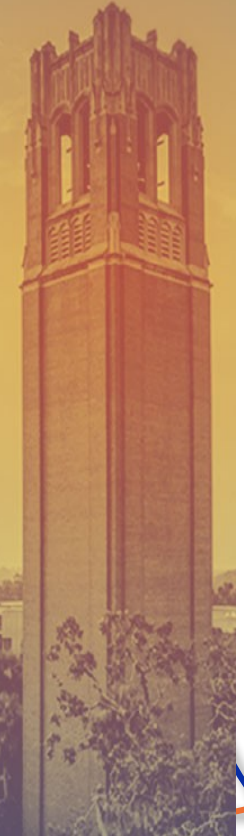
Record heaviest 205-day weight bull in SAV history at 1107 lbs!



+439
Pounds Above
Breed Average 205 Wt.



O que tem em comum?



At the Hannah Research Institute, in the mid-1950s, research workers seriously began to consider the contribution of end products of fermentation to energy metabolism of ruminant animals. The products that received most attention were the volatile fatty acids (Armstrong and Blaxter, 1957), but in general the rumen was treated as a “black box” where the inputs and outputs were emphasized, rather than what was going on inside it.

J. Czerkawski, 1986



A Microbiologist's View on Improving Nutrient Utilization in Ruminants

T. G. Nagaraja¹

University Distinguished Professor

Department of Diagnostic Medicine/Pathobiology

College of Veterinary Medicine

Kansas State University

Conclusion

Since the initiation of the study of this subject area in the 1940s by Robert Hungate, considered as the father of Rumen Microbiology, the rumen has become by far the most thoroughly investigated anaerobic microbial ecosystem. Despite the progress in our understanding of the microbiology of the rumen, the description that the rumen is a 'black box' is still unchallenged.

Gut microbiology: the black box and beyond

DOI:10.1111/j.1574-6941.2008.00607.x

First published online November 2008.

For most of the 20th century, gut microbiology studies focussed on pathogens involved in disease initiation and the role of cultivable commensals, and the microbial community was generally treated as a 'black box'.

 [Home](#)

[Background](#) | [28 Sep 2018](#) | [1 comment](#)

Rumen acidosis: Is it still a black box?



Career Goal

To positively impact society by **educating** future generations, training prospective **scientists**, and improving **livestock operations** locally and globally.



Research Impact

- Canola meal utilization
- Camelina & Carinata potential
- Omasal sampling
- Dual-flow continuous culture system

To help developing the gold standard in ruminal simulation in the world

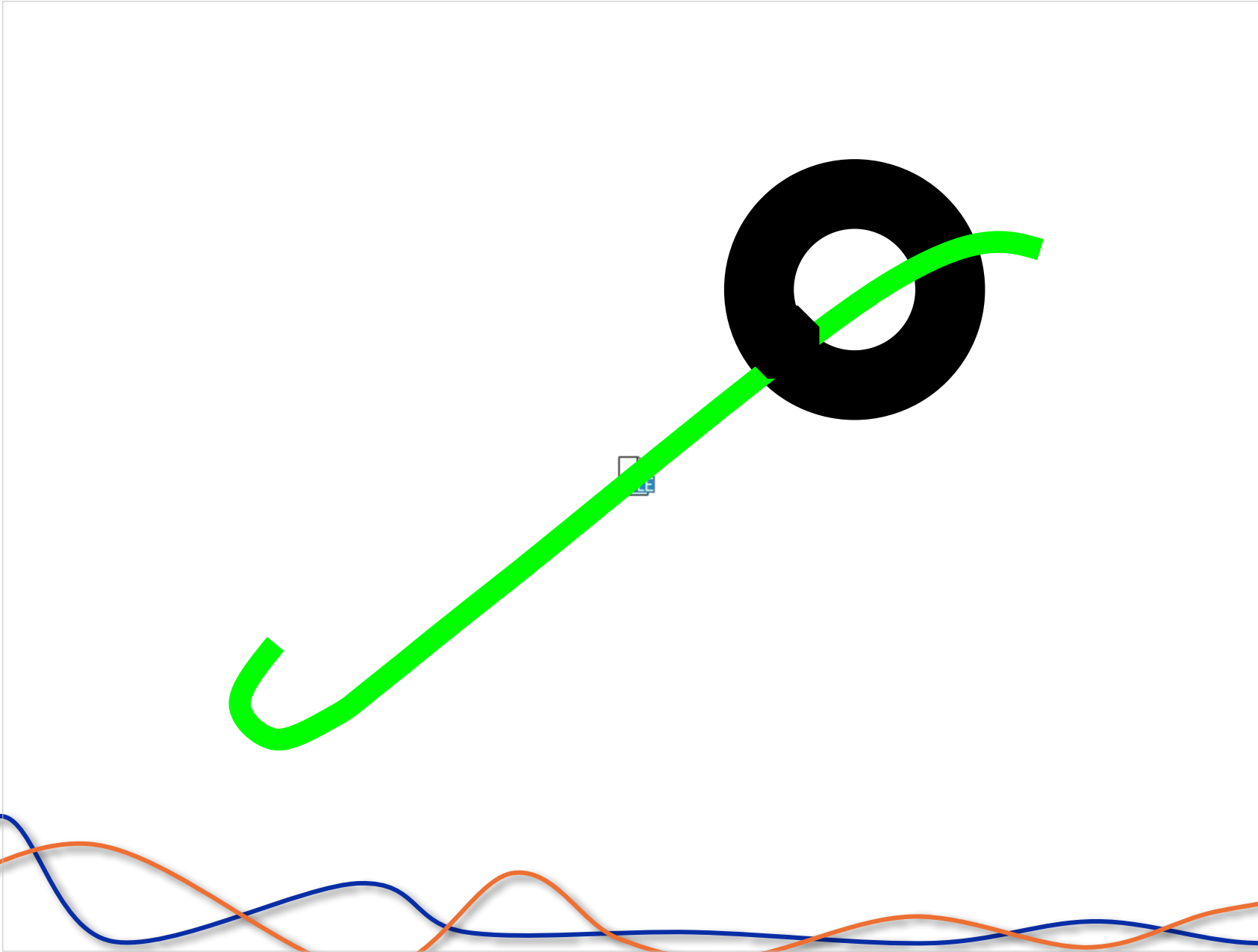


Omasal Sampling



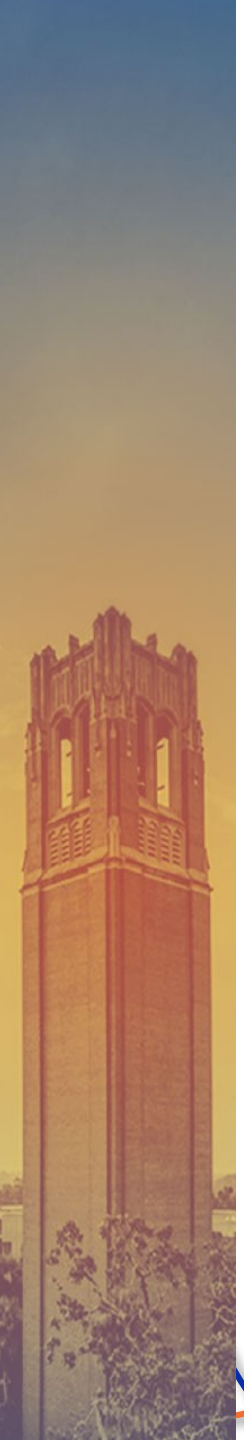
Trained over 20 scientists from Argentina, Brazil, Canada, Chile, China, Italy, Mexico, Norway, South Africa, Spain, Thailand, Turkey, and USA.

