

# Rethinking Vitamin A Needs of Beef Cows

Dr. Hannah Speer  
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## Why is vitamin A important?

- **Vision**
- **Immunity**
  - Epithelial integrity
  - GI and respiratory tracts
- Calf health-biggest concern
- **Fetal growth and development**
- **Reproduction**



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## Vitamin A deficiency

- **Vision** → night blindness
- **Immunity** → increased susceptibility to disease
  - Diarrhea and respiratory disease in young calves
- **Fetal growth and development** → birth defects
- **Reproduction** → abortion, fetal resorption, complete failure to breed

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## Vitamin A for young calves

- Calf born vitamin A deficient
  - Limited placental transfer
- High vitamin A concentration in colostrum
  - Critical to establish vitamin A stores in calf
  - Cow stores and dietary intake influence concentration

**Cow deficient = low A levels in colostrum = calf deficient = impaired calf immunity**



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## Vitamin A in feedstuffs

- Fresh green forage contains high amounts of β-carotene
  - β-carotene can be used by cow to make vitamin A
  - Vitamin A stores can be built; used during times when dietary vitamin A is low
- Brown grass and stored forages poor source of vitamin A
  - β-carotene **14X greater** in fresh green forage compared to green hay
  - Maturity, heat, light, and storage time reduce vitamin A
- Grains/by-products provide minimal vitamin A

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Feedstuff	IU/lb DM <sup>1</sup>	IU/d, 1300-lb cow <sup>2</sup>
Fresh pasture	8,571 to 23,455	222,846 to 609,830
Silage, corn	2,423 to 13,333	81,536 to 113,464
Green hay, alfalfa	8,081 to 11,111	210,106 to 288,886
Average grass hay	1,818 to 3,937	47,268 to 102,362
Brown hay	127	3,302
Straw, wheat	27	702
Corn, cracked	68	
Corn, high moisture	163	
Distillers grains, dry	219	
Distillers grains, wet	363	

<sup>1</sup>Data from Maynard et al., 1979, Calderon et al., 2006, Pickworth et al., 2012  
<sup>2</sup>Assuming 2.0% of BW/d intake (DM basis)

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### Current NASEM recommendations

- Pregnant beef cows: 1,273 IU/lb DM
  - 1,300-lb consuming 2.0% BW = 33,098 IU/d
- Lactating beef cows: 1,773 IU/lb DM
  - 1,300-lb consuming 2.0% BW = 46,098 IU/d
- Supplemental **NOT** total
  - Excludes dietary contributions

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### What are they based on?

- 3 studies with beef cows
  - Most recent was 1970!
  - Supplemented vs. no supplement
- Unclear how recommendations were set
- Diet type not specified
- What about the calf?
- A lot has changed...recommendation still relevant?
  - Genetics have influenced size, growth, performance potential

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### Comparison of recommendations

	1300-lb cow
<b>Beef NASEM 2016 (supplemental)</b>	IU/d
Pregnant heifers and cows	33,098
<b>ARC 1980 (total)</b>	
Pregnant cow	58,500
Provide for suckled calf	128,018
<b>Small ruminants NRC 2007 (total)</b>	
Late gestation ewe	89,394
<b>Ruminant CSIRO 2007 (total)</b>	
Pregnant heifers and cows	88,660

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Beef NASEM 2016 (supplemental)	1300-lb cow		
	Avg grass hay, IU/d	IU/d	Total IU/d
Pregnant heifers and cows	47,268	33,098	80,366
<b>ARC 1980 (total)</b>			
Pregnant cow		58,500	
Provide for suckled calf		128,018	
<b>Small ruminants NRC 2007 (total)</b>			
Late gestation ewe		89,394	
<b>Ruminant CSIRO 2007 (total)</b>			
Pregnant heifers and cows		88,660	

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Beef NASEM 2016 (supplemental)	1300-lb cow		
	Brown hay, IU/d	IU/d	Total IU/d
Pregnant heifers and cows	3,302	33,098	36,400
<b>ARC 1980 (total)</b>			% of recommendation
Pregnant cow		58,500	62
Provide for suckled calf		128,018	28
<b>Small ruminants NRC 2007 (total)</b>			
Late gestation ewe		89,394	41
<b>Ruminant CSIRO 2007 (total)</b>			
Pregnant heifers and cows		88,660	41

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### NEW DATA IN BEEF COWS



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### Why study it?

- **No changes** to current recommendation since establishment (NRC,1976)
- **No recent data** available reflecting supplemental vitamin A needs of modern beef cows in various production settings
- **No research** in beef cows indicating amount of supplemental vitamin A needed to ensure adequate vitamin A status of both cow and calf



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### Questions

- How does cow vitamin A status impact calf status?
- How does amount of supplemental vitamin A impact status of cow and her calf?
- Stored forage diets for extended periods of time



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### Evaluation of vitamin A status

- Multiparous beef cows (n = 120) in mid-gestation
  - 6.4 ± 1.2 years of age
- **Grazing prior to study**
- **Initial liver: 830 ± 288 SD µg/g DM**
- Individually fed using Calan gates for 144 d
  - 111 d pre-calving and 32 d post-calving



Photo: Marshfield Agricultural Research Station



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### Evaluation of vitamin A status

- Diet: alfalfa/grass hay, corn silage, and supplemental pellet
- Dietary vitamin A concentration = 223 IU/lb DM
  - 4,583 ± 649 IU/d
- 30 received 9,638 IU/d
- 90 received 24,973 IU/d
  - As retinyl acetate



