

Brassica carinata for Livestock



**Dr. Stephanie Ward, Dairy Extension Specialist
Rose Chunn, Graduate Assistant
Animal Science, NC State University**



Feed Evaluation

Production/Nutrition

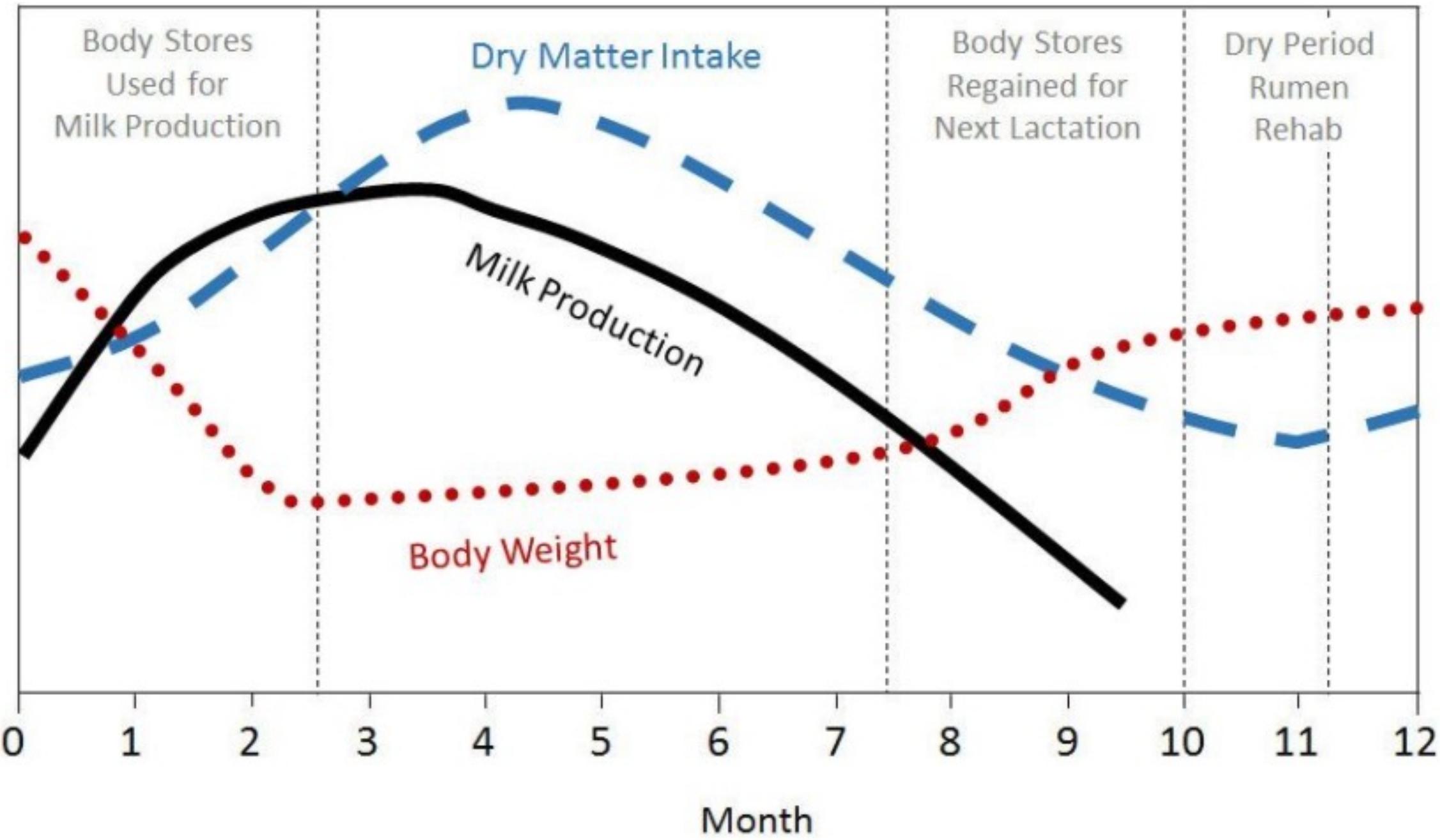
- Must support milk and milk component yields

