Pre-calving supplementation of trace minerals and fat: impacts on cow and calf performance

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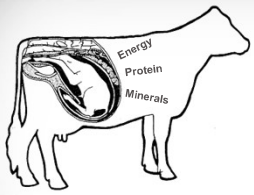
Nutrition of Gestating Cows



Fetus depends completely on the dam for proper supply of trace minerals to support metabolic processes required for growth

- Nutritional management of pregnant cows
  - Impacts calf productivity = **fetal programming**
  - Adequate nutritional status during gestation

Nutrition of Gestating Cows

- Prenatal nutrition planning for women
  - Adequate (normal) weight pre-pregnancy
    - Gain about 30-35 lbs during gestation
    - 4 lbs/month during 2nd and 3rd trimesters
  - Supplemental nutrients (beyond requirements)
    - Trace minerals from organic sources (Zn and Cu)
    - ω-6 and ω-3 fatty acids

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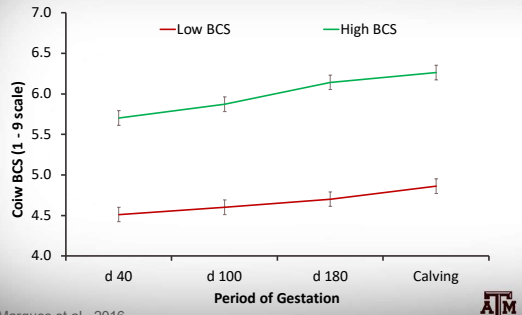
BCS during gestation

Low BCS (4.0 – 4.5)

High BCS (5.5 – 6.0)

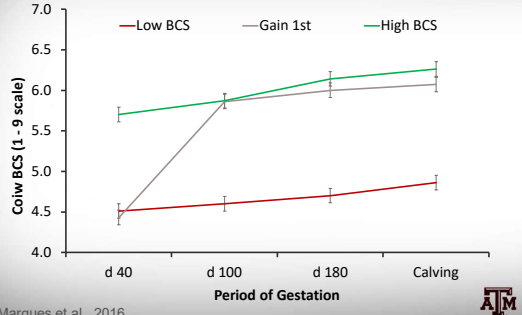
Marques et al., 2016

BCS during gestation



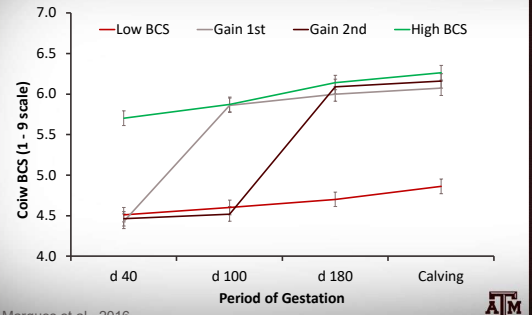
Marques et al., 2016

BCS during gestation



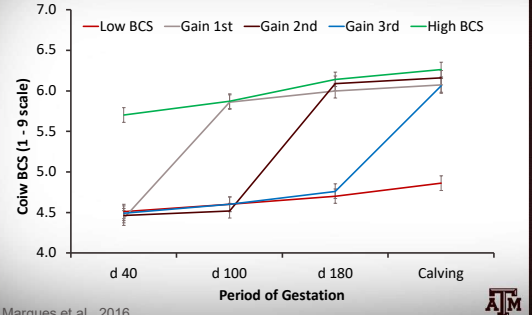
Marques et al., 2016

BCS during gestation



Marques et al., 2016

BCS during gestation



Marques et al., 2016

BCS during gestation

Item	Low BCS	Gain 1st	Gain 2nd	Gain 3rd	High BCS	P =
Calving results						
Calf birth BW, lbs	99.4	95.0	97.5	92.9	94.1	0.46
Milk yield, lbs/d	32.6	29.5	31.2	34.5	30.1	0.42
Weaning						
Weaning BW, lbs	557	572	590	581	552	0.04
Calf value, $	1168	1201	1238	1220	1159	0.04

- BCS gain during gestation is key
  - Up to 38 lbs weaning BW / $ 60 calf value
- More effective if during 2nd and 3rd trimesters
  - Greater fetal development
  - Reduced costs (non-lactating cows)

Marques et al., 2015

Nutrition of Gestating Cows

- Nutritional management of pregnant cows
  - Crucial to monitor and allow cows to gain BCS
    - Gain = when feasible
      - Proper macro (TDN, CP) and micronutrient nutrition
  - Yet, little is known about trace minerals
    - Zinc, Cobalt, Manganese, and Copper
    - Essential for fetal development
    - Available in inorganic (sulfate) or organic (AA:metal)
      - "Overlooked" by cattle producers and scientists
      - Not by human medicine

Nutrition of Gestating Cows

- Trace mineral nutrition to beef cows
  - Pregnant cows at the end of 2nd trimester

Marques et al., 2016

Nutrition of Gestating Cows

- Trace mineral nutrition to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON, INR, or ORG **until calving only**

Item	CON	INR	ORG
Ingredients, lbs/day			
Alfalfa hay	15	15	15
Grass-seed straw	6	6	6
Cracked corn	5	5	5
Macromineral mix	0.13	0.13	0.13
Inorganic trace mix (Cu, Co, Mn, Zn sulfate)	-	0.009	-
Organic trace mix (Availa®4)	-	-	0.015

Nutrition of Gestating Cows

- Trace mineral nutrition to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON, INR, or ORG **until calving only**

What does it mean?

