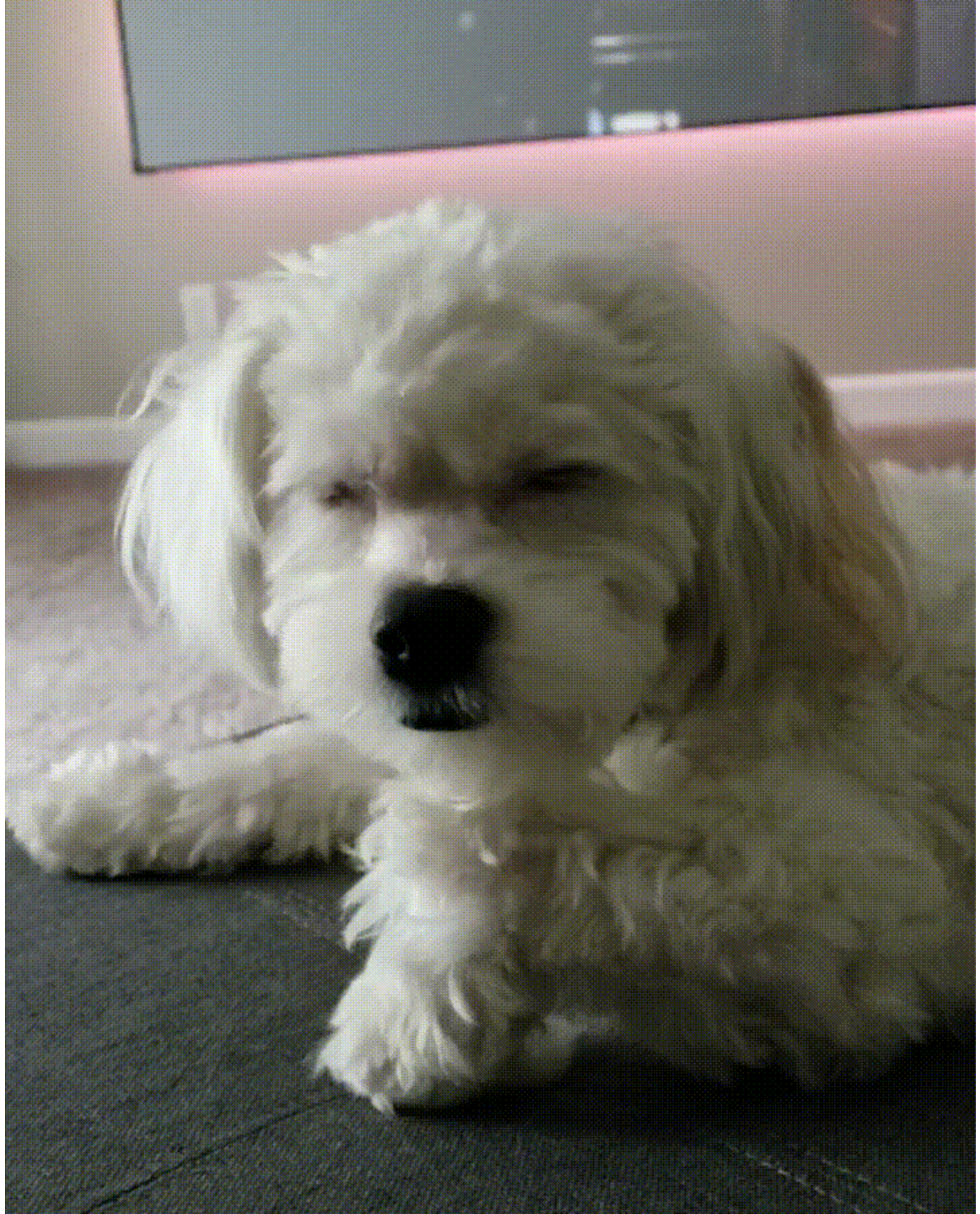
POET

Recent Advances in Understanding Ethanol Co-Product Nutrition in Ruminant Diets

Distillers Grains Technology Council Symposium

Kevin Herrick, Ph.D., PAS

May, 2019



How much do we really know about ethanol co-product nutrition in ruminant diets?

Key Points

- **Three "categories" of research**
  - Value of ethanol co-products
  - Comparison to other ingredients
  - Other research areas

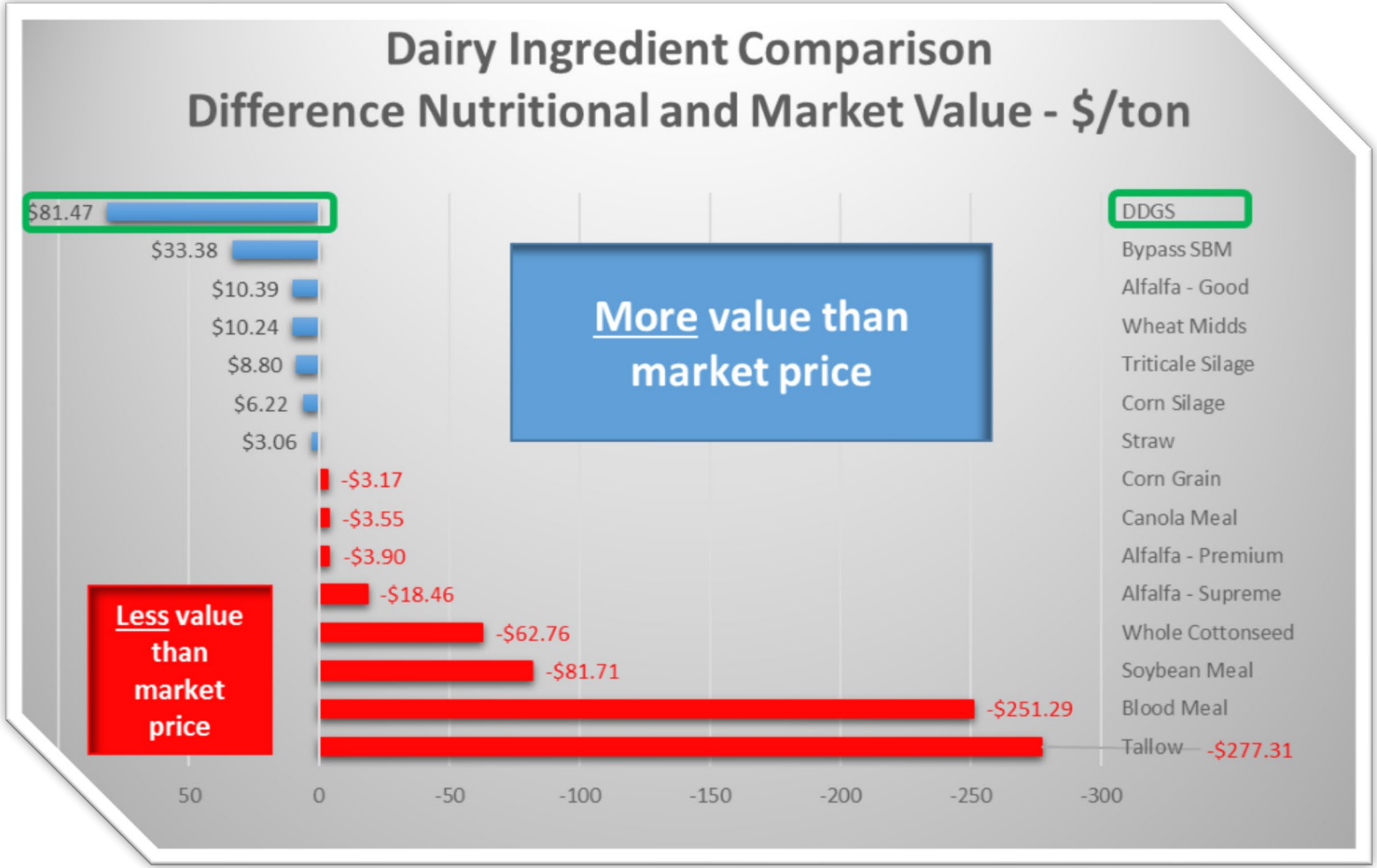
Value of Ethanol Co-Products

Value of Ethanol Co-Products

- **Difficult to determine**
  - Value to corn or other ingredient
  - Price per unit of protein or energy
  - Formulation software
  - Programs like Sesame or FeedVal
  - Varies by species