Animal Health

- No sacrifices to animal health or well-being

Economics

- Cheaper is not always better
- ROI must be +



Typical Dairy Ration

silage

corn

soybean meal

alfalfa

vitamins

minerals

buffers

fish meal

cottonseed

corn gluten

whole cottonseed

ddg

sorghum

forage

amino acids

ionophores



- No lack of protein feed options
- Must be competitive:
 - Price
 - Availability
 - No anti-quality factors
- Niche feed
 - Different market access
 - Environment or Climate friendly

Beef¹

- Improved ADG in heifers
- Some negative response to GSL
- No reports of palatability issues
- Protein digestibility and disappearance adequate for growth

Fish¹

- Decreased growth rates
- AA profile not supportive of growth
- Protein digestibility improved with processing/extraction methodology

Poultry¹

- Increased feed conversion
- GSL a concern
- Similar AA deficiencies noted as in trout

¹Rodriguez-Hernandez and Anderson (2017); Paula et. al (2019). Feeding Canola, Camelina, and Carinata Meals to Ruminants; Schulmeister, et. al, (2021); Brake et., al (2018);

¹ Gibbons, Brown, and Anderson (2017); SPARC Summit; Kasiga, et al., (2019)

¹ Yadav, et. Al., (2022); Agyekum and Woyengo (2022)

Protein Evaluation

- Protein quality must be equivalent
- Lys low in Carinata compared to SBM and Canola
- Dairy diets typically supplemented or rely on other feeds
 - Greater concern in monogastrics

| | Carinata^{1*} | Canola^{2,3} | DDG^{1, 2} | SBM^{1,2} |
|-----------------------|------------------------------|-----------------------------|---------------------------|--------------------------|
| CP, % | 43 | 37.8 | 29.7 | 53 |
| AA Profile | % CP | | | |
| Arginine | 5.80 | 7.01 | 4.06 | 7.32 |
| Histidine | 2.26 | 2.80 | 2.50 | 2.77 |
| Lysine | 3.72 | 5.62 | 2.24 | 6.29 |
| Methionine | 1.62 | 1.87 | 1.85 | 1.44 |
| Leucine | 5.96 | 6.77 | 9.59 | 7.81 |
| Isoleucine | 3.51 | 3.83 | 3.71 | 4.56 |
| Phenylalanine | 3.44 | 4.06 | 4.87 | 5.26 |
| Threonine | 3.30 | 4.42 | 3.44 | 3.96 |
| Valine | 4.23 | 4.73 | 4.70 | 4.64 |
| CP Digestibility, %CP | 97.1 | 95.5 | 93.7 | 98.7 |
| RDP, % CP | 71.8 | 76.4 | 55.1 | 72.3 |
| RUP, % CP | 28.2 | 23.6 | 44.9 | 27.8 |

¹Schulmeister, et. al, (2021); ²Nutrient Requirements of Dairy Cattle, (2001); ³Gibbons, Brown, and Anderson (2017)
 *Data from Schulmeiser, et al converted from w/w% to %CP

Methods

- Evaluated treatment of 60 lactating Holstein cows
 - 11% inclusion rate of carinata meal in treatment diet
- Feed
 - Proximate analysis (DM, NDF, ADF, CP, Ash, Net Energy of Lactation, Minerals)
 - Glucosinolates
- Blood
 - Metabolic profile (Ca, P, Mg, Alb, BUN, Glucose, Cholesterol, NEFA, Sodium, Potassium, Cl)
 - T3/T4
- Milk
 - Components (Fat, Protein, SCC, Lactose, OS, MUN)