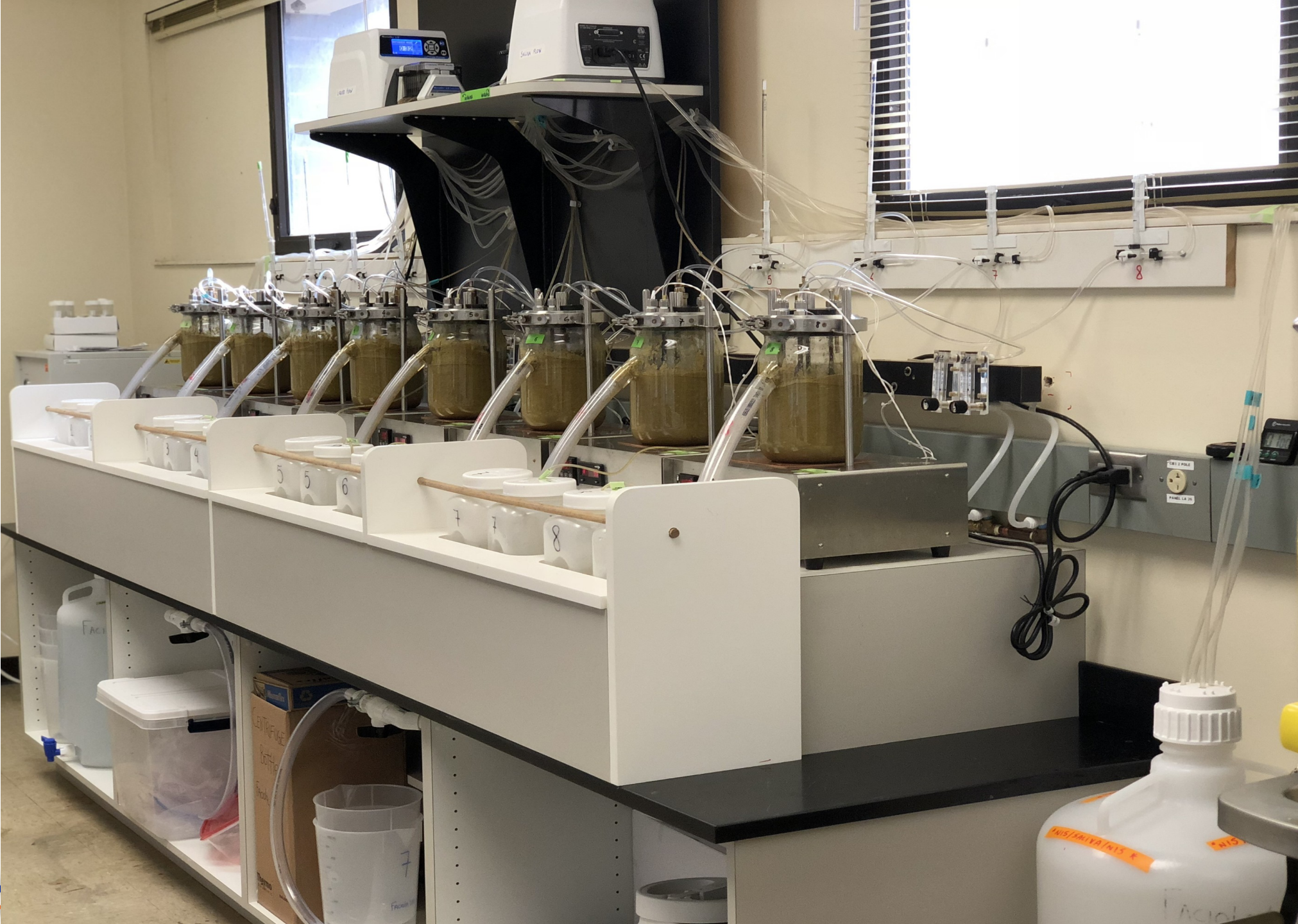
Omasal Sampling

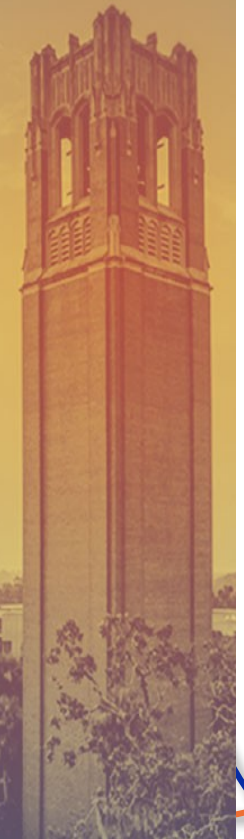


*Dual-Flow
Continuous Culture
System*

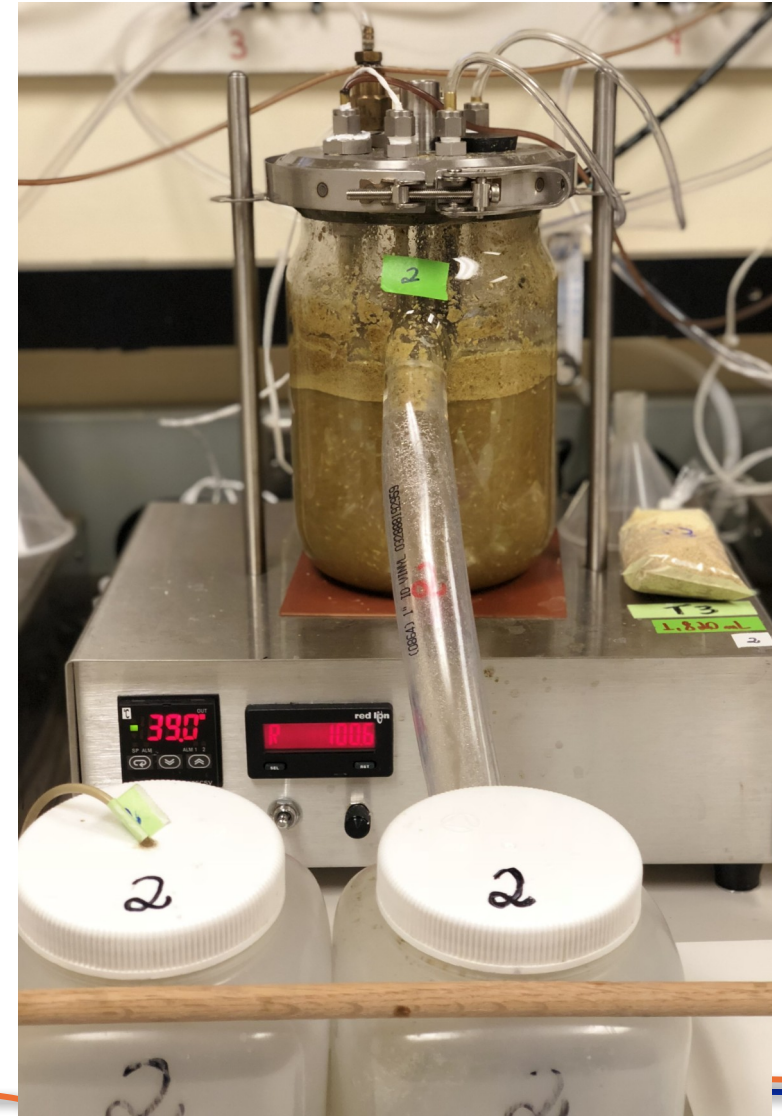
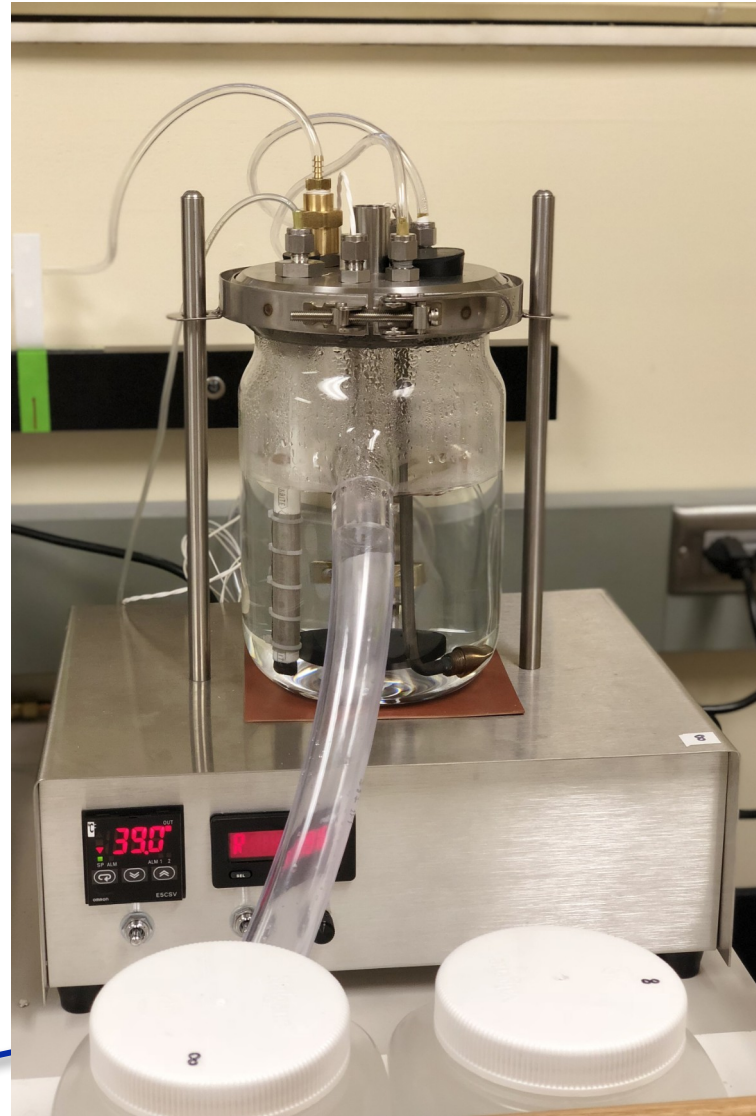
How it works