Sesame Evaluation - Dairy

$81.47 Greater Value

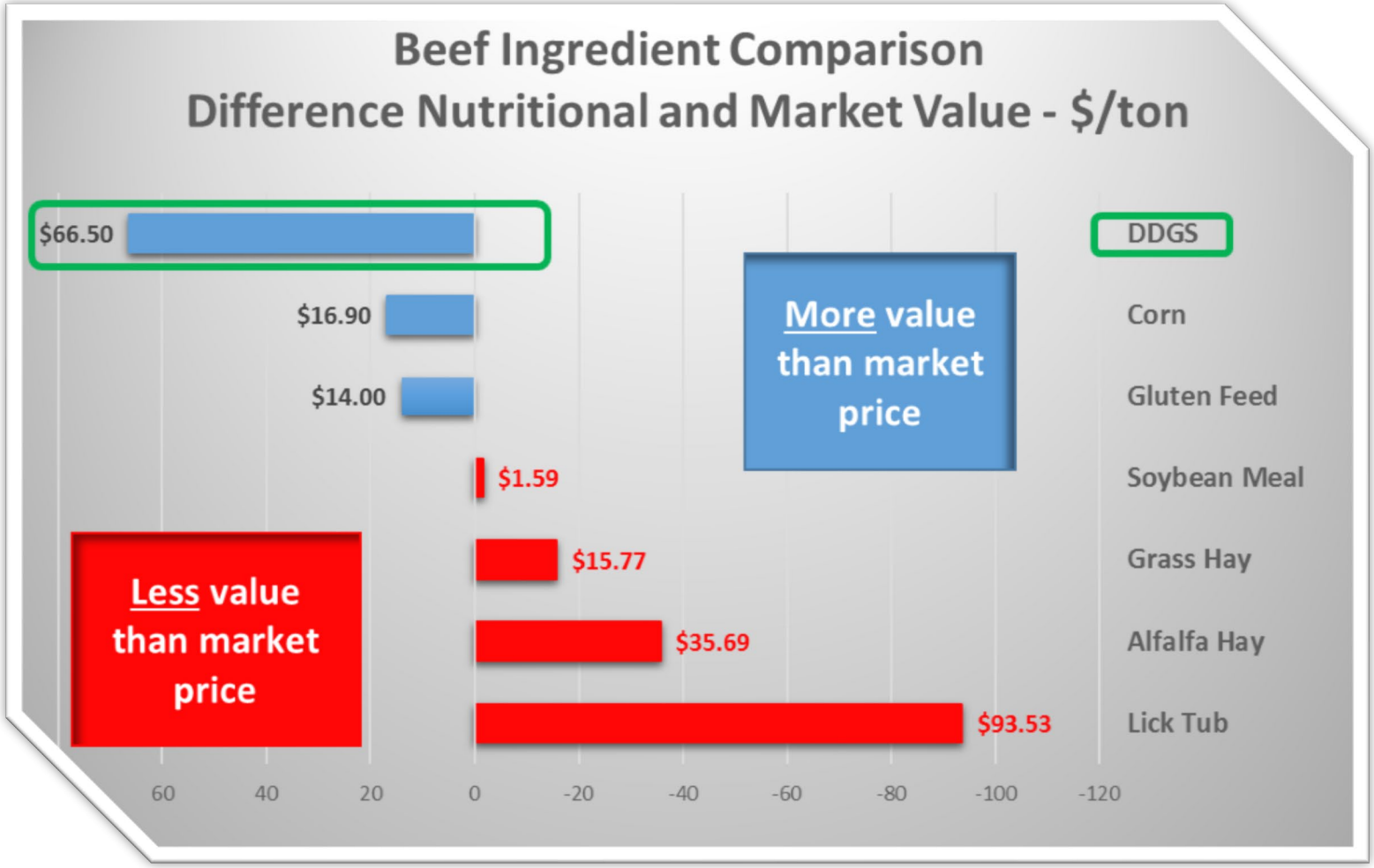


Based on NEl, dRUP, eNDF, and RDP

Prices accessed on 4.29.19 from Feedstuffs

Sesame Evaluation - Beef

$66.50 Greater Value



Based on NEg and CP

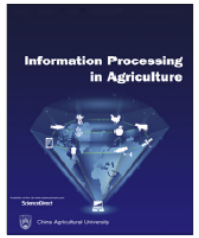
Prices accessed on 4.29.19 from Feedstuffs

DDGS Inclusion and Price - Dairy

Available at www.sciencedirect.com

INFORMATION PROCESSING IN AGRICULTURE xxx (xxxx) xxx

journal homepage: www.elsevier.com/locate/inpa



Optimal dairy feed input selection under alternative feeds availability and relative prices

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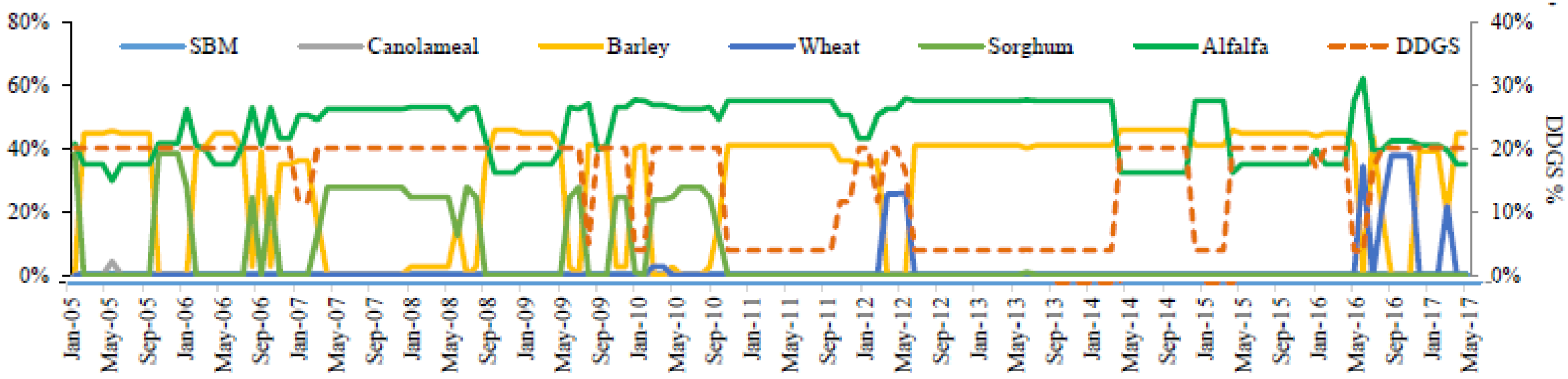
ABSTRACT

Feed formulation is essential in the dairy production chain from economic, nutritional, and environmental perspectives. Optimizing the feed formulation across those three domains – given uncertainty of input prices, input availability, and regional climatic conditions – is a challenge for those in the industry. The diet formulation method that is widely used by trading firms and feed production facilities employs a static linear programming (LP) approach. This approach does not allow for intertemporal feed formulations and switches

Evaluated a series of feeding scenarios over a 12-year period

Alqaisi, et al., 2019
https://doi.org/10.1016/j.inpa.2019.03.004

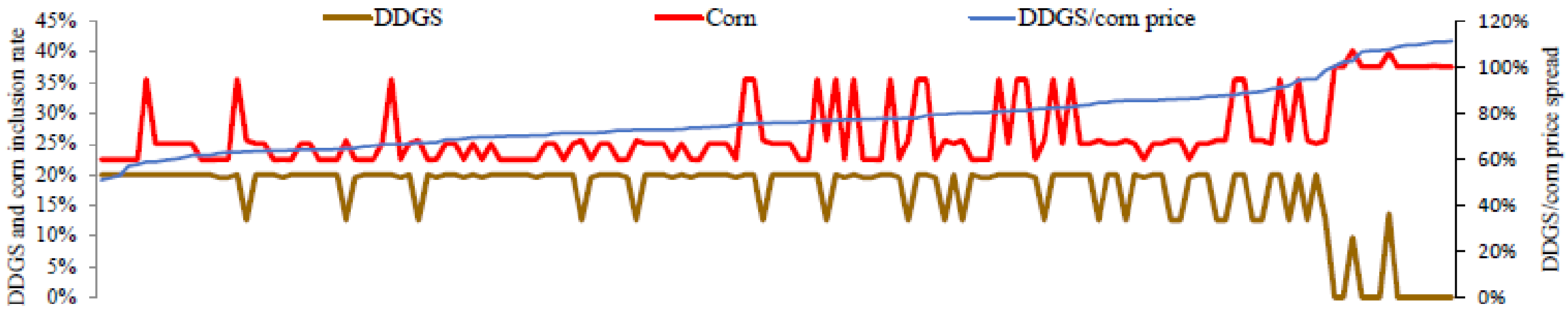
DDGS Inclusion and Price - Dairy



DDGS inclusion varied based on availability and price of other ingredients

Alqaisi, et al., 2019
https://doi.org/10.1016/j.inpa.2019.03.004

DDGS Inclusion and Price - Dairy



Even at DDGS/corn price spread of 100%, some scenarios still included DDGS

Alqaisi, et al., 2019
https://doi.org/10.1016/j.inpa.2019.03.004

Value of Ethanol Co-Products

- **Difficult to determine**
- **Depends on several variables**
- **Alqasi, et al. 2019 paper:**
  - Did not factor different nutritional value
  - Demonstrated value of DDGS

alfalfa hay. Compared to grain feeding scenarios, the inclusion of DDGS in dairy diets reduced total average feed cost by 8% (i.e. compared to S1). However, comparing scenarios

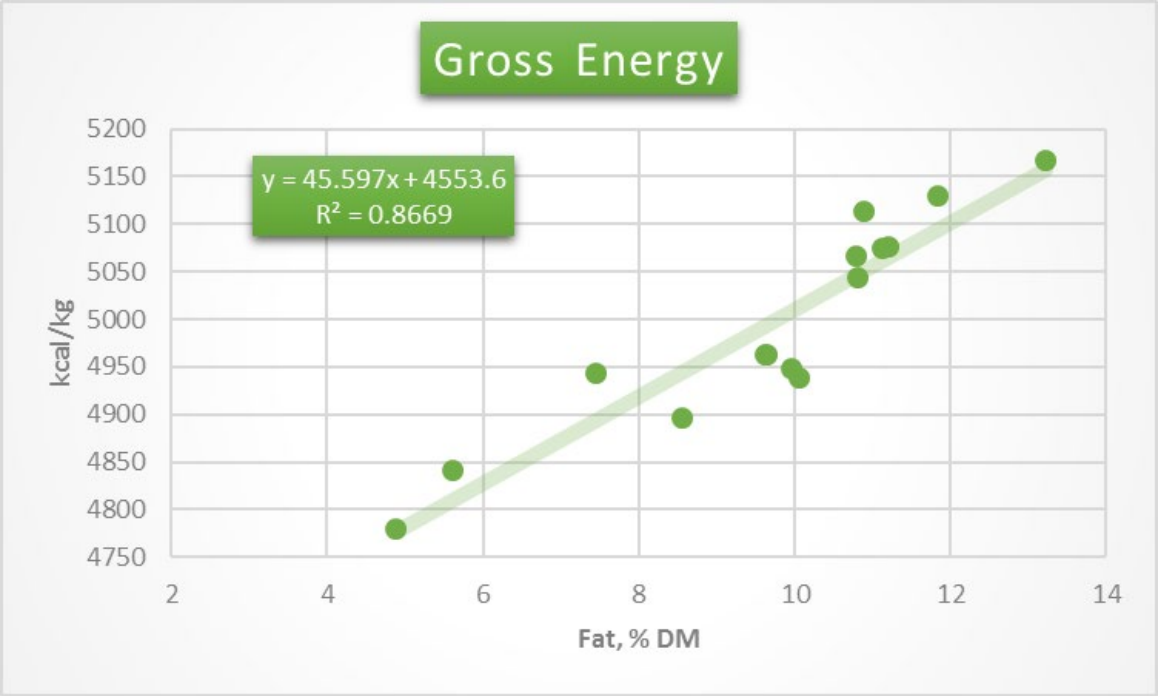
mulated feed for each 1% CP reduction. Therefore, using DDGS will reduce feed cost significantly, but will also increase dietary protein levels.