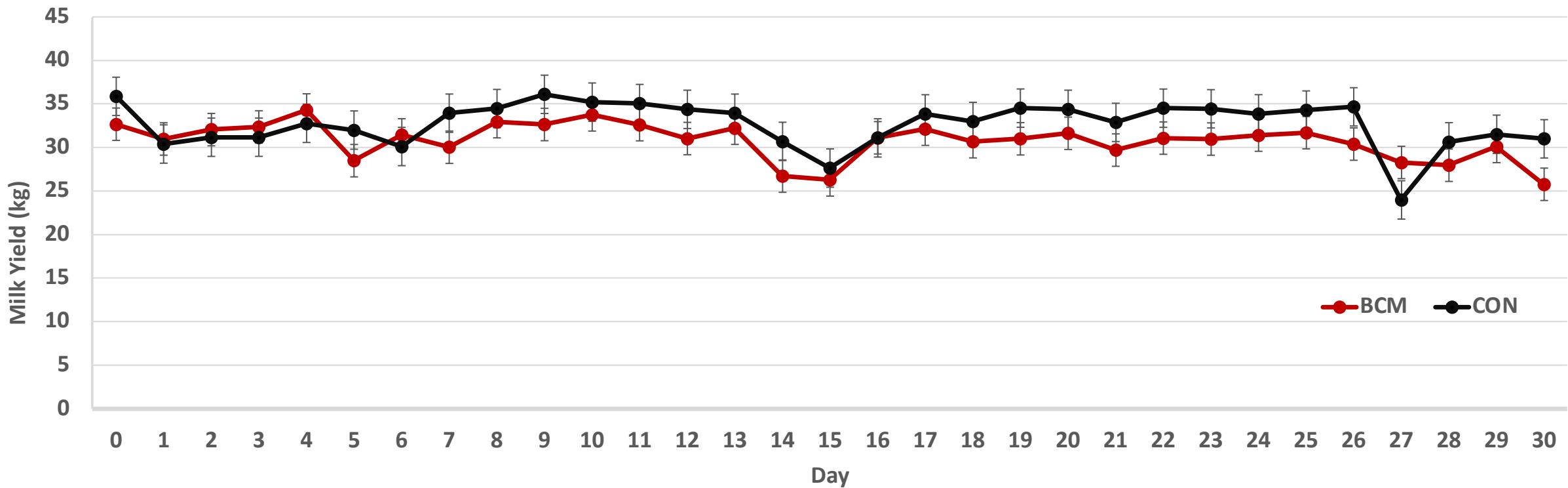
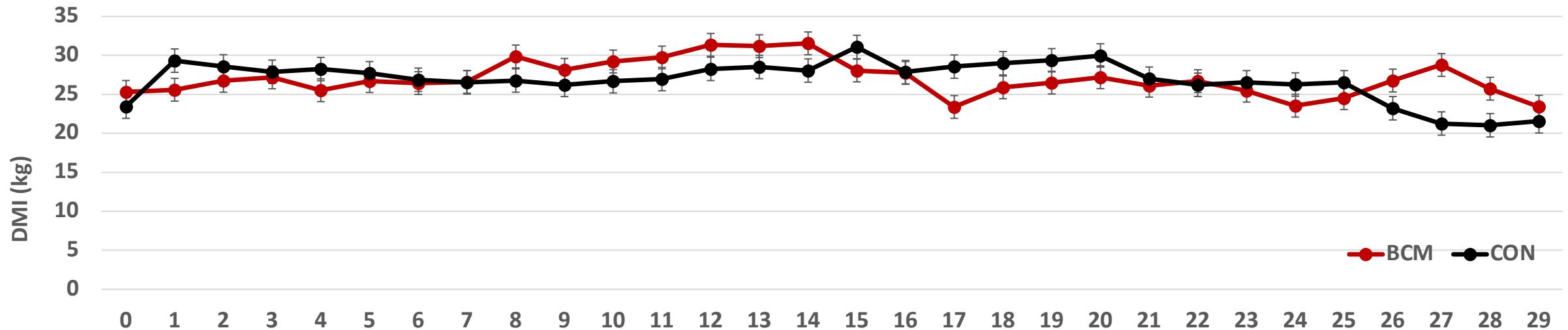