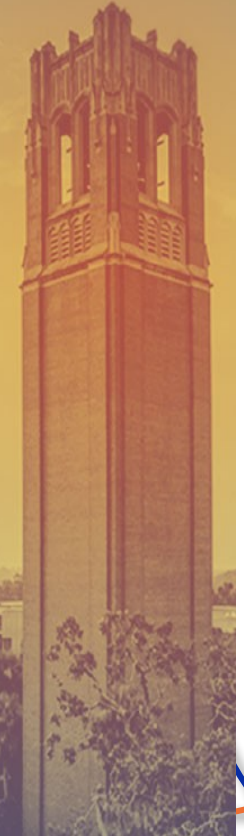
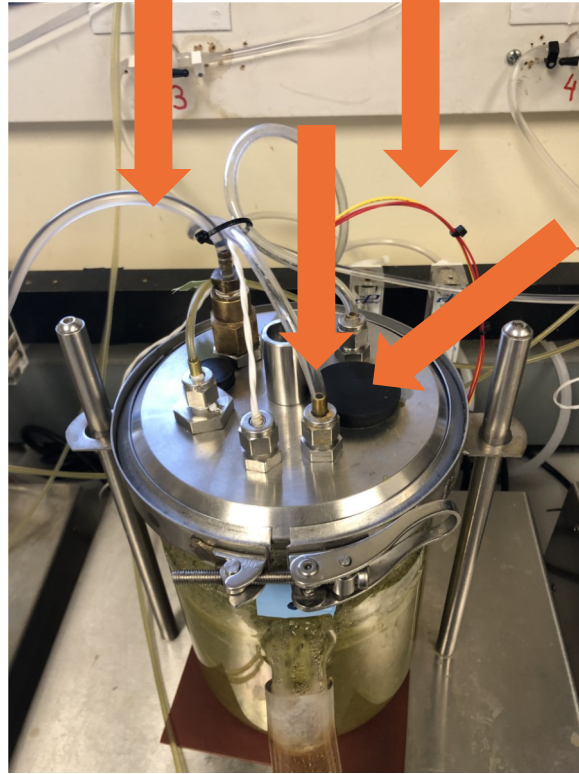
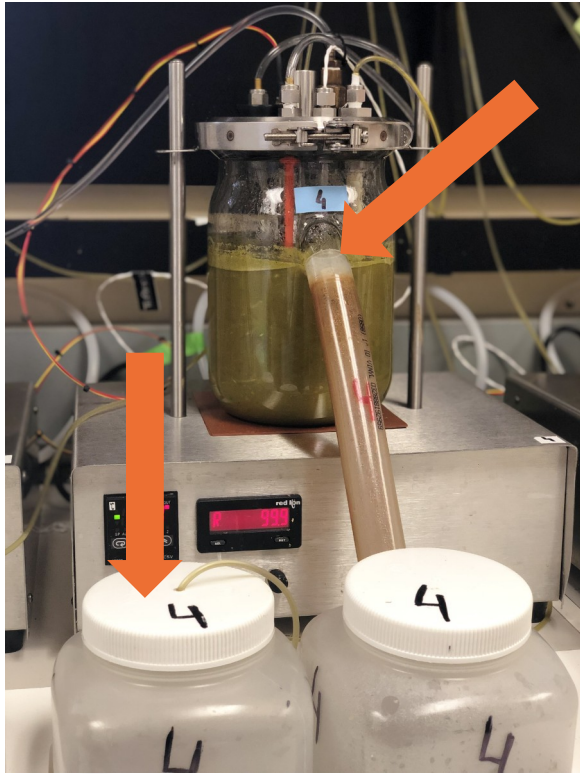




Dual-Flow Continuous Culture System

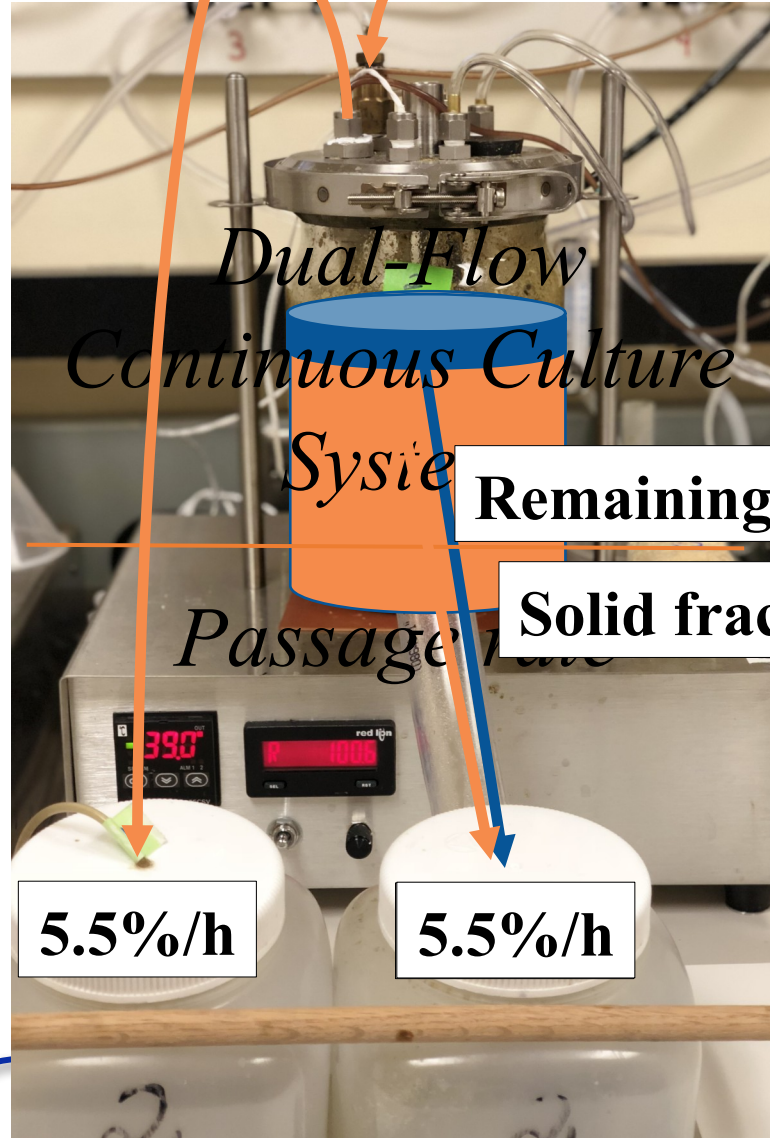


Dual-flow Continuous Culture System



Filtered liquid

Artificial saliva
11%/h



*Dual-Flow
Continuous Culture
System
Passage rate*

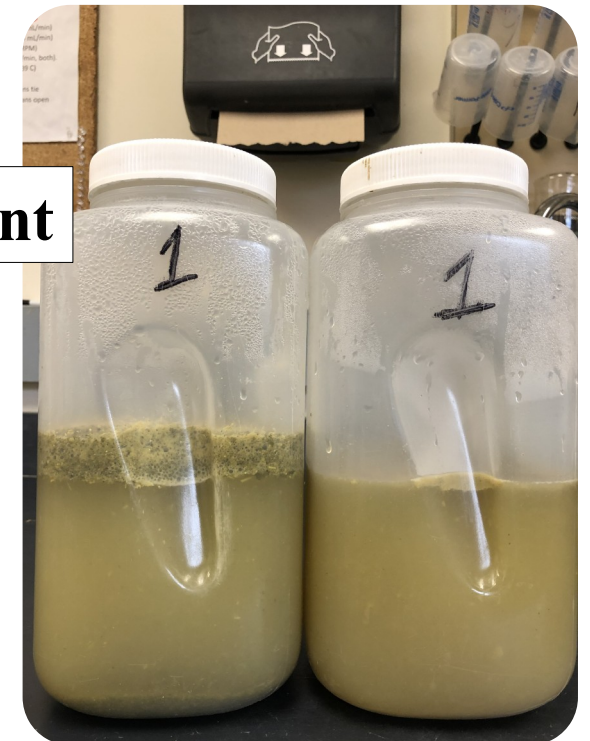
Remaining content

Solid fraction

5.5%/h

5.5%/h

- **Passage rate:**
 - 11%/h for liquid
 - 5.5%/h for solid



Pool of 24h

My Research Program

- Microbiology research



- Protein evaluation



- Forage testing



- Lipid research



- Carbohydrate research



- Micronutrients research



How would camelina seed affect ruminal bacteria?

 **frontiers**
in Microbiology

ORIGINAL RESEARCH
published: 03 November 2017
doi: 10.3389/fmicb.2017.02147

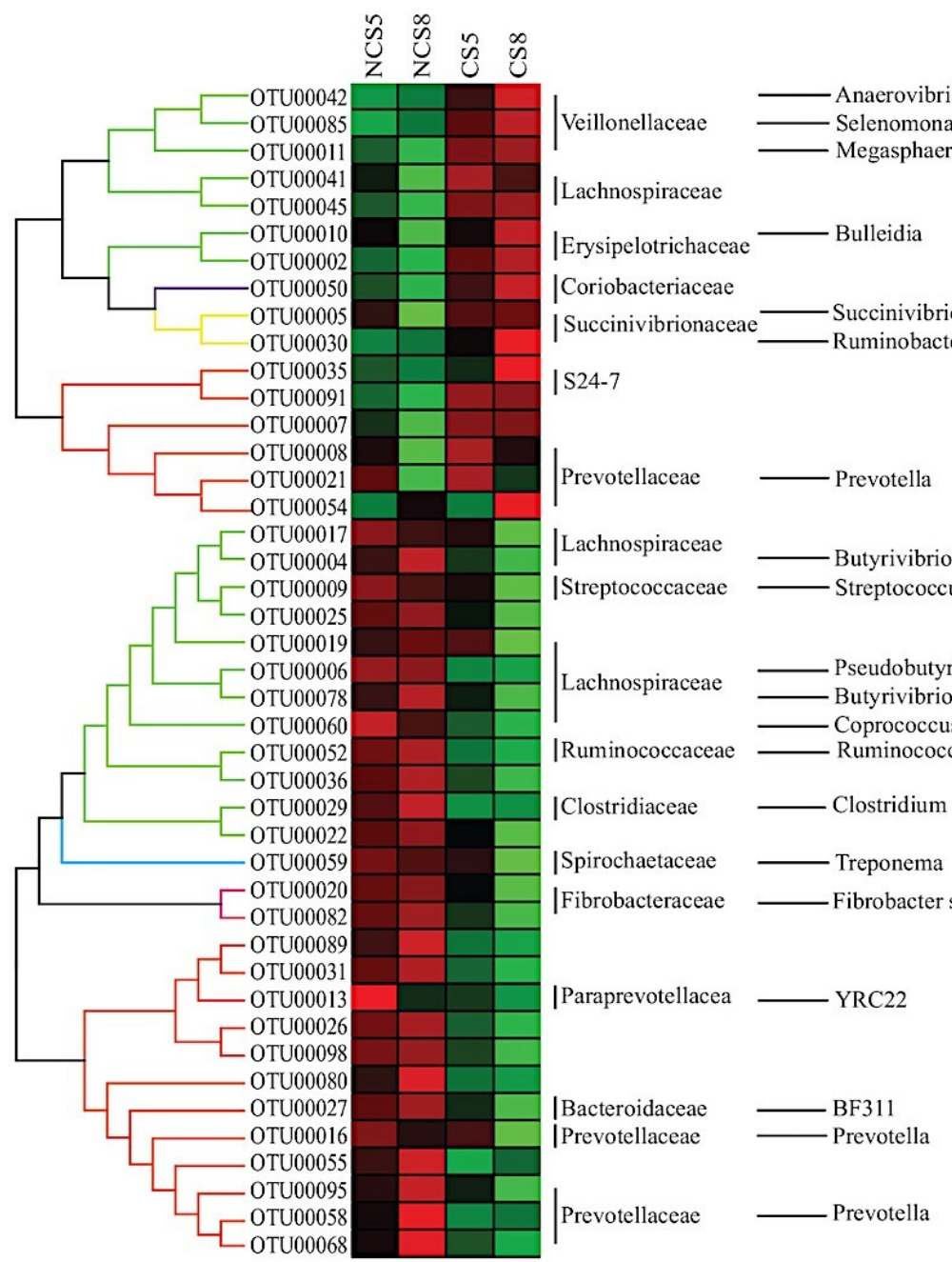
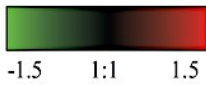