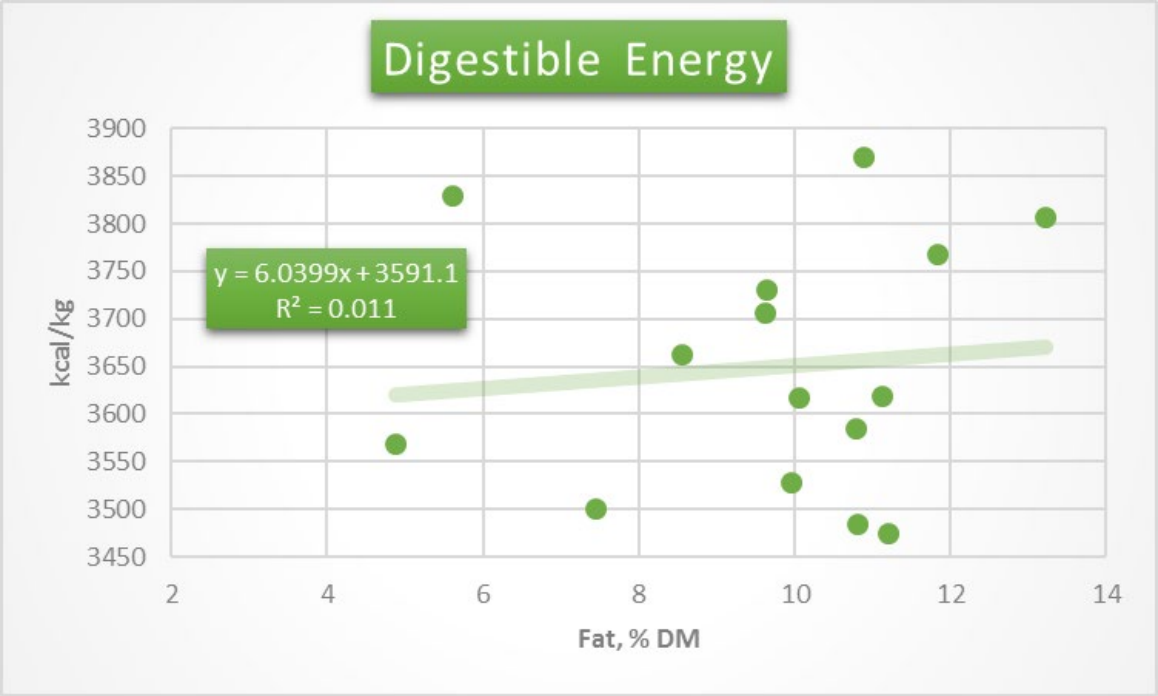
Comparison to Other Ingredients

Comparison to Other Ingredients

- Accurate characterization of DDGS?
- Older data
- Changes/advancements/ evolution of industry
- New products and new processes
- Are all DDGS the same?

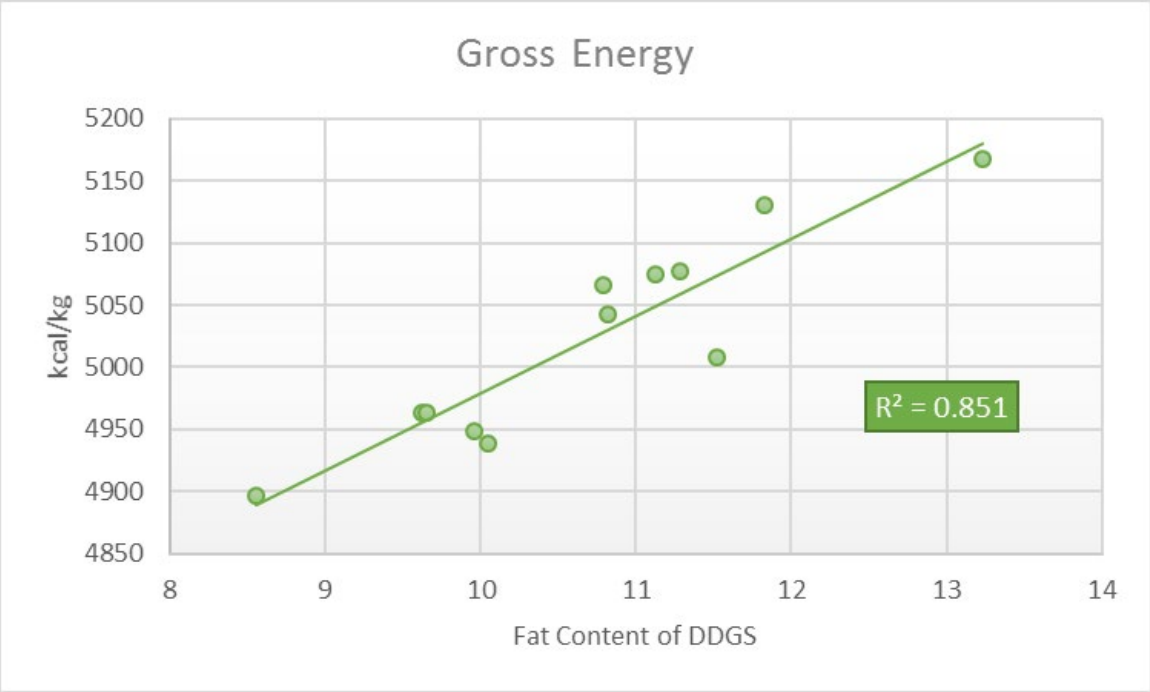
Are All DDGS the Same?

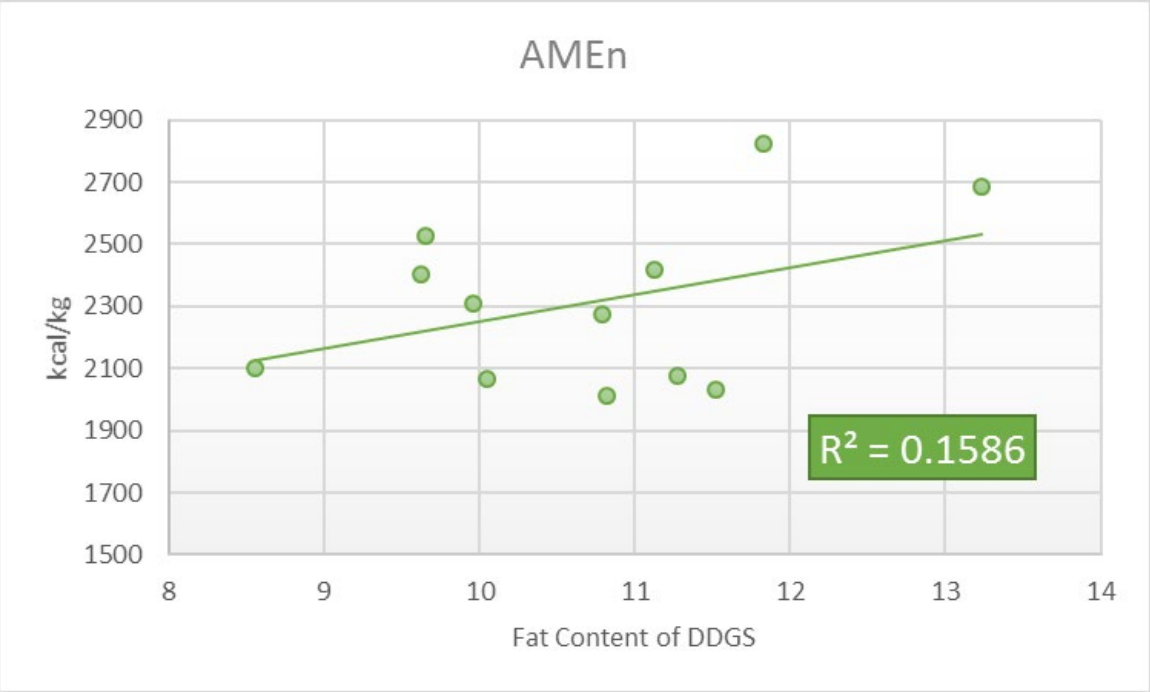




Kerr, et al., 2013

Are All DDGS the Same?