| Ingredient, kg DM | Control Diet | BCM Diet | Nutrient Analysis | Control | BCM | P-Value |
|-----------------------------------------|--------------|-------------|----------------------------------------|-------------|-------------|-------------|
| Corn grain, coarse ground | 8.74 | 8.70 | Dry matter, % | 95.58 | 95.41 | 0.03 |
| Cottonseed hulls | 1.51 | 1.52 | Crude Protein, % | 16.50 | 16.24 | 0.62 |
| Cottonseed, whole | 5.08 | 4.97 | Soluble Protein ² , % | 6.45 | 5.80 | 0.10 |
| Limestone | 0.77 | 0.57 | NDF, % | 37.18 | 37.29 | 0.96 |
| Molasses | 0.16 | 0.17 | ADF, % | 19.65 | 20.35 | 0.15 |
| Mycotoxin binder | 0.03 | 0.04 | Ash, % | 6.06 | 6.96 | 0.17 |
| Salt | 0.23 | 0.23 | Ca, % | 0.79 | 0.77 | 0.37 |
| Sodium bicarbonate | 0.52 | 0.53 | P, % | 0.36 | 0.42 | <0.01 |
| Soybean hulls | 1.06 | 1.17 | Mg, % | 0.20 | 0.27 | <0.01 |
| Soybean meal, 48% CP | 7.94 | 3.00 | K, % | 1.18 | 1.16 | 0.56 |
| Zinpro Availa-4 | 0.01 | 0.02 | Na, % | 0.51 | 0.44 | 0.07 |
| AminoPlus | 1.50 | 1.50 | Fe, ppm | 266.17 | 388.00 | 0.15 |
| Diamond V XPC | 0.03 | 0.04 | Mn, ppm | 65.10 | 67.10 | 0.68 |
| L-Methionine (MFP [©] , Novus) | 0.08 | 0.08 | Zn, ppm | 79.00 | 75.40 | 0.31 |
| Potassium-magnesium sulfate | 0.13 | 0.03 | Cu, ppm | 20.90 | 19.20 | 0.17 |
| PRS Exp Corn Silage | 29.2 | 28.80 | NE _L ³ , Mcal/kg | 1.72 | 1.69 | 0.05 |
| Carinata Meal | 0 | 6.17 | ME ³ , Mcal/kg | 2.91 | 2.84 | 0.04 |
| Trace mineral mix ¹ | 0.05 | 0 | | | | |
| Total DM | 57.07 | 57.54 | | | | |

¹Trace mineral mix contained 3.4% calcium carbonate, 0.5% zinc sulfate, 0.5% selenium, 0.275% vitamin E, 0.125% manganese sulfate, 0.1% mineral oil, 0.05% copper sulfate, 0.031% vitamin A, 0.02% vitamin D, 0.0015% iodine.

²Soluble protein was calculated according to the Borate-Phosphate procedure as detailed in Nitrogen Fractions in Selected Feedstuffs. (Krichnamoorthy et al., 1982).

³Net energy of Lactation (NE_L) and Metabolizable Energy (ME) were calculated from an ADF based equation as described in Cumberland Valley's Feed Report guide on Estimates of Energy Availability.