Camelina Seed Supplementation at Two Dietary Fat Levels Change Ruminal Bacterial Community Composition in a Dual-Flow Continuous Culture System

Xiaoxia Dai¹, Paul J. Weimer^{2,3}, Kimberly A. Dill-McFarland², Virginia L. N. Brandao¹, Garret Suen² and Antonio P. Faciola^{1*}



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Propionate producing bacteria ↑

Propionate producing bacteria ↑

↑ Hepatic gluconeogenic substrate

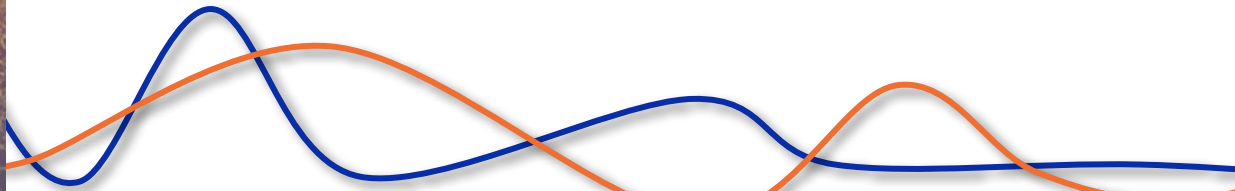
Biohydrogenation ↑ unsaturated FA ↓ saturated FA

Fiber digestion ↓

Conclusions

❖ Camelina seed

- Changed bacterial community composition
- Increased propionate-producing bacteria
- Reduced ruminal bacteria associated with biohydrogenation
- Reduced cellulolytic bacteria



Does LPS contribute to ruminal acidosis by affecting ruminal bacteria ?



J. Dairy Sci. 102:334–350
<https://doi.org/10.3168/jds.2018-14807>

© American Dairy Science Association®, 2019.

Effects of lipopolysaccharide dosing on bacterial community composition and fermentation in a dual-flow continuous culture system

X. Dai,¹ E. M. Paula,¹ A. L. J. Lelis,¹ L. G. Silva,¹ V. L. N. Brandao,¹ H. F. Monteiro,¹ P. Fan,¹ S. R. Poulson,² K. C. Jeong,¹ and A. P. Faciola^{1*}

¹Department of Animal Sciences, University of Florida, Gainesville 32611

²Department of Geological Sciences and Engineering, University of Nevada, Reno 89557



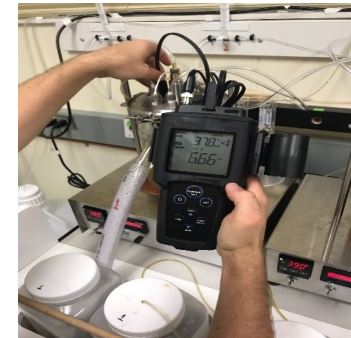
Conclusions

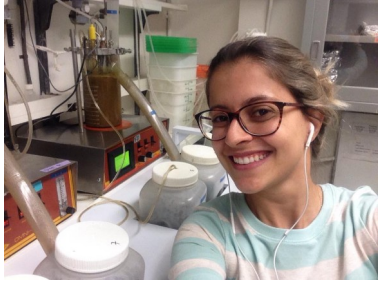
- ❖ **LPS dosing** **changed** BCC, stimulated the **gram-negative bacteria** associated with **starch digestion**.
- ❖ Dynamic patterns of VFA and LPS concentration in LPSD started to be similar to WBD (**SARA**) **6 h after the first LPS dosing**.

LPS may contribute to ruminal acidosis by affecting ruminal bacteria

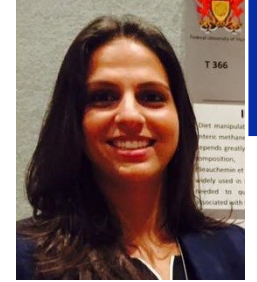
Ruminal Protein Degradation

- ***Soja***
- ***Soja tratada***
- ***Canola***
- ***Carinata***
- ***Camelina***
- ***Suplementos (AA, prebioticos, etc.)***





Oscillating Dietary CP Research



Objectives: To evaluate the effects of static versus oscillating dietary CP.

Material and Methods:

CP Static 10% CP diet

Static 12% CP diet

Static 14% CP diet

Oscillating 10 and 14% CP diets every 48 h



Forage Studies

Effects of carbohydrate and nitrogen supplementation on fermentation of mature cheatgrass (*Bromus tectorum*) in a dual-flow continuous culture system

Objectives: to evaluate the effects of urea, molasses, or a combination of both supplementation on a **MATURE** cheatgrass-based diet

Hypothesis: supplying carbohydrate and nitrogen concurrently on a mature cheatgrass-based diet would improve ruminal fermentation

Evaluation of immature cheatgrass and ephedra as alternative arid-land forages for beef cattle in a dual-flow continuous culture system

Objectives: to evaluate nutritional composition and ruminal fermentation patterns of **IMMATURE** cheatgrass and **ephedra**

Hypothesis: ruminal fermentation would be similar among the these forages and a commonly used forage in NV



Forage Kochia Research



UF

Objectives: To determine the nutritional value of forage kochia when compared to alfalfa and orchardgrass.



Uzbekistan & Turkmenistan

PEER – Partnership for Enhanced Engagement in Research



USDA - NIFA Food Security



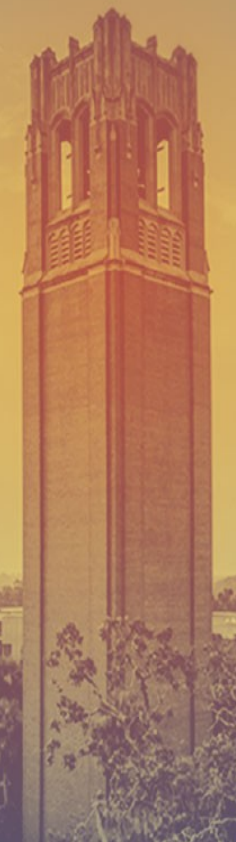
United States Department of Agriculture
National Institute of Food and Agriculture