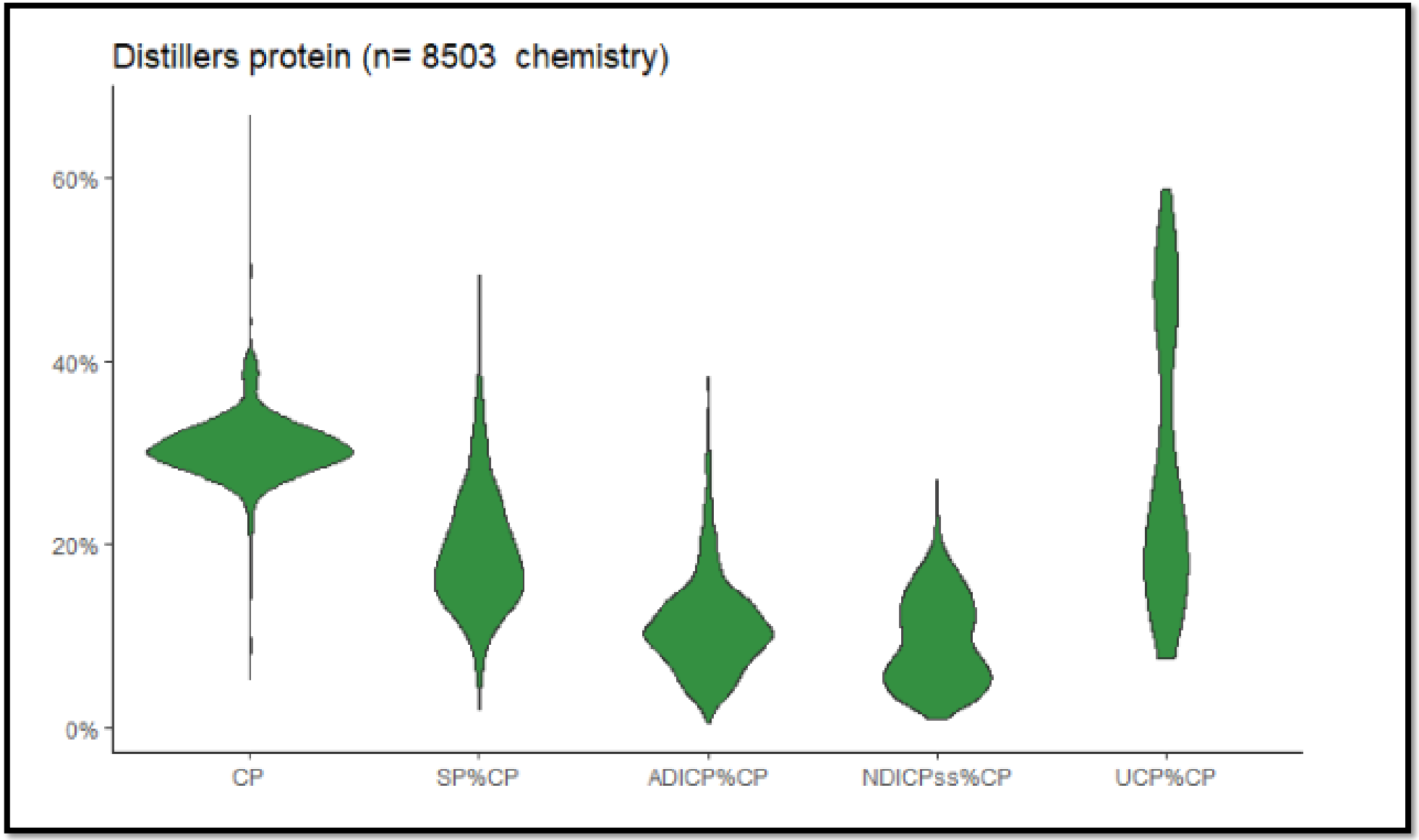
Meloche, et al., 2013

Are All DDGS the Same?

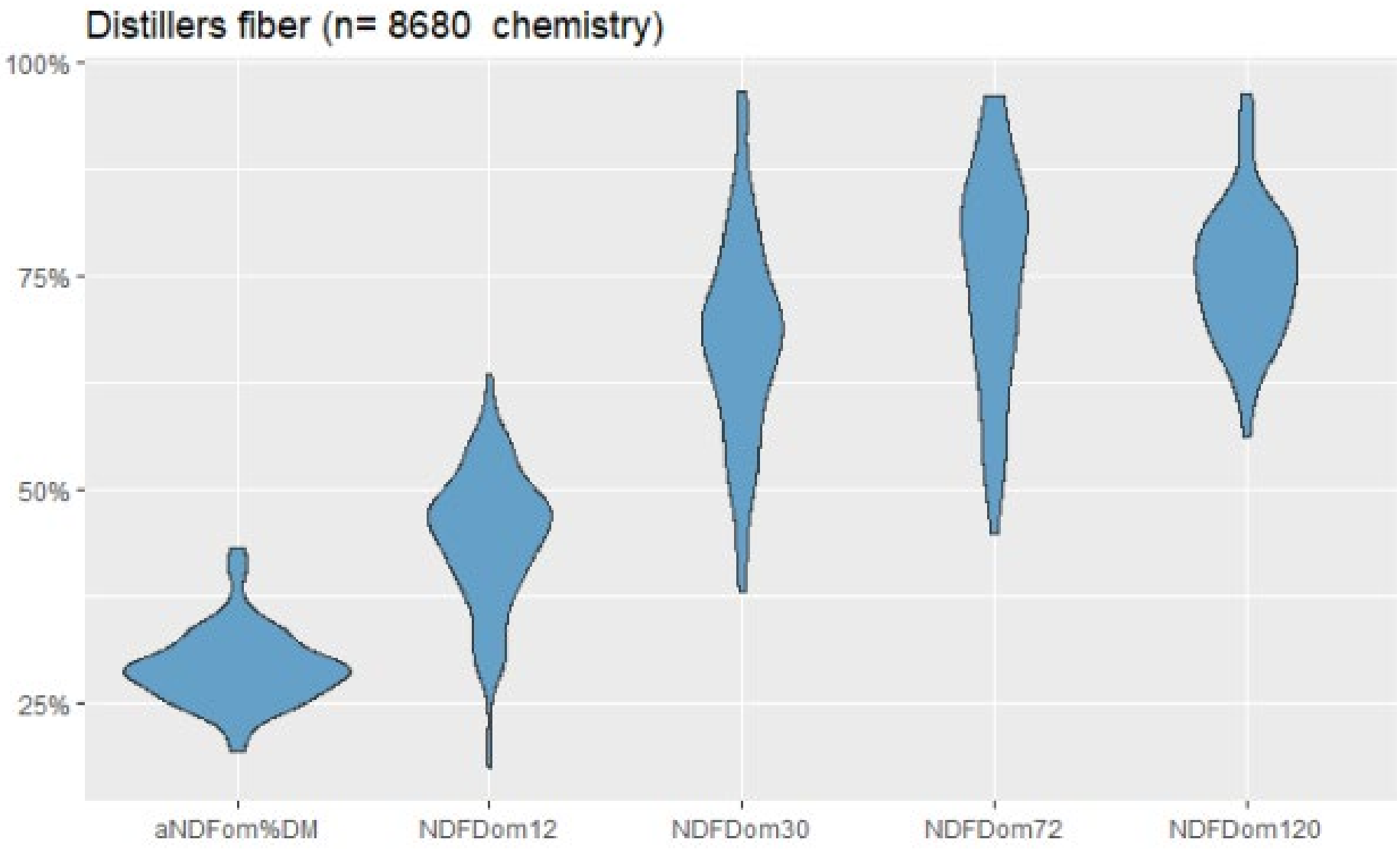
- Industry focuses on fat
- Other components vary
- Significance?

	Average	Minimum	Maximum	Difference	% Difference
Dry Matter	90.35	87.93	93.29	5.36	5.93
Protein	29.94	24.58	32.21	7.63	25.48
Fat	7.92	5.25	10.58	5.33	67.30
ADF	13.58	8.38	19.08	10.7	78.79
NDF	28.42	23.42	33.26	9.84	34.62
Hemicellulose	14.84	10.19	19.18	8.99	60.58
Cellulose	9.66	6.22	11.93	5.71	59.11

Curry, et al., 2016. The Professional Animal Scientist. Pages 687-694
Concentration of DE and ME of DDGS Produced in Illinois