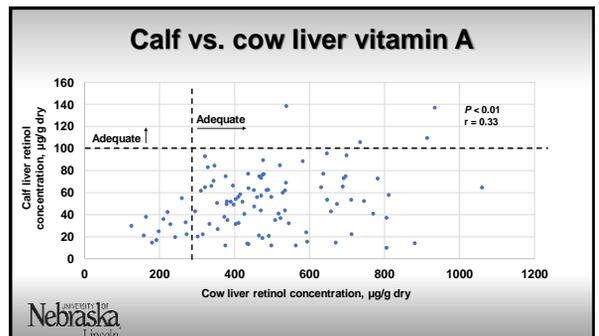

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### Evaluation of vitamin A status

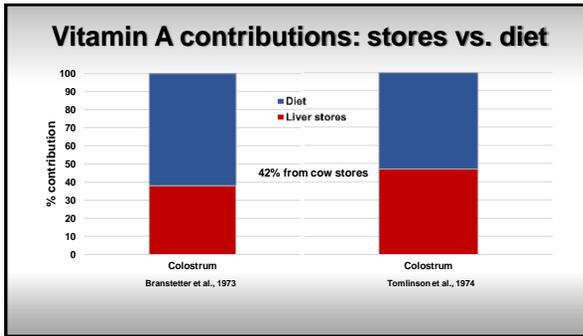
- Current NASEM recommendations
  - 1,273 IU/lb DM (33,098 IU/d) dry cows
  - Supplemental **NOT** total
- Levels in current study are lower
- Status assessed with liver biopsies
  - 32-d post calving




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### Conclusions

- Colostrum is important source of vitamin A for neonate
  - Cow stores + diet in late gestation contribute
- adequate cow ≠ adequate calf
- Suggests dietary levels in late gestation important

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### Effect of supplemental amount

- Multiparous beef cows in mid gestation (n = 54)
  - Long-term confinement (≥ 1 year)
- Stratified by time in system and BCS and assigned to pen (n = 9)
- **Current NASEM recommendation: 1,273 IU/lb DM (31,000 IU/d)**
  - Supplemented 31,000 IU/d prior to start of experiment (> 1 year)
- Pens were assigned randomly to treatment (n = 3 per treatment)
  - 1X: 31,000 IU/d
  - 3X: 93,000 IU/d
  - 5X: 155,000 IU/d

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Ingredient, % of diet DM	Gestation	Lactation	Lactation
	study day d 0	d 108	d 154
Wheat straw	54.5	44.5	37.5
Corn silage	25.0	32.0	37.0
WDGS*	20.0	23.0	25.0
Mineral supplement	0.625	0.500	0.521
Vitamin A supplement	0.011	0.009	0.009
<b>Nutrient composition</b>			
CP	11.0	11.9	12.6
TDN	65.7	68.7	70.8
<b>Amount offered, lb/d</b>			
Diet DM	20.0	25.1	25.1

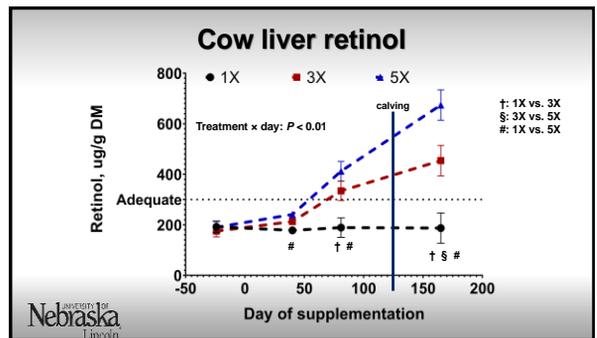
\*Wet distillers grains plus solubles

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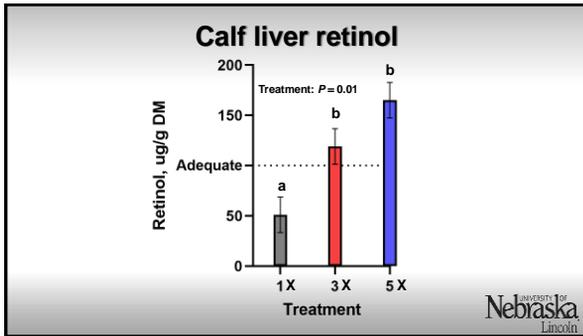
### Effect of supplemental amount

- Average dietary vitamin A = 21,125 IU/d
- Vitamin A was provided as retinyl acetate (30,000 IU/g)
- Vitamin A and mineral supplement delivered daily via micronutrient machine
  - 1X: 31,000 IU/d
  - 3X: 93,000 IU/d
  - 5X: 155,000 IU/d

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### Comparison of recommendations

	1200-lb cow	
<b>Beef NASEM 2016 (supplemental)</b>	IU/d	1X: 31,000 IU/d
Pregnant heifers and cows	31,000	3X: 93,000 IU/d
		5X: 155,000 IU/d
<b>Small ruminants NRC 2007 (total)</b>		
Late gestation	82,700	
<b>Ruminant CSIRO 2007 (total)</b>		
Pregnant heifers and cows	81,900	

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- ### Takeaways
- Current recommendation likely doesn't reflect need of modern beef cows
    - Diet changes supplemental need
  - Stored/brown forages don't provide much vitamin A in diet
    - Fresh green forage high in vitamin A
  - Calf at greater risk for vitamin A deficiency
    - Health issues

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- ### Takeaways
- Adequate cow status ≠ adequate calf status
  - Colostrum: 60% cow diet, 40% cow liver stores (Branstetter et al., 1973; Tomlinson et al., 1974)
  - Late gestation key time for calf
    - Adequate liver stores in cow
    - Adequate supplementation

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- ### Takeaways
- Current NASEM recommendation (31,000 IU/d) did not result in liver vitamin A being within the adequate reference range
    - Cows and their calves
  - 93,000 IU/d: adequate liver retinol concentrations in cows and calves
    - Cow liver stores did increase over time
    - More research needed

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