Fatty Acid Studies

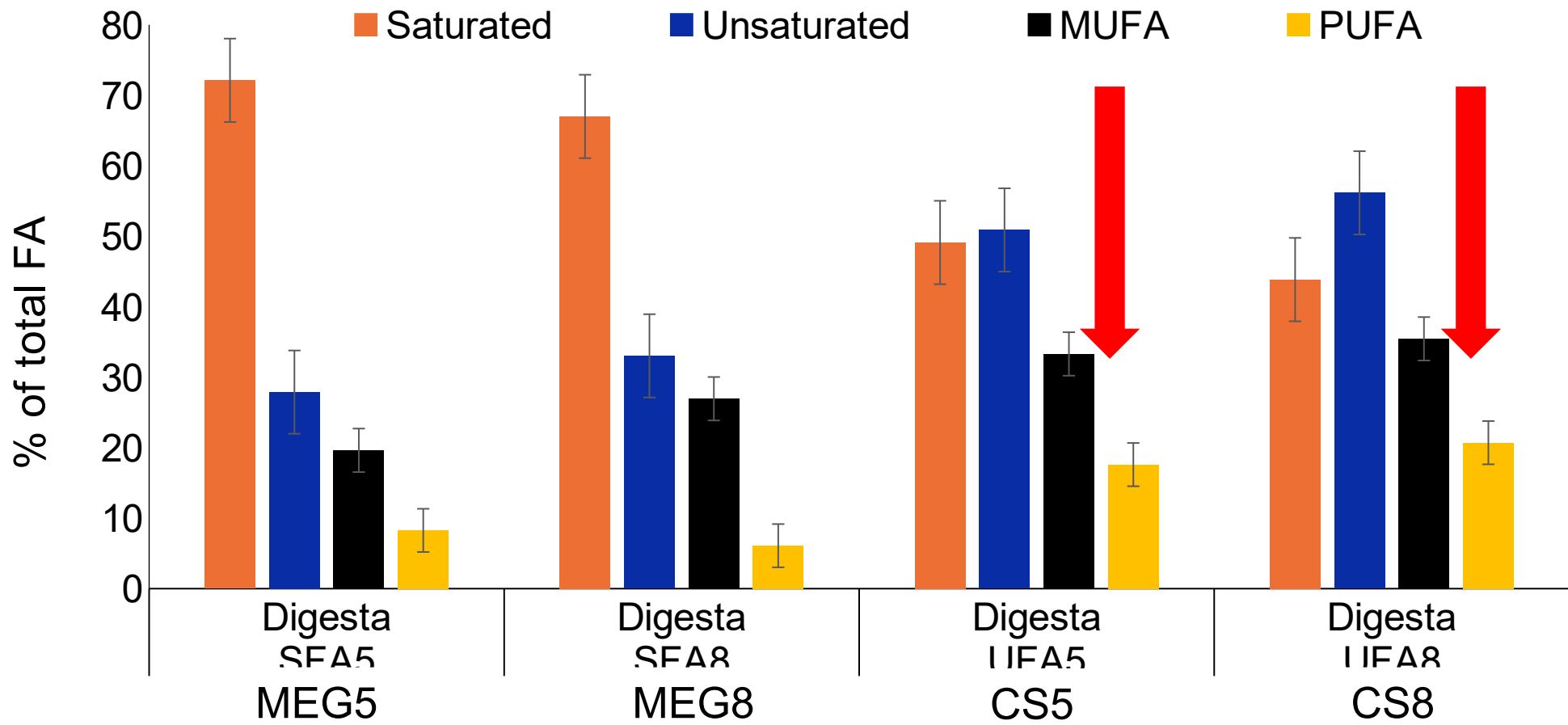
Camelina Seed

Effect of replacing calcium salts of palm oil with camelina seed at 2 dietary ether extract levels on digestion, ruminal fermentation, and nutrient flow in a dual-flow continuous culture system

J. Dairy Sci. 101:5046–5059
Brandao et al. 2018a



Fatty Acids Flow



* $P < 0.05$ only for camelina



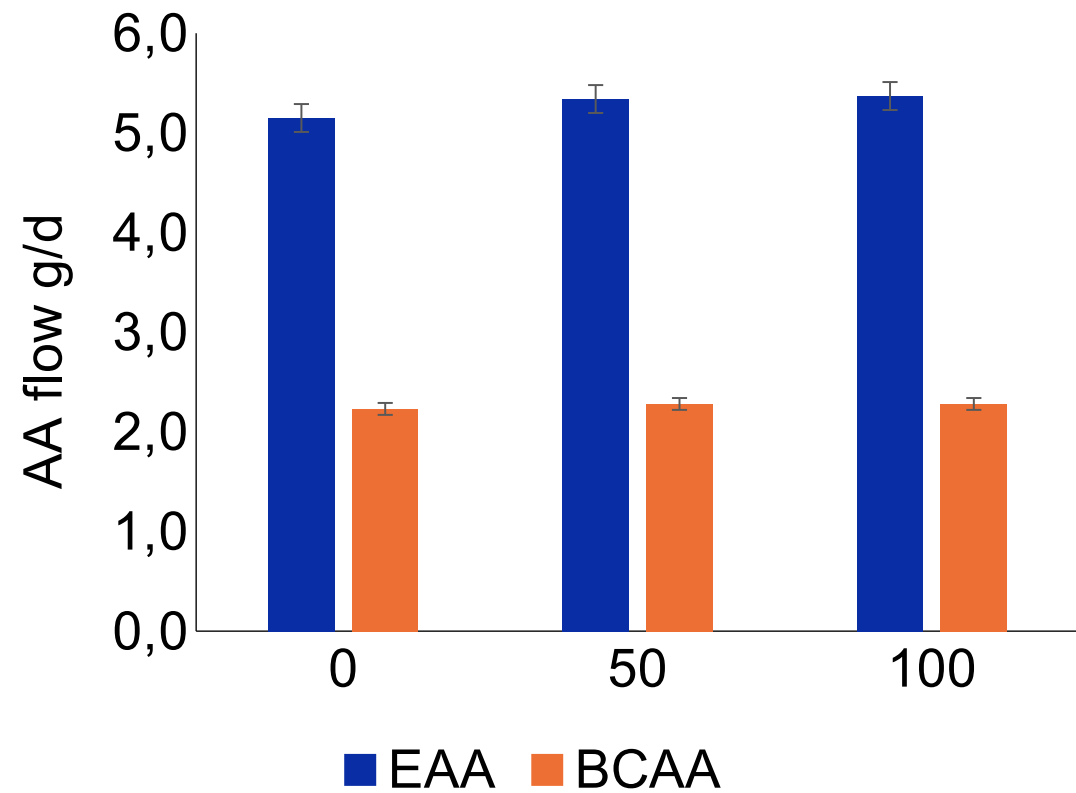
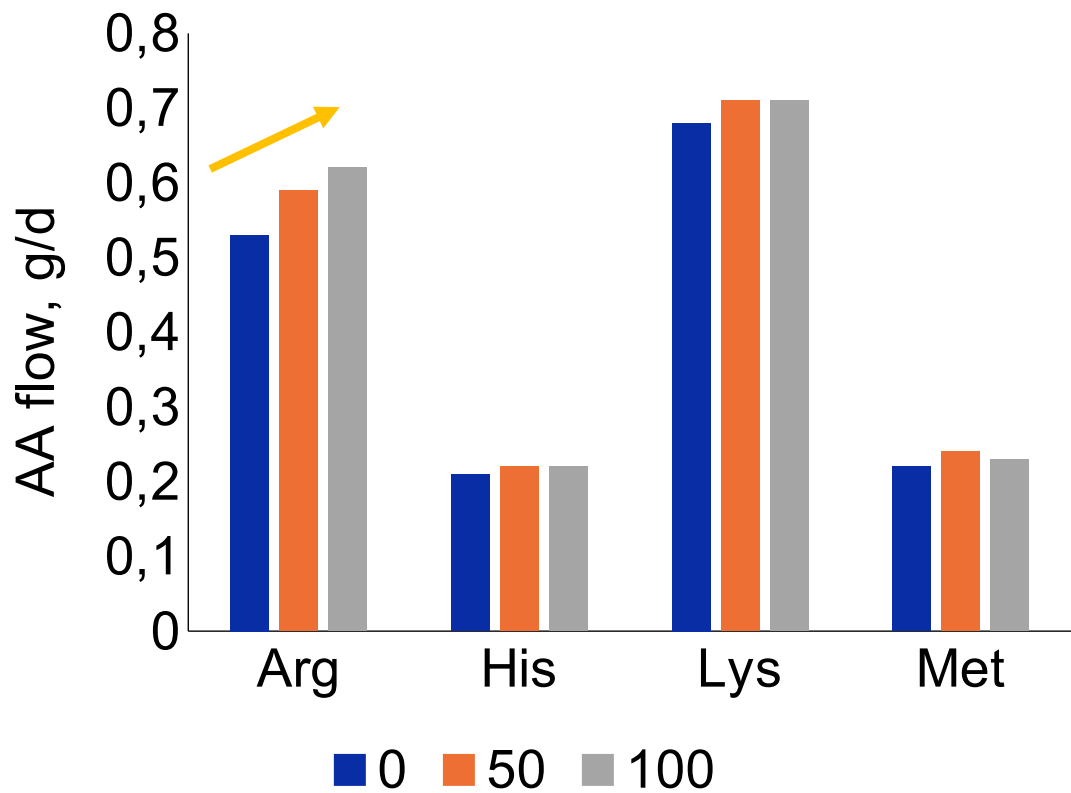
Solvent Extracted Camelina Meal

Effects of replacing canola meal with solvent extracted camelina meal on microbial fermentation in a dual-flow continuous culture system

J. Dairy Sci. 101:9028–9040
Brandao et al. 2018b



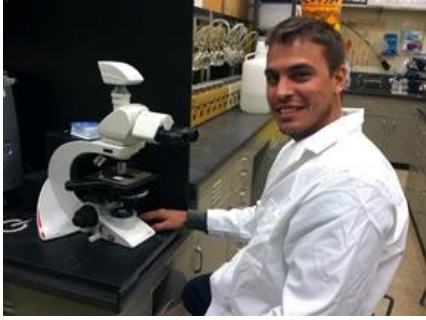
Amino Acid Flow



$P = 0.01$: Linear contrast for Arg

No effect





Glycerin Research



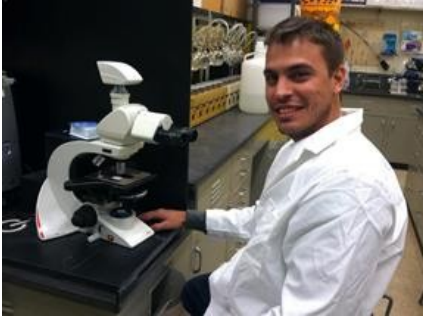
UF

Objectives: To evaluate the effects of partially replacing dry ground corn with glycerin on ruminal traits.

Treatments: 0, 15, and 30% of glycerin replacing corn.