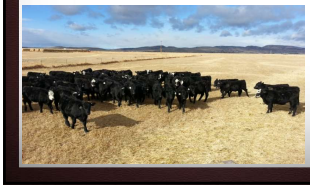
Results from this research should not be associated with trace mineral deficiency in the CON diet, but with the potential ***fetal programming*** effects of additional Co, Cu, Mn, and Zn intake by ORG and INR cows.

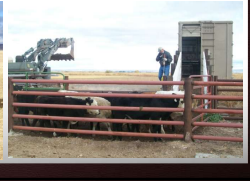
Nutrition of Gestating Cows

- What else was done?
  - Liver samples collected from cows and calves
  - Placenta collected after calving

Nutrition of Gestating Cows

- What else was done?
  - After calving, managed the same (INR only)
  - Calves weaned at 7 months of age
    - Preconditioned for 45-d
    - Shipped to feedlot until slaughter





Nutrition of Gestating Cows

- How about results? *Cow liver mineral status*

Item	CON	INR	ORG	*P* =
Cobalt, ppm				
Initial	0.29	0.28	0.27	0.38
Pre-calving	0.21[a]	0.40[b]	**0.44[c]**	< 0.01
Copper, ppm				
Initial	93	106	95	0.68
Pre-calving	69[a]	**155[b]**	129[c]	< 0.01
Manganese, ppm				
Initial	12.8	12.8	12.2	0.58
Pre-calving	8.7	9.0	8.7	0.67
Zinc, ppm				
Initial	171	176	171	0.70
Pre-calving	211[a]	230[b]	235[b]	0.05

Nutrition of Gestating Cows

- How about results? *Calf and placenta mineral status*

What does it mean?

Both INR and ORG similarly improved trace mineral status in the cows.

ORG enhanced transfer of trace elements from dam to fetus.

Nutrition of Gestating Cows

- How about results? *Calving and weaning results*

What does it mean?

ORG increased weaned calf value by $70 compared with CON, with extra feeding cost of $3.10/cow

INR increased weaned calf value by $32 compared with CON, with extra feeding cost of $2.00/cow

Similar outcomes if using 45-d preconditioned calf value

*All calves sent to feedyard****

Nutrition of Gestating Cows

- How about results? *Feedlot and slaughter results*

What does it mean?

ORG reduced incidence of BRD during its critical time (initial month in the feedyard).

Greater weaning BW of ORG calves was maintained until slaughter, resulting in heavier carcasses

Potential fetal programming effects on calf growth and health!

Nutrition of Gestating Cows

- How about results? *Heifers reared as replacements*

What does it mean?

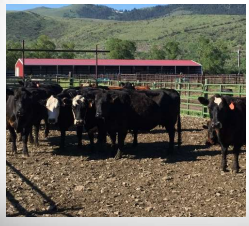
ORG hastened puberty attainment in heifers reared as replacements

Despite similar ADG during the post-weaning period

Potential fetal programming effects on female reproductive development and functioning

Nutrition of Gestating Cows

- Essential fatty acids to beef cows
  - Pregnant cows at the end of 2nd trimester



Marques et al., 2017

Nutrition of Gestating Cows

- Essential fatty acids to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON or EFA **until calving only**

Item	CON	EFA
Ingredients, lbs/day		
Grass-alfalfa hay	23.0	23.0
Soybean meal	1.0	1.0
Ca salts of palm oil (saturated; EnerGII)	0.45	-
Ca salts of soybean oil (ω-6; Prequel)	-	0.225
Ca salts based on fish oil (ω-3; Strata)	-	0.225

Nutrition of Gestating Cows

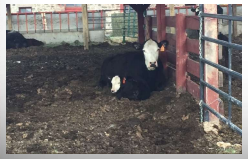
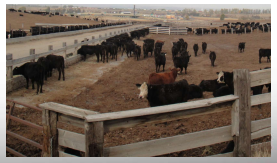
- Essential fatty acids to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON or EFA **until calving only**

What does it mean?

Results from this research should not be associated with energy or fat intake, but with the potential ***fetal programming*** effects of supplemental ω-6 and ω-3 to EFA cows.