| | Control | BCM | SEM | P-Value |
|------------------------------|---------|--------|-------|---------|
| Dry Matter Intake, kg | 27.03 | 26.85 | 1.23 | 0.91 |
| Organic Matter, kg | 23.38 | 22.56 | 1.05 | 0.55 |
| NDF, kg | 19.64 | 21.76 | 0.96 | 0.09 |
| ADF, kg | 11.37 | 12.49 | 0.55 | 0.11 |
| CP, kg | 10.07 | 9.81 | 0.53 | 0.65 |
| SP, kg | 1.57 | 1.41 | 0.09 | 0.15 |
| Ca, g | 177.67 | 182.29 | 10.52 | 0.48 |
| P, g | 87.19 | 103.30 | 5.36 | 0.02 |
| Mg, g | 49.23 | 65.97 | 3.27 | 0.0001 |
| K, g | 283.78 | 278.31 | 16.04 | 0.79 |
| Na, g | 109.77 | 102.59 | 6.23 | 0.37 |
| Fe, g | 7.51 | 12.65 | 0.56 | 0.0001 |
| Mn, g | 1.49 | 1.67 | 0.09 | 0.11 |
| Zn, g | 1.86 | 1.86 | 0.11 | 0.99 |
| Cu, g | 0.47 | 0.48 | 0.03 | 0.91 |
| NE _I , Mcal | 39.06 | 40.11 | 1.40 | 0.56 |
| Body Weight, kg | 715.18 | 687.99 | 16.74 | 0.22 |