Benedeti, et al. 2015. PLoS ONE, 10(11): e0143201

Glycerin Research

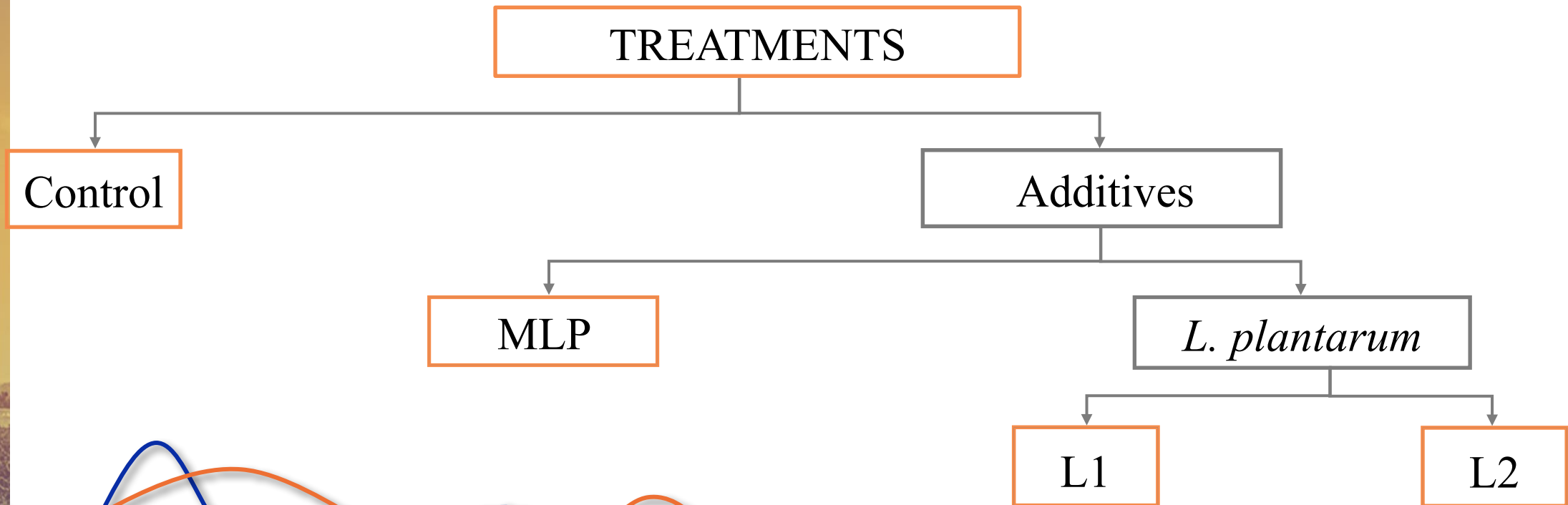


A large white rectangular area containing two horizontal red-outlined boxes, likely intended for text or images. A small blue icon with the letters 'OLE' is positioned in the center of the lower portion of this area.



Lactobacillus Study

- 4 treatments (Control; MLP; and 2 doses of *L. plantarum*):



Other studies

- Unprotected **choline chloride** in a dual-flow continuous culture system improves propionate concentration from low NDF diets
- Lipid-coat protection of **sodium selenite** and **copper sulfate** from microbial fermentation impacts VFA synthesis and Nitrogen metabolism in a dual-flow continuous culture system
- **Calcium-magnesium tetrahydroxide** and **sodium sesquicarbonate** similarly impact microbial fermentation in a dual-flow continuous culture system
- Evaluation of **yeast, live bacteria, and enzymatic compounds**

Assessment of Fermentation Responses in Dual-flow

Unveiling the relationships between diet composition and fermentation parameters response in dual-flow continuous culture system: a meta-analytical approach

Transl. Anim. Sci. 2019.3:1064–1075
Brandao and Faciola, 2019



Objectives

- To investigate the functional form of the relationship between diet composition (**dietary CP and NDF**) and amount of substrate (**fermenter DMI**) with microbial fermentation end products in a dual-flow continuous culture system (DFCCS) using a meta-analytical approach.

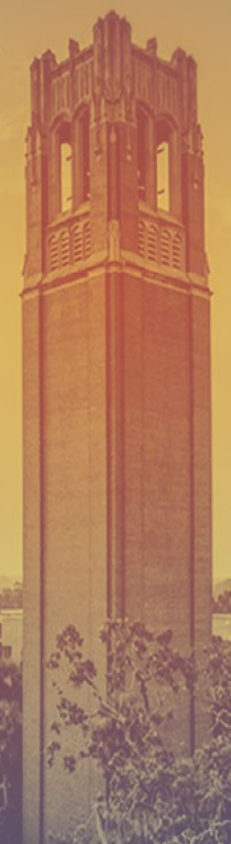
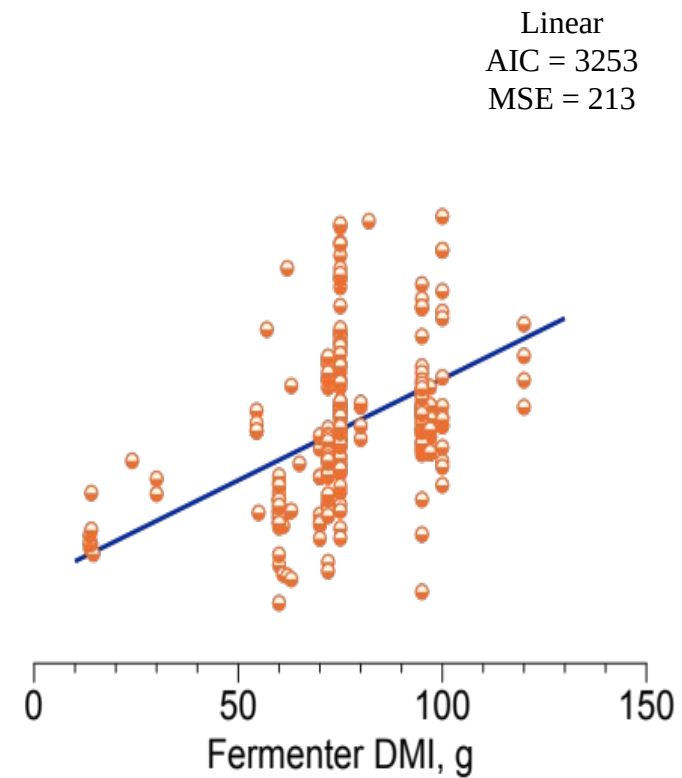
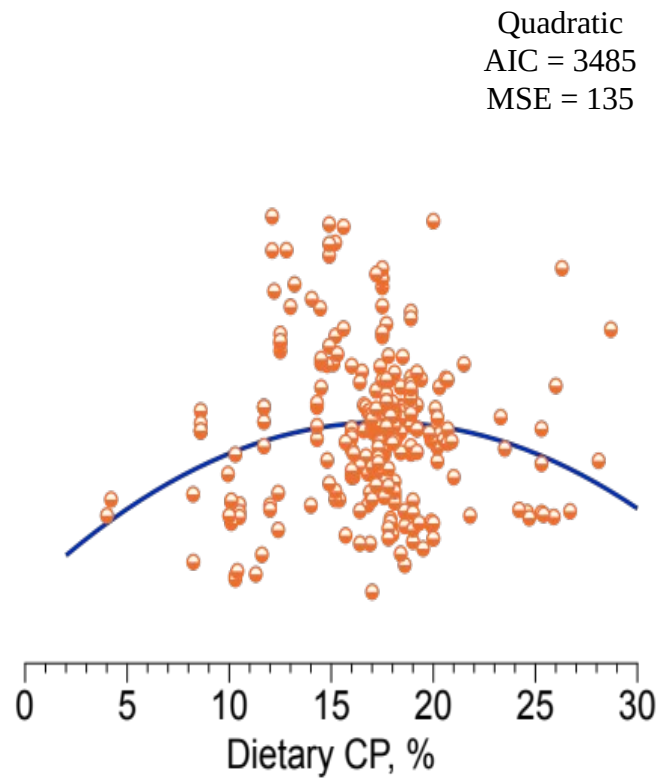
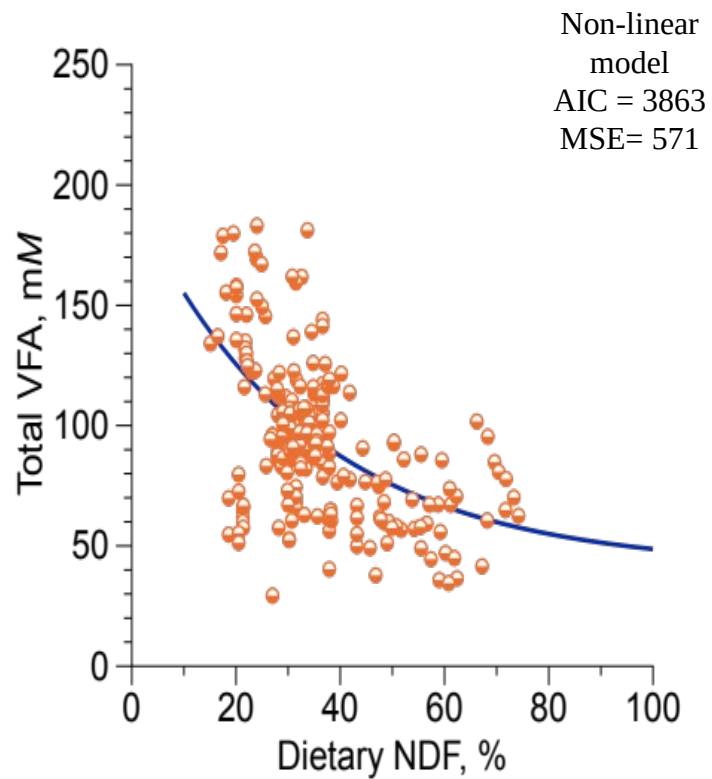


