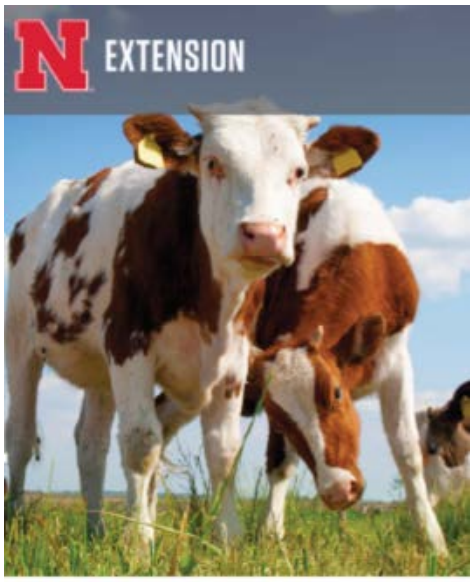


REARING YOUNG STOCK FOR DAIRY AND BEEF PRODUCTION WORKSHOP

November 9, 2016: Gage County Extension Office
Beatrice, NE

November 10, 2016: Lifelong Learning Center
Norfolk, NE

EXTENSION

Agenda

9:00 am	Registration
10:00 am	Welcome
10:15 am – 11:00 am	**Feeding the pre-weaned calf** Dr. Pete Erickson, State Dairy Specialist, University of New Hampshire
11:00 am – 11:30 am	**Reducing Cold Stress** Kim Clark & Paul Kononoff, Dairy Extension Educators, University of Nebraska-Lincoln
11:30 am - 12:15 pm	**Calf Nutrition: Post-weaning and starter feeding** Dr. Pete Erickson, State Dairy Specialist, University of New Hampshire
12:15 pm - 12:45 pm	Lunch
12:45 pm - 1:30 pm	**Development, growth rate targets, and feeding strategies for growing heifers.** Dr. Jill Anderson, Assistant Professor, South Dakota State University
1:30 pm - 2:00 pm	**Dairy Beef: Performance and Carcass Characteristics** Dr. Andrea Watson, Research Assistant Professor, University of Nebraska-Lincoln
2:00 pm – 2:30 pm	Break
2:30 pm – 3:15 pm	**Utilizing distillers grains and other alternative protein sources in growing heifer rations** Dr. Jill Anderson, Assistant Professor, South Dakota State University
3:15 pm	Conclusion and evaluation

Thank You to Our Sponsors

Prime:

NEBRASKA STATE DAIRY ASSOCIATION

Nebraska CornBoard

SCCL
SCIENCE ◆ NATURE ◆ CARE

STRONG ANIMALS®

CONNOR AGRISCIENCE
See the difference®

Choice:

Alltech®
...naturally

AD AUTOMATED DAIRY SPECIALISTS, LLC
WWW.AUTOMATEDDAIRYSPECIALISTS.COM

U.S. Registered Holsteins
FOR MAXIMUM PROFIT
HOLSTEIN ASSOCIATION USA, INC.

FEED GREATNESS™

Phibro
ANIMAL HEALTH CORPORATION ™

POET nutrition

Elanco™

HUBBARD FEEDS INC.

CCS THE PROFESSIONALS
Central Confinement Service, Ltd.

Workshop Speakers

Dr. Peter Erickson is Professor of Dairy Management and Extension Dairy specialist at the University of New Hampshire. His teaching includes courses in dairy cattle nutrition, physiology of lactation, technical writing, and advanced dairy herd management. He and his graduate students conduct research in the nutrition of the transition cow, newborn and post weaned heifer. He is a native of New England having worked on his neighbor's dairy farm in central Massachusetts. He holds a B.S. in Animal Science from the University of Massachusetts, a M.S. in Animal Science from the University of Maine, and a Ph.D. in Dairy Science from the University of Illinois. He has been employed as a nutritionist with Ralston Purina Canada, Hoffmann-LaRoche, and Agri-King. He lives with his wife and two daughters on a small farm in central New Hampshire.

Kim Clark is a dairy extension educator at the University of Nebraska-Lincoln (UNL) in the Animal Science Department. She joined the faculty at UNL in July 2015. Clark earned both her B.S. degree in Animal Science and her M.Ag. degree in Animal Science and Agricultural Economics with a minor in Agriculture Leadership from the University of Nebraska-Lincoln. Her responsibilities include communicating with Nebraska dairy producers on the latest research from UNL and the dairy industry, providing them with educational resources for their operation, collaborating with the Nebraska State Dairy Association (NSDA), dairy organizations, universities across the nation, and planning in-state and multi-state programs. Clark will work with UNL faculty, Nebraska and other state Extension Educators, NSDA and other organizations and for the benefit of Nebraska's dairy producers.

