Energy of lactating dairy cattle fed increasing inclusion of new high protein processed corn product

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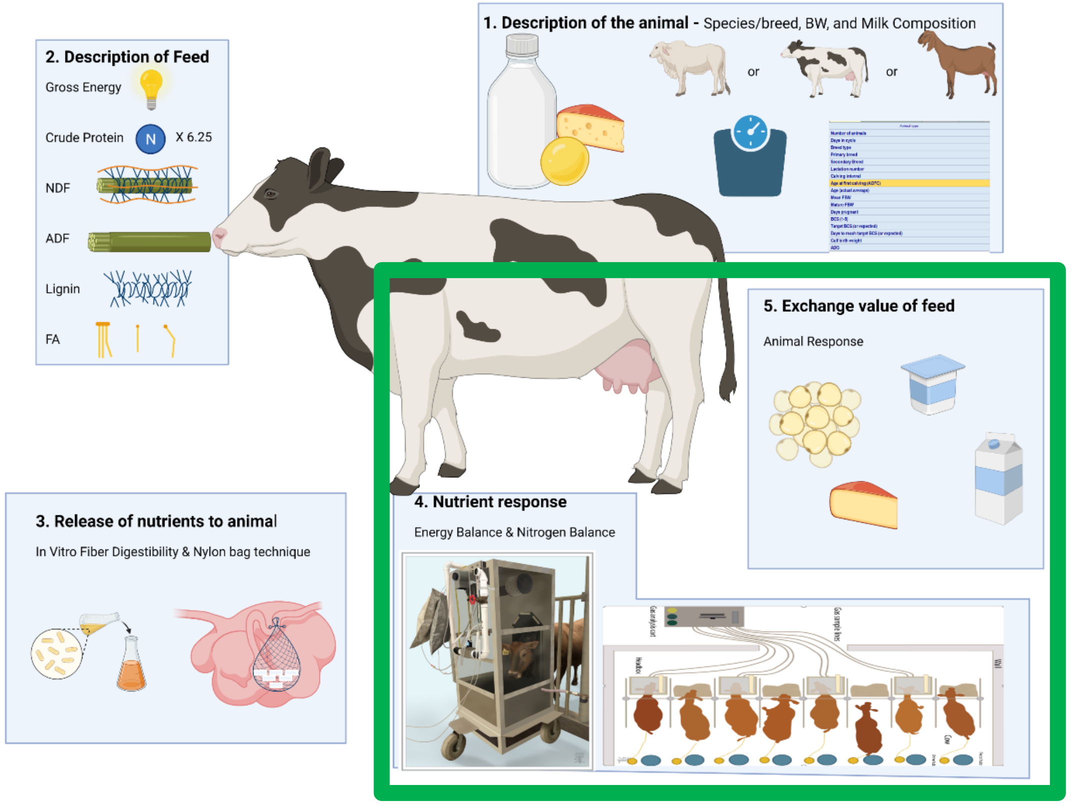
Introduction

- As of 2020, the United States supplied 33.1 million metric tons of DDGS, contributing $34.7 billion dollars to nation's Gross Domestic Product.
- Since the value of DDGS is typically based on their protein and energy content → new coproducts aim to concentrate the protein relative to the fiber fraction.
- New technology = new products
  - analyzed for chemical composition
  - animal productive responses.
- For greater utilization in the field, controlled feeding experiments with differing feeding strategies are needed to determine the optimal inclusion of new feed ingredients.