Materials & Methods

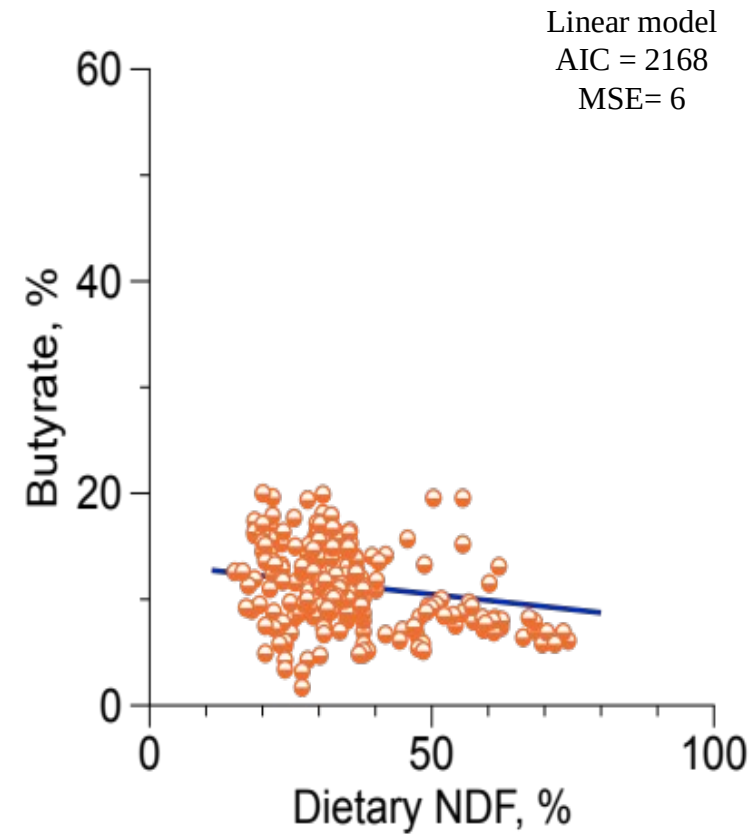
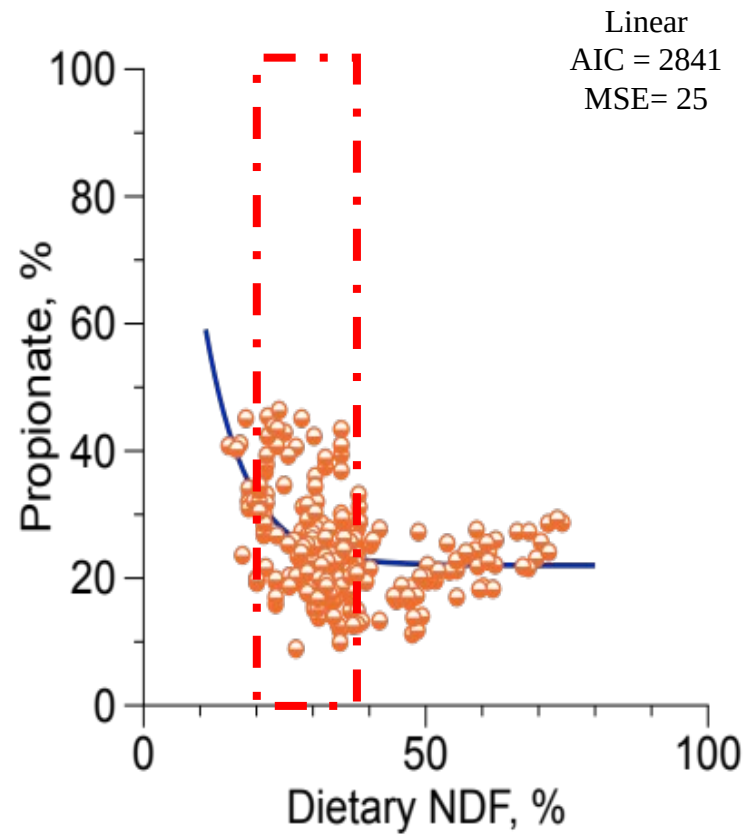
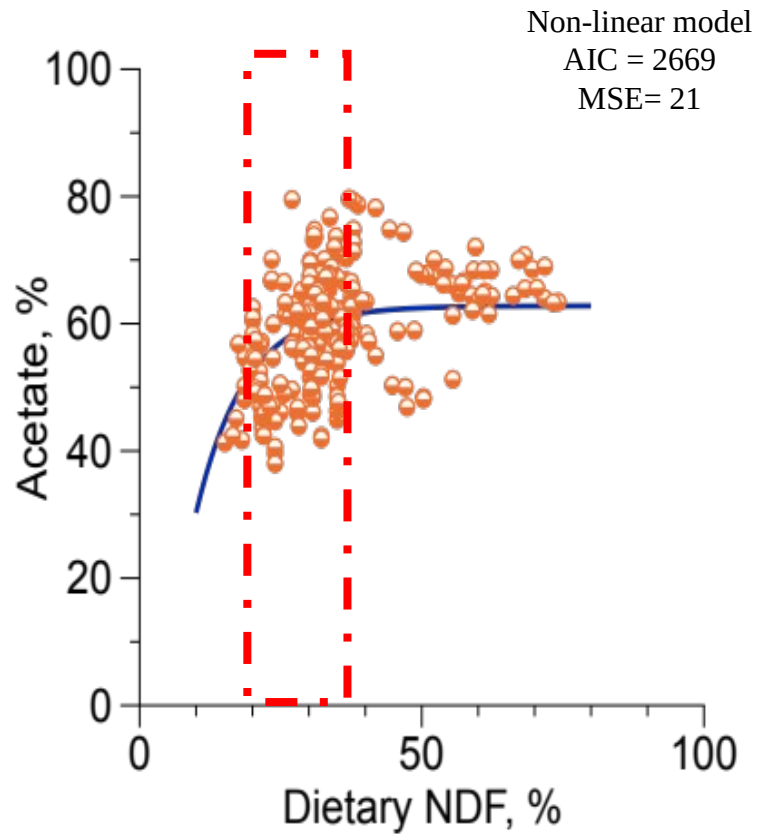
- Data Collection and Preparation
 - 75 peer-reviewed papers, published from 1985 – 2018
 - Only dual-flow continuous culture experiments using ruminal fluid from cattle
- Model Derivation Procedure
 - According to St-Pierre (J. Dairy Sci. 84:741:755, 2001)
 - Random coefficient model considering study as a random effect, and including the possibility of covariance between the slope and the intercept



Total Volatile Fatty Acid (VFA)



Individual VFA, %



How Comparable is Dual-flow Data to *in vivo*?

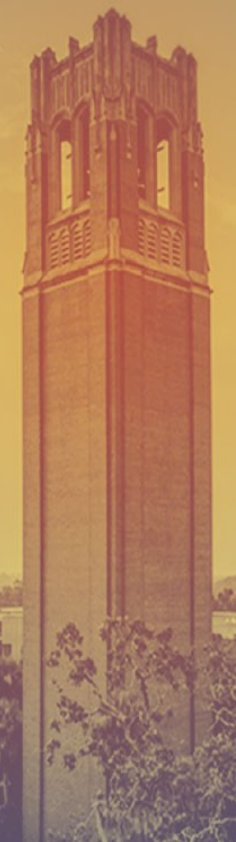
How comparable is microbial fermentation data from dual-flow continuous culture system to omasal sampling technique? A meta-analytical approach