| Body Weight Change | -5.43 | -0.93 | 7.43 | 0.63 |
| Feed Efficiency ¹ | 1.17 | 0.93 | 0.12 | 0.13 |

¹Feed Efficiency calculated as Dry Matter Intake (kg) ÷ Milk Yield (kg).

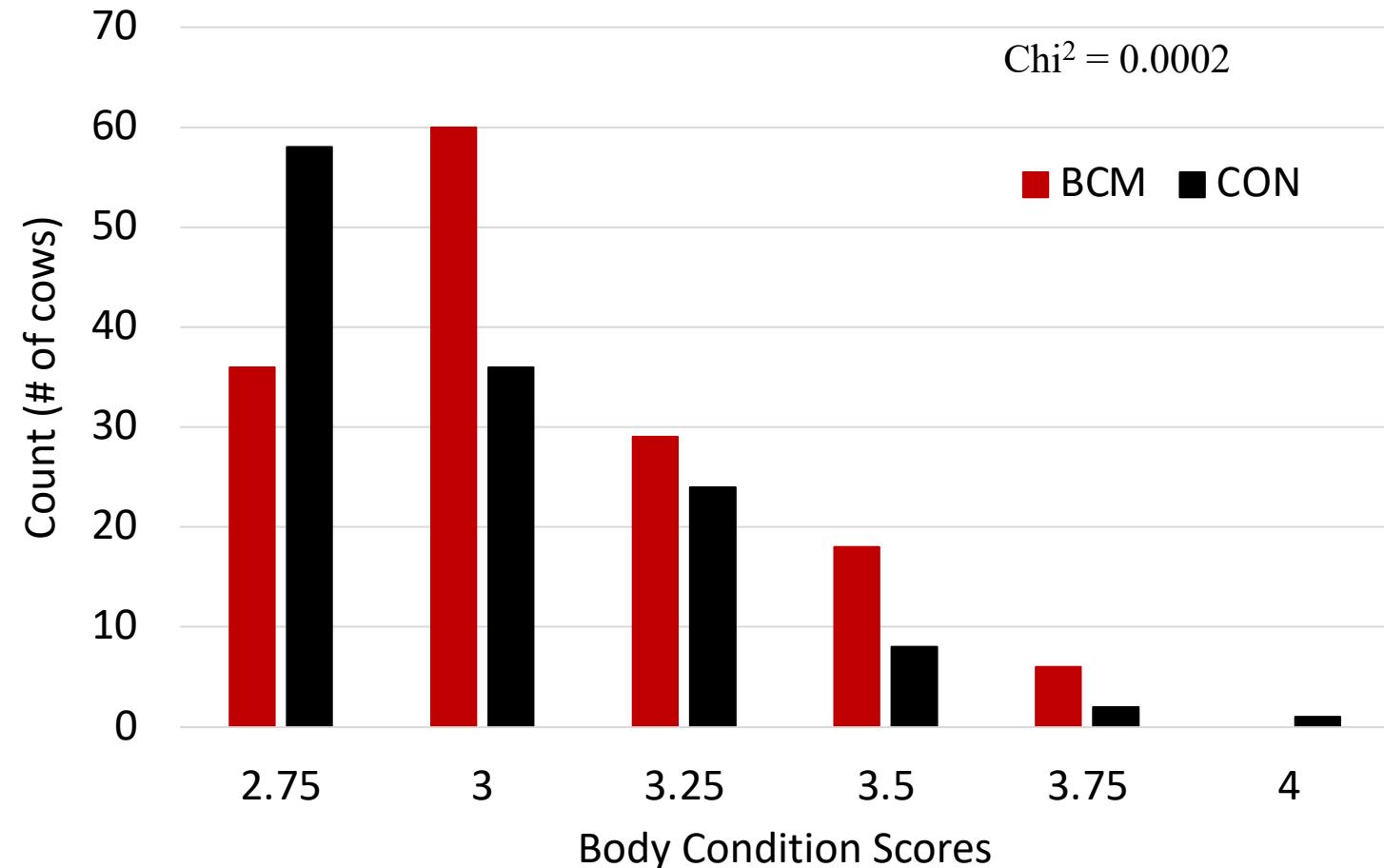
| | Control | BCM | SEM | P-Value |
|----------------------------------------------------|-------------|-------------|-------------|-------------|
| Milk Yield, kg/d | 32.8 | 31.0 | 1.80 | 0.42 |
| ECM¹ Yield, kg/d | 81.7 | 77.9 | 4.28 | 0.49 |
| Milk Protein | | | | |
| g/d | 920.1 | 891.4 | 50.69 | 0.66 |
| % | 2.80 | 2.90 | 0.04 | 0.05 |
| Milk Fat | | | | |
| g/d | 1,489.4 | 1,423.1 | 77.1 | 0.50 |
| % | 4.56 | 4.63 | 0.08 | 0.44 |
| Lactose, % | 4.23 | 4.21 | 0.04 | 0.78 |
| Conductivity, mS | 9.08 | 9.01 | 0.20 | 0.77 |
| Somatic Cell count, 10³ cells/mL | 453.0 | 114.1 | 134.3 | 0.05 |
| MUN², mg/dL | 11.5 | 11.2 | 0.48 | 0.58 |