INPUTS FOR FEED EVALUATION SYSTEM

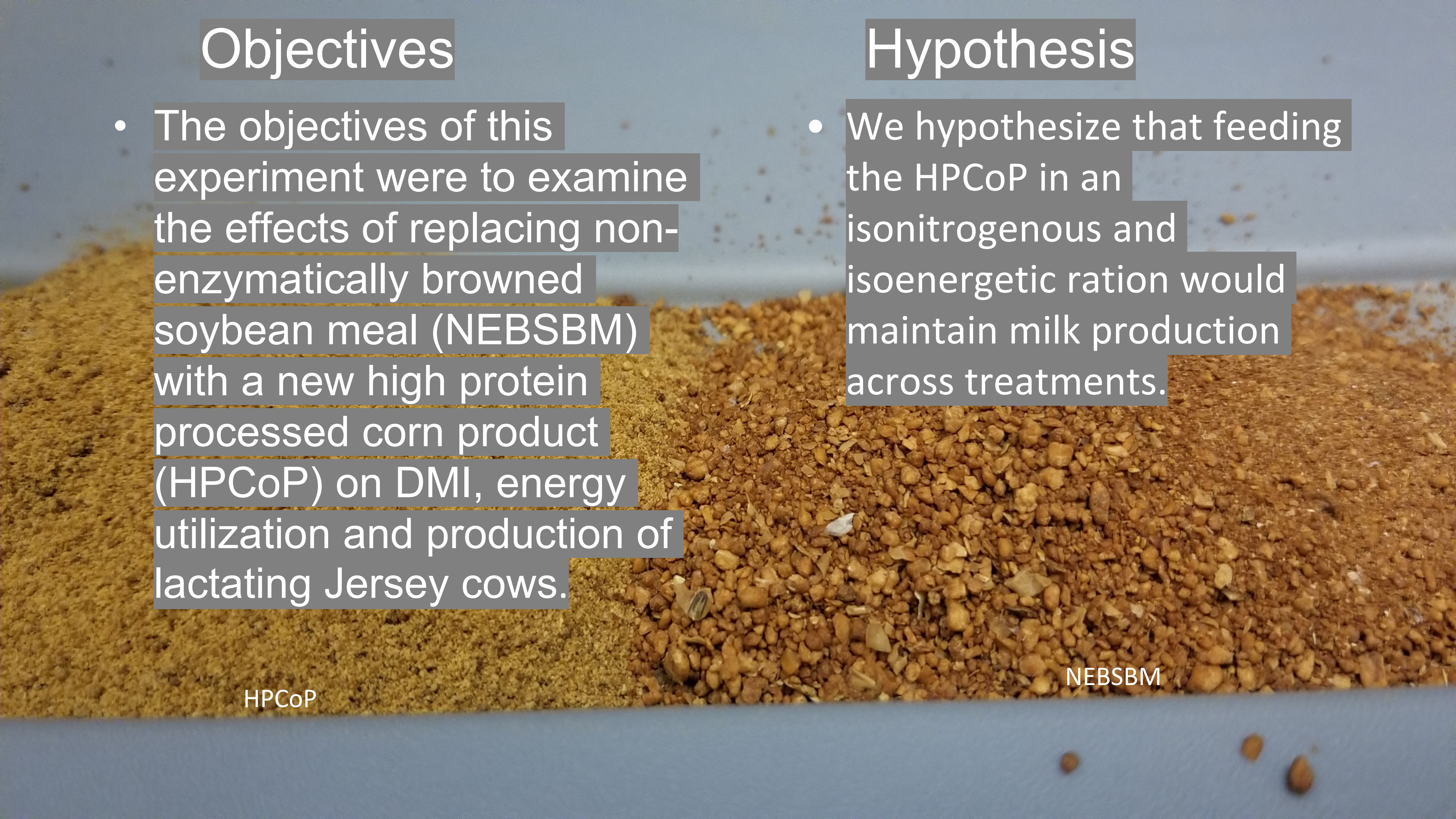


Objectives

- The objectives of this experiment were to examine the effects of replacing non-enzymatically browned soybean meal (NEBSBM) with a new high protein processed corn product (HPCoP) on DMI, energy utilization and production of lactating Jersey cows.

Hypothesis

- We hypothesize that feeding the HPCoP in an isonitrogenous and isoenergetic ration would maintain milk production across treatments.



Materials and Methods

The University of Nebraska-Lincoln Animal Care and Use Committee approved animal care and expiermenetal procedures.

Animals

12 Multiparous lactating Jersey cows (95 ± 7.3 DIM)

Blocked by milk yield and randomly assigned one of four dietary treatments

Treatments and Design

4 TMRs containing increasing inclusion of HPCoP (Flint Hills Resources, Wichita, KS.)

1. **CRTL** [0 % HPCoP DM basis]
2. **2.6L** [2.6 % HPCoP DM basis]
3. **5.4M** [5.4 % HPCoP DM basis]
4. **8.0H** [8.0% HPCoP DM basis]

Feed dispensing with Calan Data Ranger

Triplicated 4 × 4 latin square design

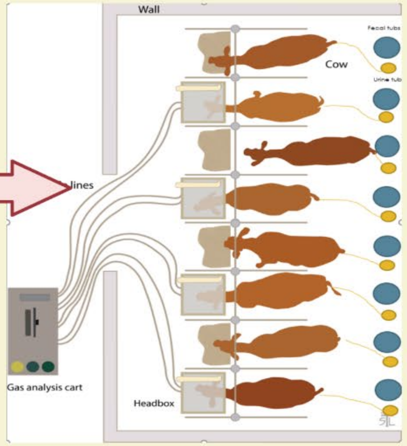
4 periods of 28 d

24 d adapation followed by 4 days of collection

Energy Balance and Production Procedures

Daily:

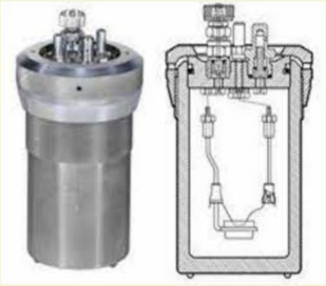
- Total fecal and urine collection
- Refusals
- 2 × daily milk samples



Collection week setup including continuous gas measurements, fecal tubs (blue), and urinary catheters connecting to urine containers (yellow)

23 hour period:

- Continuous O_2 consumption CO_2, and CH_4 production
- Composite O_2 consumption CO_2, and CH_4 production
- Heat production (indirect calorimeter shown below)



Bomb Calorimeter

Sample analysis:

- Chemical composition of feces, feed ingredients and refusals*
- Urinary N analysis*
- Bomb calorimetry of feces, feed ingredients and refusals

* = Analyzed by Cumberland Valley Analytical Services Inc. (Waynesboro, PA.)