Brandao et al., 2020

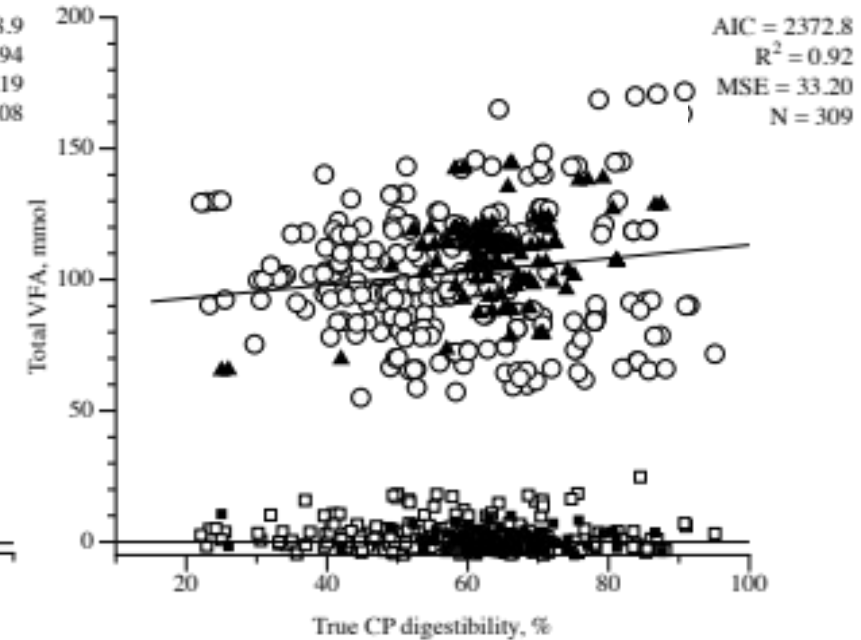
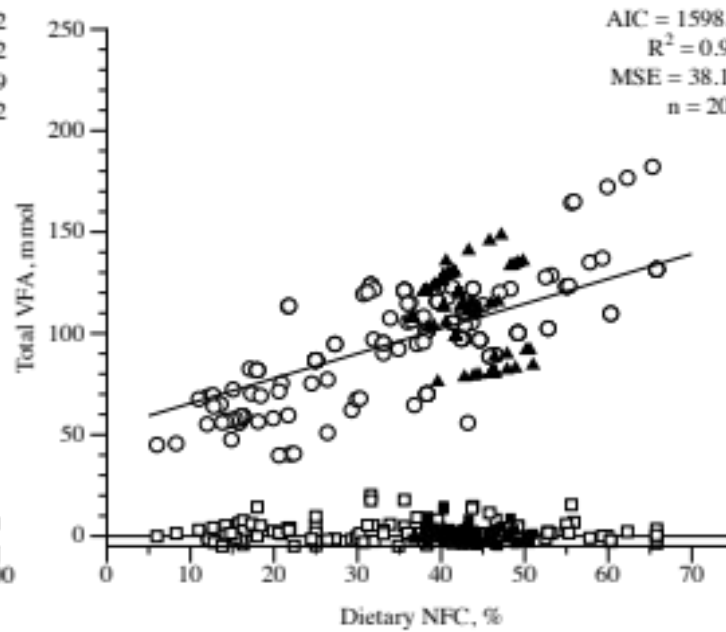
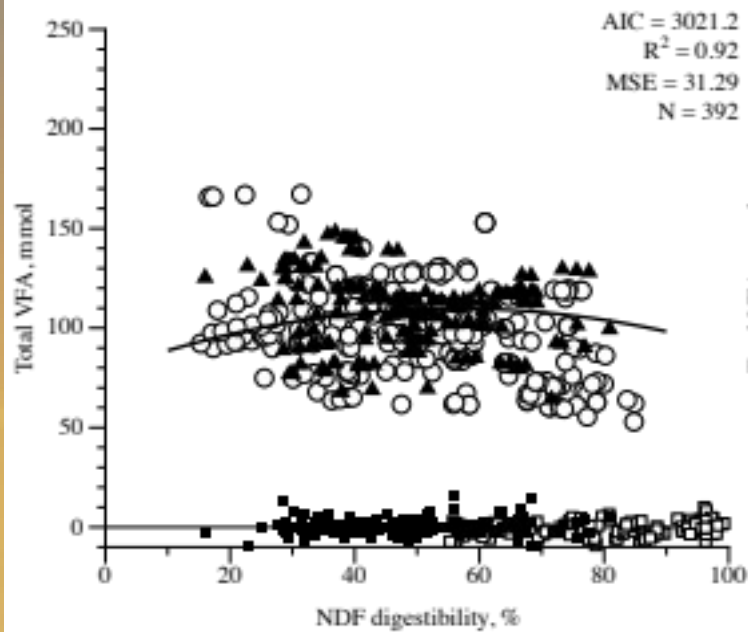


Materials & Methods

- Data collection and preparation
 - 151 studies: 96 DFCCS and 55 OST
 - Rumen inoculum only from dairy or beef cattle
 - Only DFCCS
 - Bacterial and NANMN are expressed as % of total N flow
 - Data cleaning: Dependent variables
 - SEM: truncated at 25% of the mean SEM
 - Weight factor was normalized to 1
 - Data were weighted within class (DFCCS vs OST)
- To remove bias of class



Total Volatile Fatty Acid (VFA)



No class effect

Conclusions

Functional responses to dietary manipulations and fermentation responses are overall similar in the DFCCS compared to *in vivo*



Limitations of the System

Does not predict in vivo response

Assumes equal saliva flow and concentration

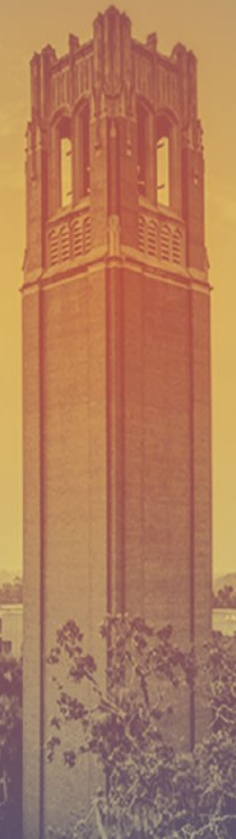
No effects of DMI

No ruminal absorption

Less retention of protozoa

Maybe differences in bacterial population

Usually no gas emission data



Advantages of the System

When compared to other in vitro or in situ techniques

Longer fermentation

Larger volume

Liquid and solid flows

Not a batch culture

Complete diets

Not affected by bags' pore size, numbers, location, etc.



Advantages of the System

When compared to in vivo studies

Faster

Cheaper

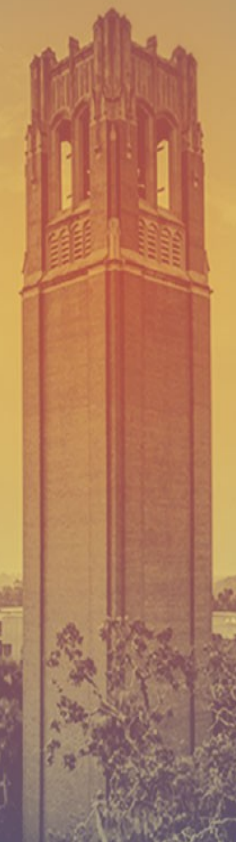
Less invasive

Greater range of diets/ additives

More controlled condition

Isolates ruminal function (no DMI, saliva, intestinal differences)

Scientific inputs/outputs

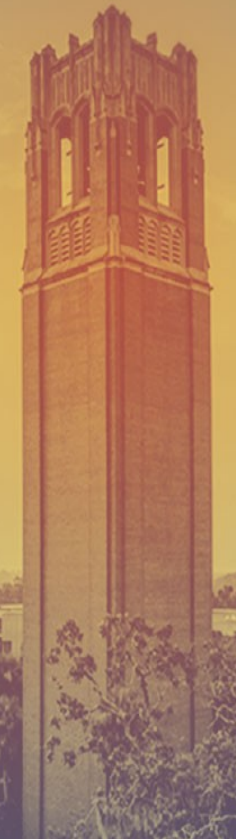


Conclusion

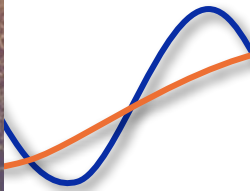
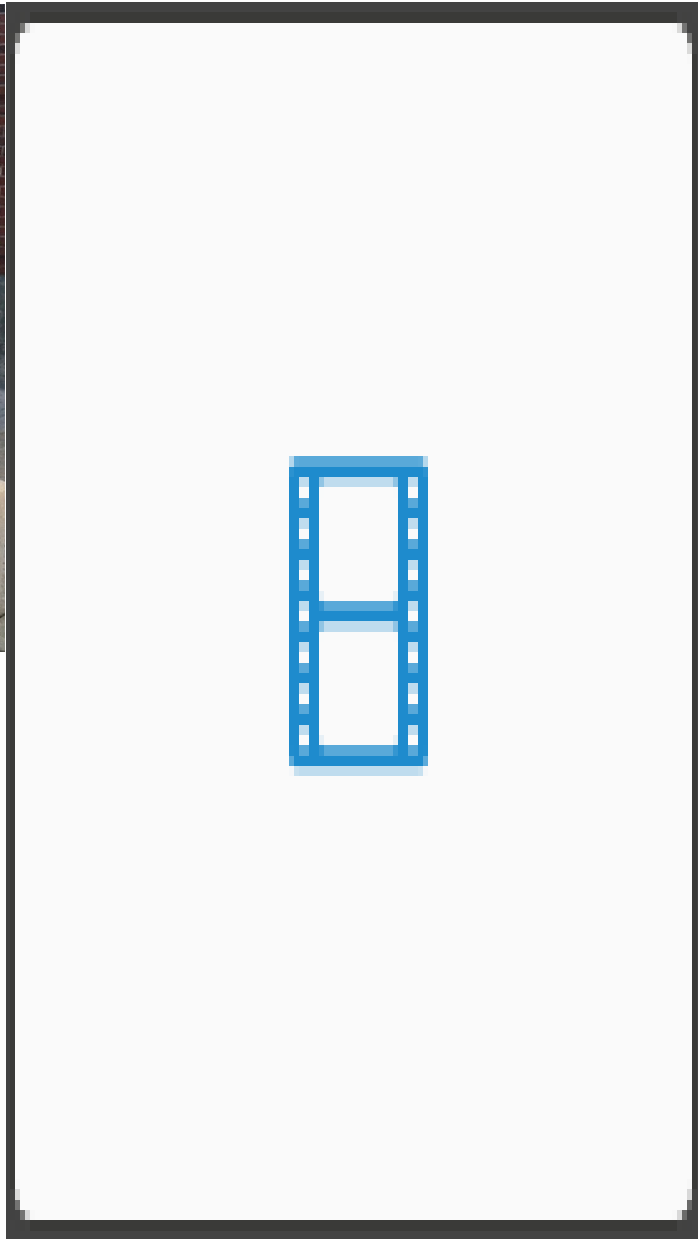


The rumen should
NOT be a “black box”!

#FermenGators



Acknowledgments



Thanks!

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Questions??

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www.faciola.com



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