Nutrition of Gestating Cows

- What else was done?
  - After calving, managed the same (no fat supp)
  - Calves weaned at 7 months of age
    - Preconditioned for 45-d
    - Shipped to feedlot until slaughter

Nutrition of Gestating Cows

- How about results? *Cow plasma FA at calving*

Item (g/100 g plasma	**CON**	**EFA**	***P* =**
Linoleic, ω-6	19.5	38.7	< 0.01
Linolenic, ω-3	2.01	3.73	< 0.01
Arachdonic, ω-6	0.55	2.08	< 0.01
DPA, ω-3	0.10	0.44	< 0.01
DHA, ω-3	0.00	0.57	< 0.01
PUFA	22.6	44.9	< 0.01
Total ω-3	2.25	4.80	< 0.01
Total ω-6	20.4	41.1	< 0.01
Total fatty acids	99.3	98.4	0.75

Nutrition of Gestating Cows

- How about results? *Feedlot and slaughter results*

What does it mean?

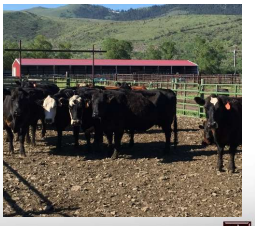
Offspring from EFA and CON cows had similar development until weaning and preconditioning

Offspring from EFA had increased BW gain and intramuscular fat deposition when exposed to high-energy feedlot diets, resulting in heavier carcasses and increased marbling @ slaughter

Potential fetal programming effects on growth and carcass development

Nutrition of Gestating Cows

- Unravelling the effects of **omega-6 only**
  - Pregnant cows at the end of 2nd trimester

Brandão et al., 2019

Nutrition of Gestating Cows

- **Omega-6** FA to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON or OM6 **until calving only**

Item	CON	OM6
Ingredients, lbs/day		
Grass-alfalfa hay	30	30
Soybean meal	1.0	1.0
Prilled palm oil (saturated; EnergyBooster)	0.45	-
Ca salts of soybean oil (ω-6; Prequel)	-	0.45

Nutrition of Gestating Cows

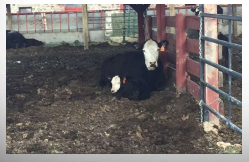
- **Omega-6** FA to beef cows
  - Pregnant cows at the end of 2nd trimester
  - CON or OM6 **until calving only**

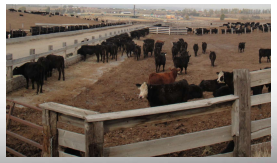
What does it mean?

Results from this research should not be associated with energy or fat intake, but with the potential ***fetal programming*** effects of supplemental ω-6 EFA to cows.

Nutrition of Gestating Cows

- What else was done?
  - After calving, managed the same (no fat supp)
  - Calves weaned at 7 months of age
    - Preconditioned for 45-d
    - Shipped to feedlot until slaughter





Nutrition of Gestating Cows

- How about results? *Calf plasma FA at calving*

Item (µg/mL plasma)	CON	OM6	*P* =
Linoleic, ω-6	24.5	41.9	< 0.01
Linolenic, ω-3	1.23	0.100	< 0.01
Arachdonic, ω-6	7.98	11.6	< 0.01
PUFA	40.1	60.6	< 0.01
Total ω-3	2.50	1.05	0.05
Total ω-6	37.6	59.5	< 0.01
Total fatty acids	311	319	0.73

Nutrition of Gestating Cows

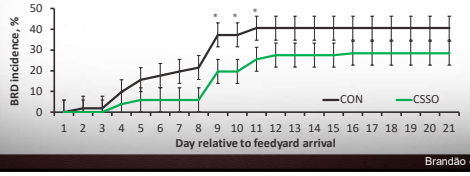
- How about results? *Calving and weaning results*

Item	CON	OM6	P =
Calving results			
Calving rate, %	100	100	-
Calf birth weight, lbs	81.5	83.0	0.42
Colostrum IgG, mg/mL	373	423	0.02
Calf IgG (24h of life), mg/mL	55.7	97.9	< 0.01
Weaning results			
Weaning rate, %	96.0	100	0.17
Calf weaning age, d	209	209	0.91
Calf weaning weight, lbs	576	581	0.72

Nutrition of Gestating Cows

- How about results? *Feedlot health results*

Item	CON	OM6	P =
Cattle treated for BRD, %			
Once	40.5	28.4	0.16
Twice	19.2	5.64	0.03
N of antimicrobial treatments	1.49	1.18	0.05



Brandão et al., 2020

Nutrition of Gestating Cows

- How about results? *Feedlot to slaughter results*

Item	CON	CSSO	P =
Average daily gain, lbs/day	3.06	3.35	0.05
Final BW, lbs	1,216	1,274	0.02
Hot carcass weight, lbs	768	803	0.02
Ribeye area, in^2	12.34	12.77	0.03

What does it mean?

In utero programming effects of omega-6 on lifelong health, growth and **muscle** development of the offspring

Brandão et al., 2020

Nutrition of Gestating Cows

Make sure cows are in adequate BCS status/change during gestation (up to 5.5 – 6.0).

Strategic prenatal supplementation, including organic trace minerals and EFA (omega-3 and omega-6), are alternatives to optimize offspring productivity.

Thank you!

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