Dairyland Laboratories, May 2019 Newsletter

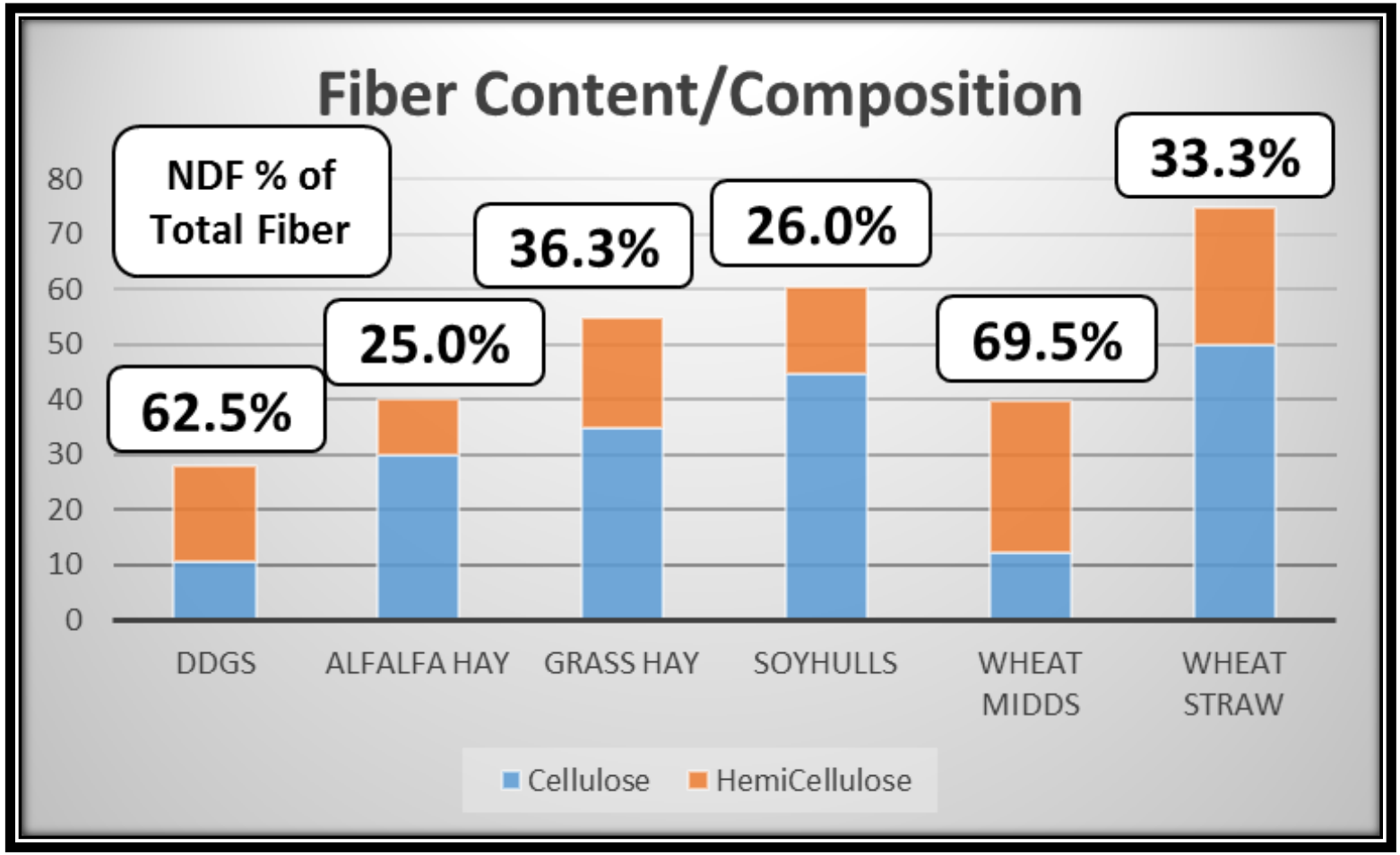


Dairyland Laboratories, May 2019 Newsletter

Fiber in DDGS

- Industry perspective?
  - Source of protein
  - Source of energy
- Similar fiber to other ingredients?
- Effectiveness?
- Digestibility?

Time to look at DDGS fiber differently!



NDF Digestibility

- Only for alfalfa?
- Laboratory assays now available
  - Less expensive
  - Quicker
- Variability

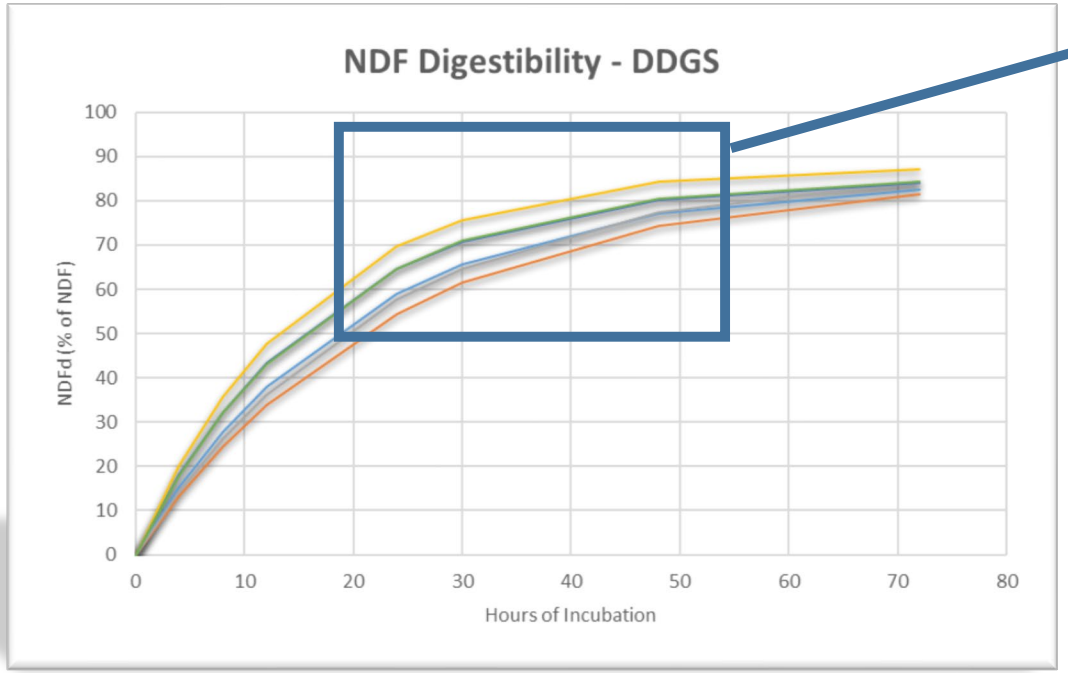
NDF Digestibility Time Point Analysis October 30, 2017
NDF Standard Rate & Pool Evaluation

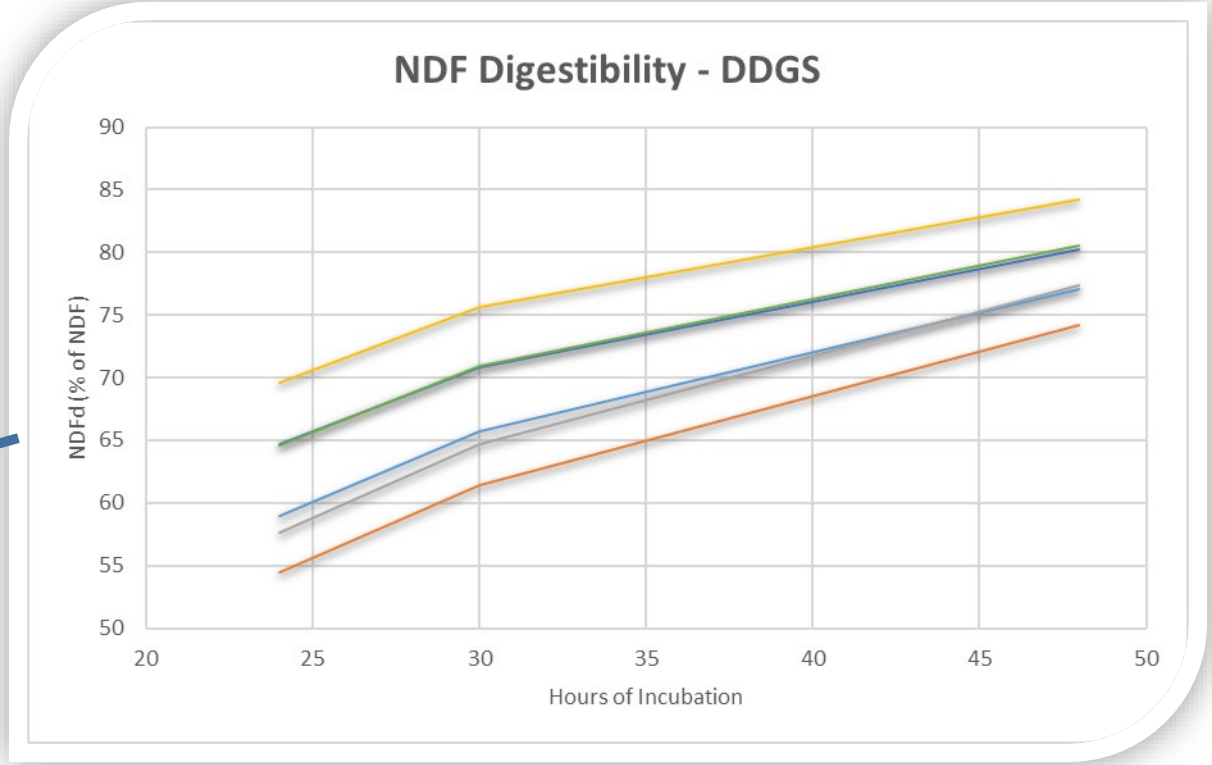
22895-30 #1 DDGS

Hour	Invitro NDF Residue (% DM)	Modeled NDF Residue (% DM)	Modeled uNDFD (% NDF)	Modeled NDFd (% NDF)
0	29.1	30.4	100.0	0.0
4	28.0	25.7	84.8	15.2
8	21.9	22.0	72.3	27.7
12	18.3	18.8	62.0	38.0
24	11.5	12.4	41.0	59.0
30		10.4	34.3	65.7
48	7.2	7.0	22.9	77.1
72	6.2	5.3	17.4	82.6
120	4.3	4.6	15.1	84.9
240	4.1	4.5	14.9	85.1