Statistical Analysis

Data analyzed with the Glimmix procedure of SAS (9.4)

Fixed effects of HPCoP inclusion

Random effects of period, square and cow nested in square

Tested linear quadratic and cubic effects of level of HPCoP inclusion

Results and Discussion

Table 1. Ingredient inclusion and chemical composition of the diets fed to all experimental cows

Item (% DM)	CTRL	2.6L	5.4M	8.0H
Composition (% DM, mean ± SD)				
DM	59.6 (2.43)	59.4 (1.92)	60.3 (1.94)	59.4 (1.73)
CP	16.14 (0.43)	16.11 (0.35)	16.09 (0.35)	16.06 (0.45)
aNDFom	30.67 (1.46)	30.97 (1.31)	31.28 (1.18)	31.59 (1.07)
Starch	27.15 (1.98)	27.42 (2.02)	27.70 (2.09)	27.98 (2.19)
Fatty Acids				
Total fatty acids	5.03 (0.32)	5.11 (0.36)	5.19 (0.41)	5.27 (0.46)
C16 fatty acids	1.93 (0.24)	1.93 (0.27)	1.94 (0.30)	1.95 (0.33)
C18 fatty acids	2.86 (0.12)	2.93 (0.12)	3.00 (0.13)	3.07 (0.14)
MP supply (g) [1]	2410.0	2360.5	2309.5	2260.0

[1]Value determined assuming 21.34 kg DMI

Table 2. Chemical composition of HPCoP

Item (% DM ± SD)	HPCoP[1,2]
DM	94.3 ± 0.49
CP	52.4 ± 0.35
NDF	36.2 ± 1.63
Starch	1.90 ± 0.28
Total fatty acids	6.44 ± 0.099
Ash	4.78 ± 2.39

[1]NexPro (Flint Hills Resources, Wichita, KS.)
[2]Mean and SD (n = 2)

Table 3. The effects of increasing inclusion of HPCoP on energy partitioning

Item	Treatment[1]				SEM	*P*-Value[2]		
	CTRL	2.6L	5.4M	8.0H		L	Q	C
Fractions, Mcal/d								
GE	81.8	83.5	88.8	85.7	3.04	0.05	0.20	0.18
DE	54.1	55.9	58.8	56.4	2.36	0.13	0.18	0.34
ME	47.9	50.1	52.7	50.5	2.23	0.13	0.15	0.47
NE_L	31.2	33.6	35.9	34.1	1.77	0.07	0.11	0.51

[1]CTRL = Control Diet (0% HPCoP); 2.6L = Low Diet (2.6% HPCoP); 5.4M = Medium Diet (5.4% HPCoP); 8.0H = High diet (8.0% HPCoP).
[2]L = linear, Q = quadratic, C = cubic.

Table 4. The effects of increasing inclusion of HPCoP on DMI, Milk production and composition

Item	Treatment[1]				SEM	*P*-Value[2]		
	CTRL	2.6L	5.4M	8.0H		L	Q	C
DMI, kg	19.2	19.9	20.7	19.9	0.62	0.11	0.07	0.38
Milk yield, kg	27.8	28.6	29.8	29.0	1.00	0.08	0.20	0.36
Fat, %	5.05	5.18	5.15	5.47	0.288	<0.01	0.35	0.26
Fat, kg	1.40	1.46	1.53	1.58	0.065	<0.01	0.87	0.80
Protein, %	3.35	3.43	3.40	3.40	0.098	0.22	0.14	0.16
Protein, kg	0.93	0.98	1.01	0.99	0.033	0.06	0.12	0.63

[1]CTRL = Control Diet (0% HPCoP); 2.6L = Low Diet (2.6% HPCoP); 5.4M = Medium Diet (5.4% HPCoP); 8.0H = High diet (8.0% HPCoP).
[2]L = linear, Q = quadratic, C = cubic.

Summary & Overall Conclusions

- DM, OM, CP, NDF, starch, fatty acid and energy digestibility was unaffected by increasing inclusion of HPCoP
- GE in Mcal/d and Mcal/kg increased with increasing inclusion but did not affect DE or ME in Mcal/d or Mcal/kg
- Increasing inclusion of HCoP increased ECM and milk fat percent and yield