¹Energy corrected milk, calculated as ECM = (0.327 x lbs. milk) + (12.95 x lbs. fat) + (7.65 x protein lbs.).

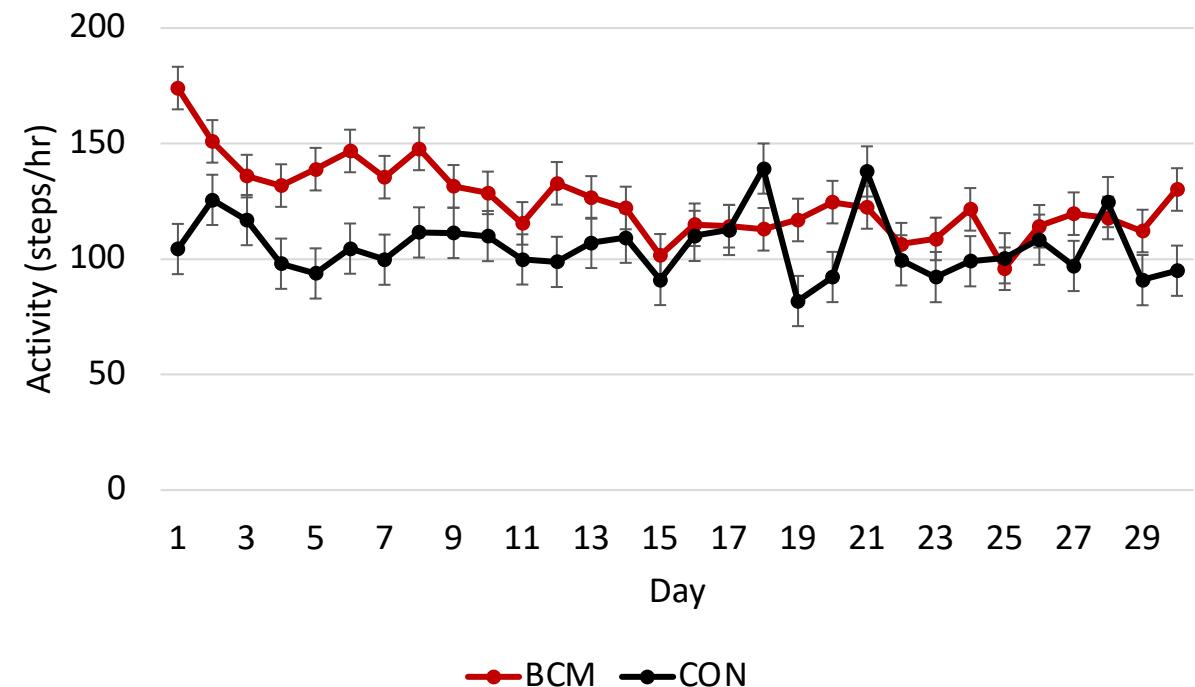
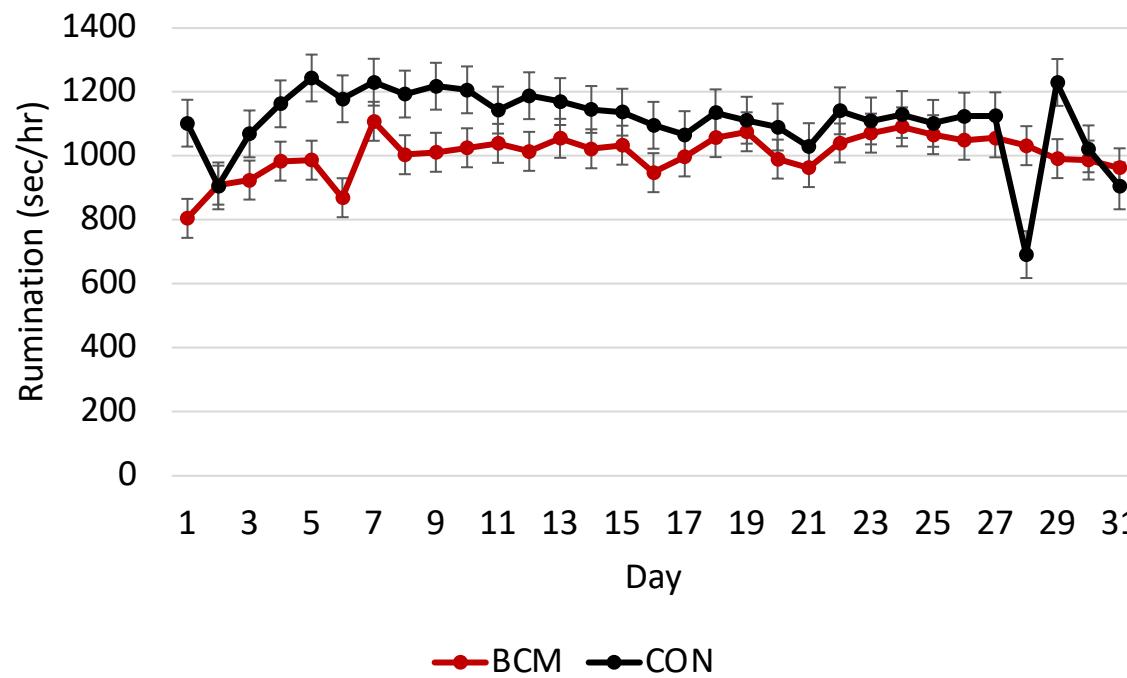
²Milk urea nitrogen