R^2	RMSE	Rate
0.9891	1.2078	0.0493

NDF Digestibility





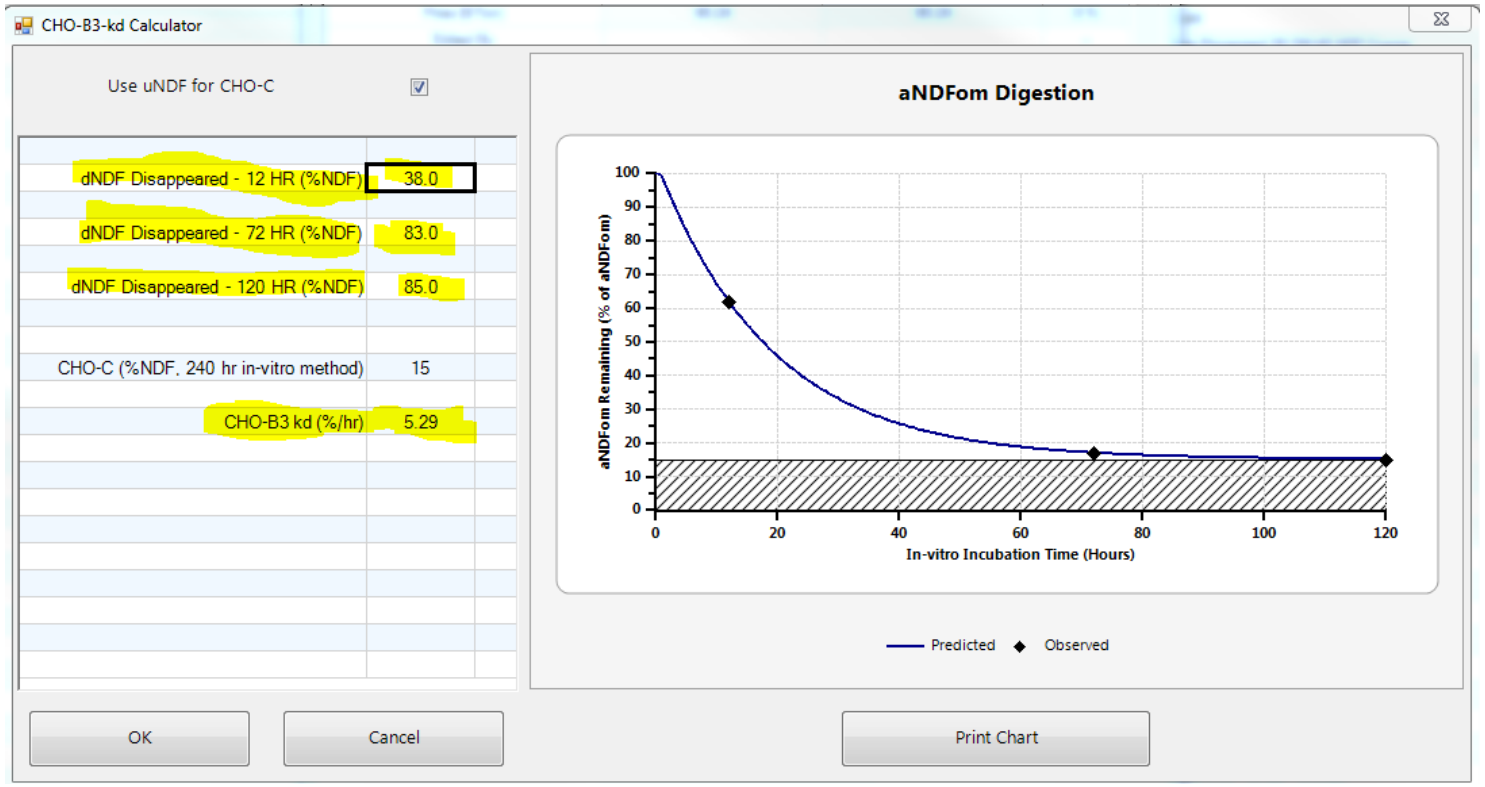
- **Rates – 4.22 to 6.53% per hour**
- **>40% difference**

Confidential Internal Data – POET Nutrition. Cumberland Valley Analysis

Does NDF Digestibility Matter?

- Value of NDF Digestibility of DDGS
- Formulation software to predict
- Assumptions
- Formulate diets with high/low NDF digestibility

NDF Digestibility



- Elaborate models
- Very dynamic
- Predict performance
- Models vs actual performance?

NDF Digestibility of DDGS

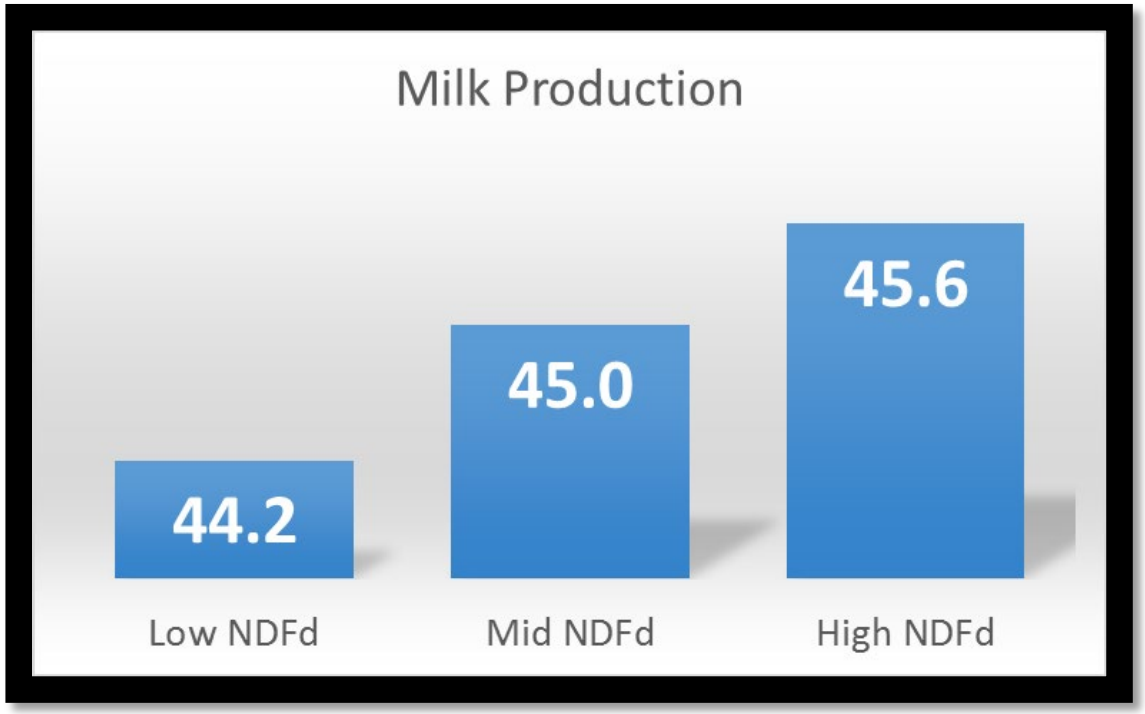
Item	Low-NDF Digestibility DDGS	Mid-NDF Digestibility DDGS	High-NDF Digestibility DDGS
NDFD (% of NDF)	50.0	62.0	67.0
NDFD hours	24	24	24
NDFD kd (%/hr)[1]	6.7	12.2	21.8
ME Allowable Milk (kgs/hd/day)[1]	44.6	45.2	45.6
MP Allowable Milk (kgs/hd/day)[1]	44.2	45.0	45.6

[1]Estimated by AMTS software

Range for NDF disappearance for samples in previous figure: 54 to 70% at 24 hours

NDF Digestibility

- Formulated with 7% DDGS inclusion
- At $18 cwt milk, this means over **$0.24** more revenue
- $0.06 / lb of DDGS more value
- Performance differences
- Interesting exercise



Other Research Areas

Other Research Areas

- Reduced oil
- See less research as industry moves to less fat
- Research lag: still see higher fat

DDGS Fat Content - Beef

- Ribeiro, et al. 2017 – Canadian Journal of Animal Science
- 5.6% vs 8.3% fat DDGS
- 160 crossbred Angus steers
- Combined growing and finishing study

530

NRC Research Press

SHORT COMMUNICATION

Impact of low- and medium-oil corn dried distillers' grains plus solubles on growth performance of feedlot cattle

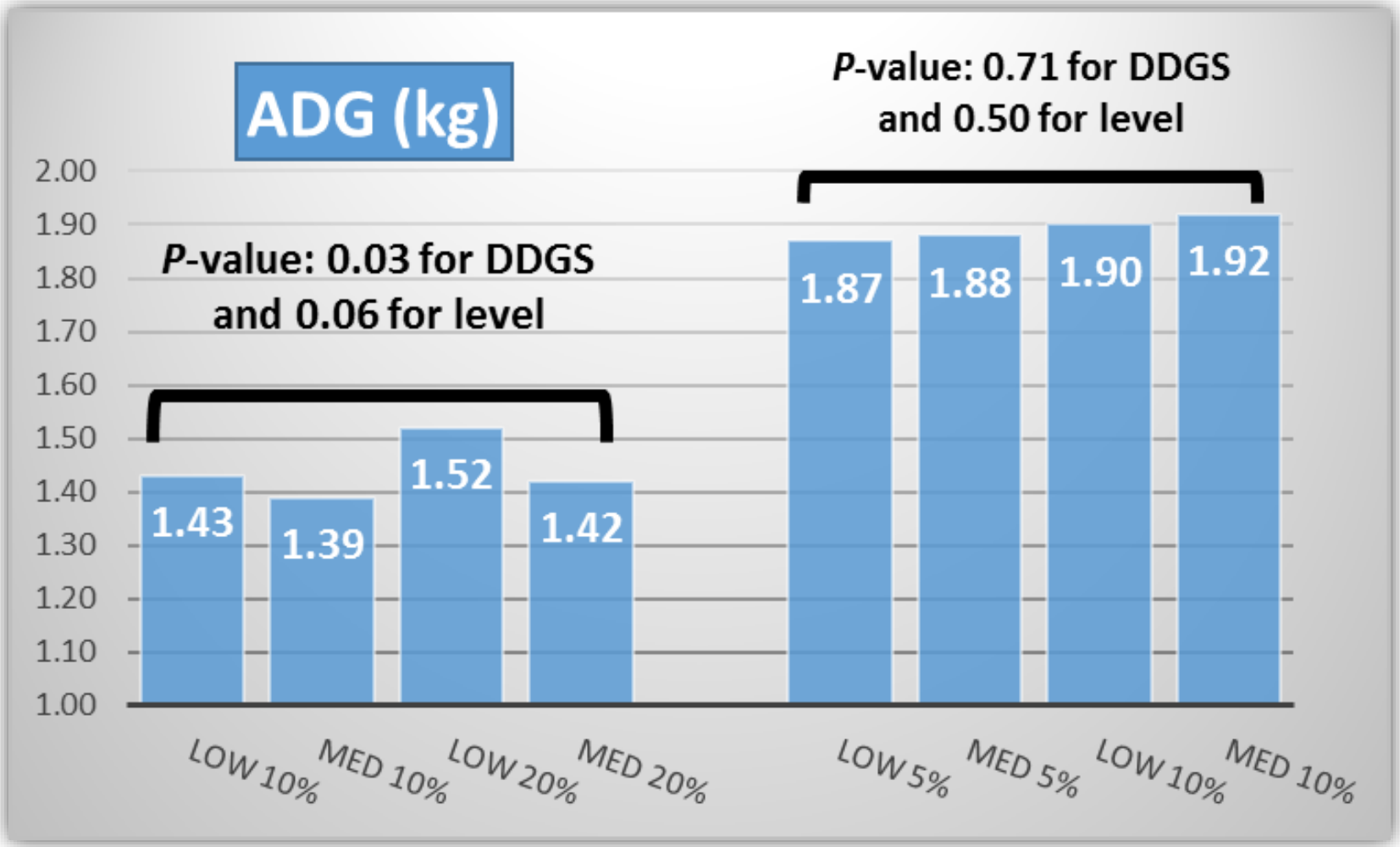
Gabriel O. Ribeiro, Jr., Martin Hünerberg, Darryl Gibb, and Tim A. McAllister