- No difference in body weight, weight change, or average BCS
- BCM fed cows did have greater frequency of BCS @3 or greater compared to control

Body Condition



Rumination and Activity



- Rumination
 - BCM = 16.75 min/hr
 - CON = 18.5 min/hr
- Eating Time
 - BCM = 3.78 min/hr
 - CON = 3.0 min/hr
- Activity
 - BCM = 125 steps/hr
 - CON = 105 steps/hr

| | Control | BCM | SEM | P-Value | Normal Range ¹ |
|----------------------------|---------|--------|------|---------|---------------------------|
| T3 ² , ng/dL | 116 | 124 | 6.0 | 0.30 | N/A |
| T4 ³ , ng/dL | 54.8 | 60.0 | 2.85 | 0.18 | N/A |
| Calcium, mg/dL | 9.12 | 8.85 | 0.10 | 0.06 | 8.3 – 10.4 |
| Phosphorus, mg/dL | 5.49 | 5.54 | 0.15 | 0.81 | 4.9 – 9.1 |
| Magnesium, mEq/dL | 1.90 | 1.93 | 0.05 | 0.72 | 1.5 – 2.5 |
| Albumin, mg/dL | 3.57 | 3.64 | 0.07 | 0.46 | 3.1 – 4.3 |
| BUN ⁴ , mg/dL | 14.2 | 14.35 | 0.60 | 0.94 | 10 – 25 |
| Glucose, mg/dL | 73.4 | 71.96 | 0.74 | 0.10 | 31 – 77 |
| Cholesterol, mg/dL | 188.3 | 188.32 | 9.10 | 0.68 | 73 – 280 |
| Sodium, mEq/dL | 138.9 | 138.50 | 0.78 | 0.65 | 135 – 153 |
| Potassium, mEq/dL | 4.43 | 4.50 | 0.07 | 0.46 | 3.9 – 6.0 |
| Chloride, mEq/dL | 96.4 | 96.67 | 0.62 | 0.77 | 92 – 117 |
| NEFA ⁵ , mEq/dL | 0.27 | 0.28 | 0.02 | 0.77 | 0 – 0.60 |

¹Normal ranges for metabolites are referenced from the Texas A&M Veterinary Medical Diagnostic Laboratory.²Triiodothyronine; ³Thyroxine; ⁴Blood urea nitrogen; ⁵Non-esterified fatty acids

| | Sinigrin, umol/g | Total GSL, umol/g | Total GSL, mg/g |
|--------------------------------------|------------------|-------------------|-----------------|
| Chunn et. al¹ | | | |
| Control Diet | <0.25 | - | |
| BCM Diet | <0.25 | - | |
| Carinata Meal | <0.25 | - | |
| Solvent Extracted² | | | |
| Carinata | 26.8-106.8 | 22.2 | |
| Canola | - | - | 6.0 |
| Camelina | 20.8 | 25.9 | |
| Cold pressed² | | | |
| Carinata | 132.7 mg/g | 23.7 | 20.6 |
| Canola | - | - | 12.2 |
| Camelina | 0 | 24.9 | |

¹Analysis conducted by Dr. Mark Berhow, USDA

²Rodriguez-Hernandez and Anderson (2017); Paula et. al (2019). Feeding Canola, Camelina, and Carinata Meals to Ruminants; Schulmeister, et. al, (2021); Brake et., al (2018); “Oilseed Meal Processing and Feeding Trials”, Gibbons, Brown, and Anderson (2017); SPARC Summit

Going Forward

- Protein fractionation in dairy
- Further explore GSL
 - Potential for positive impact of “good” GSL
 - Extraction method – further breakdown in the rumen to reduce GSL in milk
- Product development
 - Meat/Milk quality and safety
- Because **EXTRACTION** method is so important **EDUCATION** of producers and nutritionists is **ESSENTIAL**

Questions?