DDGS Fat Content - Beef

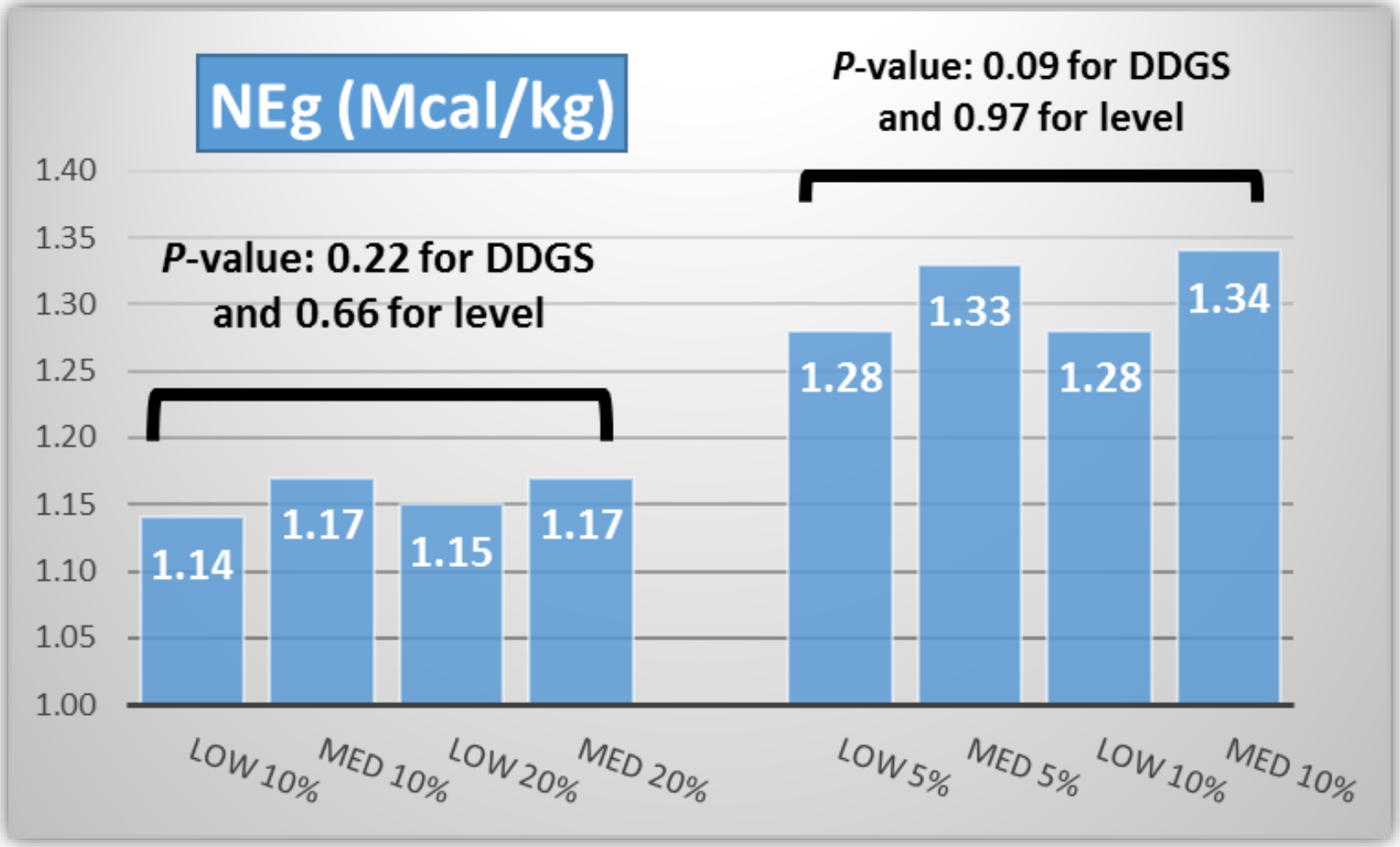
	Backgrounding Diets				Finishing Diets			
	10% DDGS	10% DDGS	20% DDGS	20% DDGS	5% DDGS	5% DDGS	10% DDGS	10% DDGS
Corn Silage	60.00	60.00	60.00	60.00	10.00	10.00	10.00	10.00
Barley	24.30	24.30	15.00	15.00	79.65	79.65	75.00	75.00
Low-oil DDGS	10.00	---	20.00	---	5.00	---	10.00	---
Med-oil DDGS	---	10.00	---	20.00	---	5.00	---	10.00
Supplement	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Urea	0.70	0.70	---	---	0.35	0.35	---	---

Ribeiro, et al., 2017 - CJAS

DDGS Fat Content - Beef

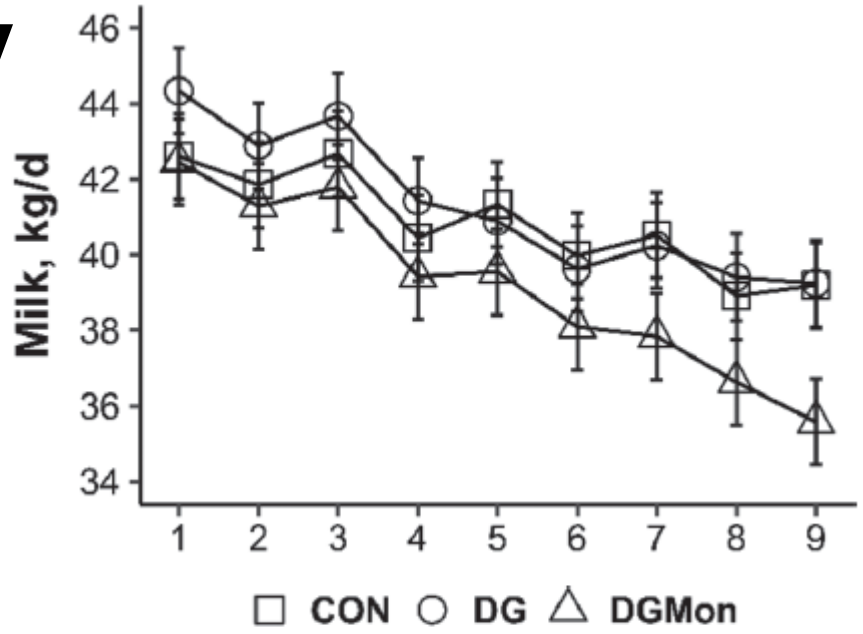


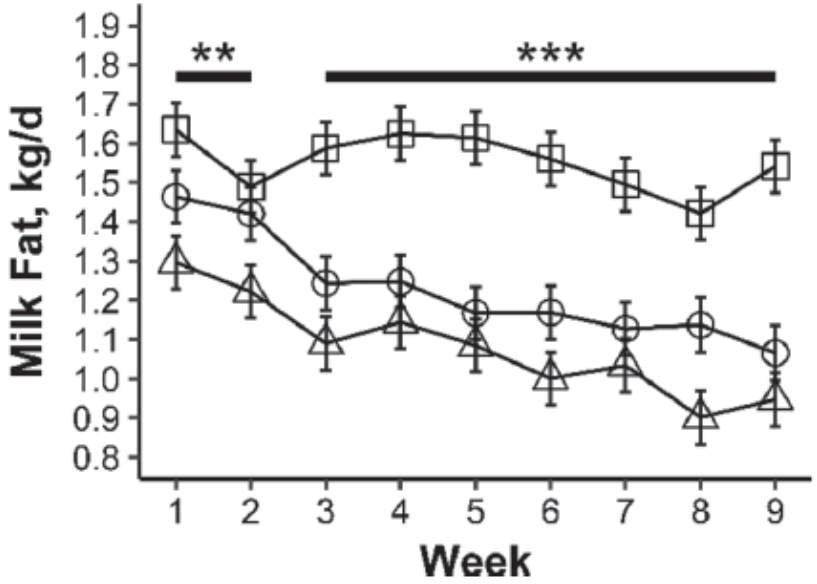
DDGS Fat Content - Beef



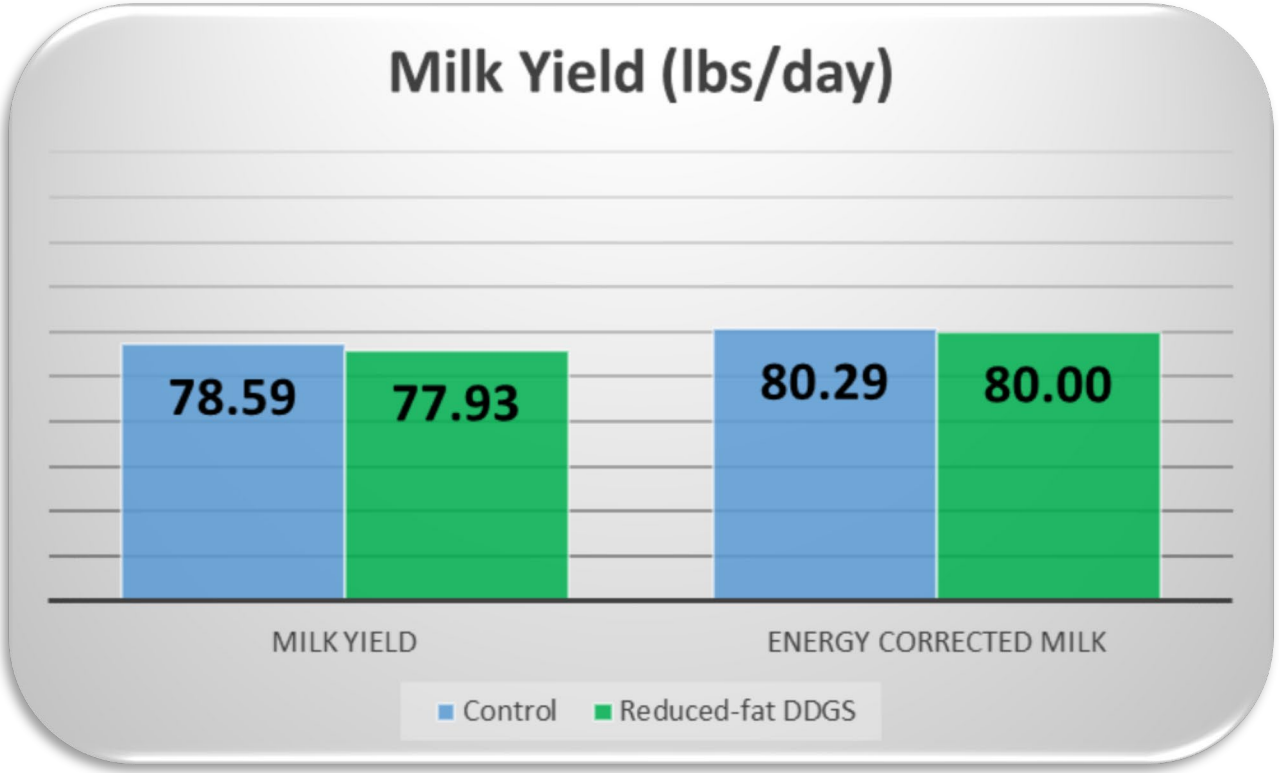
Low-fat DDGS in Dairy Diets

- Morris, et al., 2018
- Combination with monensin
- Almost 30% DDGS
- Significant milk-fat response





Low-fat DDGS in Dairy Diets



- Testroet et al., 2018
- 20% reduced-fat DDGS
- 2 × 2 crossover design
- No difference in production

Additional Research Areas…

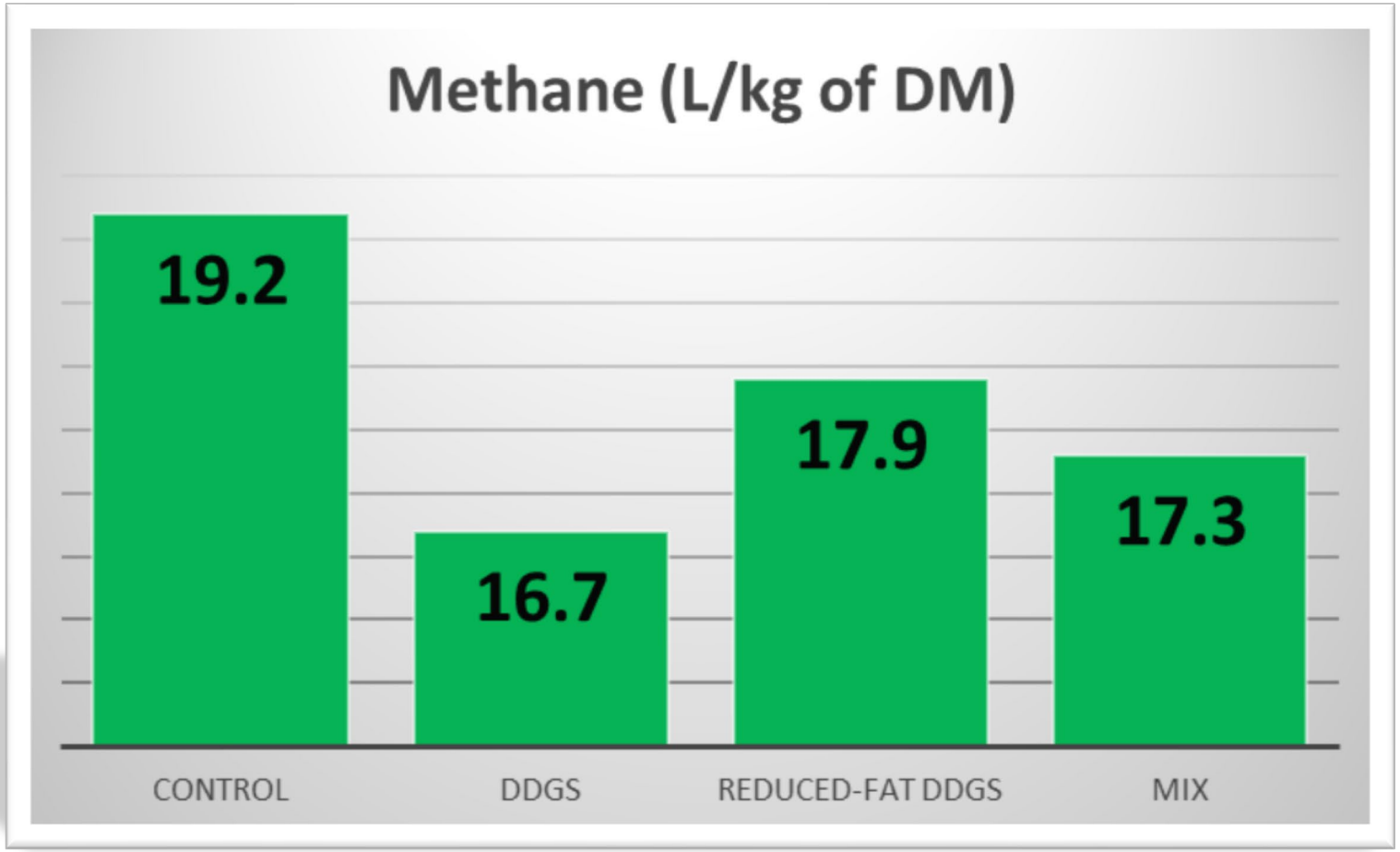
Lancet – EAT Report

Methane

- **Can ethanol co-products affect methane production?**
  - Judy et al., 2019
  - Corn oil reduced methane production 6.4% compared with a control diet
  - Fat replaces carbohydrates, fat may affect rumen methanogens, fat can increase biohydrogenation =➔ sink for hydrogen

Methane

- Castillo-Lopez et al., 2017
- Suggests fat may affect methane production?



Methane

- Castillo-Lopez, et al., 2017
- *“DDGS may shift the abundance of bacteria which affect methane production”*
- *“Replacing corn and soybean meal with DDGS may reduce proportion of dietary energy wasted as methane”*

Corn Oil Supplementation - Beef

- Winders, et al., 2019
- Finishing study
- 3% corn oil

Table 3. Effects of corn oil supplementation (3% of diet DM) on methane production from cattle fed finishing diets

	Control	Corn Oil	SEM	*P*-value	
				TRT	Period
DMI, lb[2]	23.7	23.1	0.5	0.72	0.80
Methane					
g / d	132	115	3	0.03	< 0.01
g / lb DMI[1]	5.13	4.68	0.09	0.04	-
g / lb DMI[2]	5.82	5.05	0.43	0.29	0.50
g / ADG[3]	34.3	29.1	0.4	< 0.01	-

[1]DMI over the 127 d trial

[2]DMI in the methane barn across all 3 periods of collection

[3]ADG, lb over the 127 d trial

More Research

Oczkowicz *et al. BMC Genomics* (2018) 19:864
https://doi.org/10.1186/s12864-018-5265-x

BMC Genomics

RESEARCH ARTICLE Open Access

Corn dried distillers grains with solubles (cDDGS) in the diet of pigs change the expression of adipose genes that are potential therapeutic targets in metabolic and cardiovascular diseases

Maria Oczkowicz[1*], Tomasz Szmatoła[1], Małgorzata Świątkiewicz[2], Klaudia Pawlina-Tyszko[1], Artur Gurgul[1] and Tomasz Ząbek[1]

More Research

- High protein DDGS
- Different fiber
- Yeast components
- Etc….

What else could go wrong today?

Conclusion

- Ethanol co-products provide significant value
- Areas such as methane – commercial value?
- **Still a lot of research to do**

Questions?