Dr. Jill Anderson is an Assistant Professor of Dairy Production in the Dairy and Food Science Department at South Dakota State University. She joined the faculty at SDSU in 2012. She earned her B.S. degree in Animal Science from the University of Delaware, her M.S., in Animal Science specialization in Dairy Production in 2005 from SDSU and in 2012 earned her Ph.D. in Dairy Science specialization in Production also from SDSU. Her Ph.D. research was focused on the effects on feeding fat from dried distillers grains on dairy heifer growth and development. Jill's current research program at SDSU is focused on evaluation of different feeding strategies and alternative feed ingredients for growing replacement dairy calves and heifers. Major objectives of this research are to help dairy producers understand their feeding options, improve heifer performance, and decrease rearing cost. Recent research projects have focused on feeding distillers grains, developing oilseed meals, microbially-enhanced feeds, or hydroponically grown feeds to dairy calves or heifers. Jill is a member of Multi-state North Central Cooperative Research Project NC-2042: Management Systems to Improve Economic and Environmental Sustainability of Dairy Enterprises and the South Dakota Oilseed Initiative**.** Additionally, she is involved with teaching a few courses at SDSU including Introduction to Dairy Science and is co-advisor for the Dairy Club.

Dr. Andrea Watson is a Research Assistant Professor in the Animal Science department at UNL focusing on Ruminant Nutrition. Areas of research she is involved in include protein utilization and metabolism as well as nutrient cycling through agriculture systems. She is also the coordinator for an online minor in Beef Cattle Nutrition through the Master of Applied Science degree program.

THE VOICE OF NEBRASKA'S DAIRY FARMERS

- REPRESENT
- ENCOURAGE
- PROMOTE
- COLLABORATE

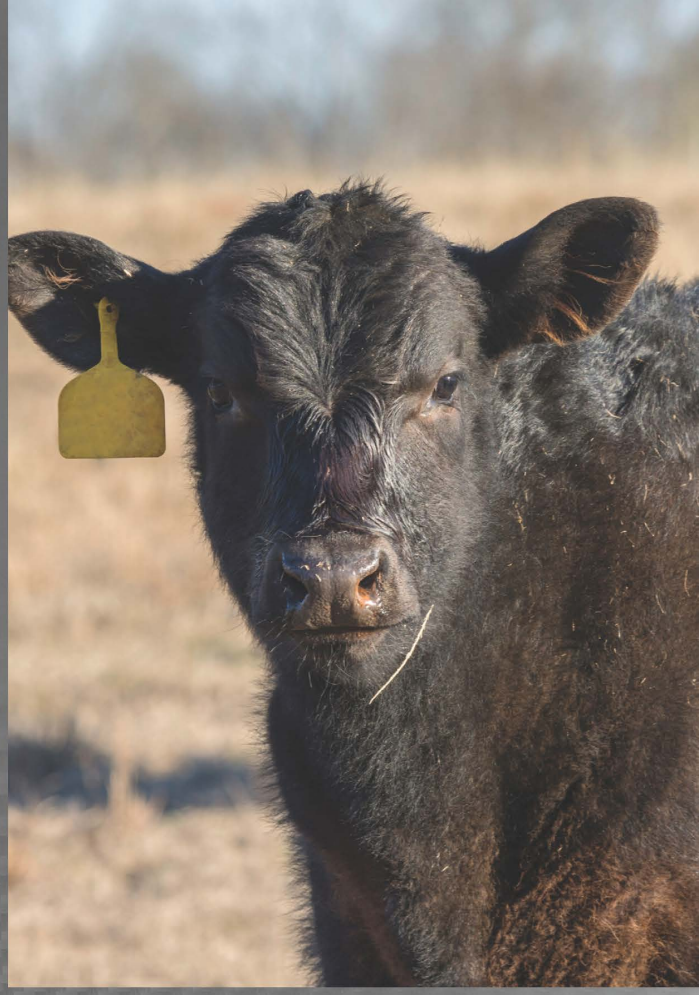
NSDA
NEBRASKA STATE DAIRY ASSOCIATION

WWW.NEBRASKAMILK.ORG

FIGHT STRONG®
FOR CATTLE

WHEN THE STRESS IS ON

Fight Strong® for Cattle is a natural feed additive that gets cattle eating, boosts immunity, and doesn't require a VFD.



NO VFD REQUIRED

POWERED BY

U.S. PATENT NO. 8,575,212

STRONG ANIMALS® TECHNOLOGY

Microbial Catalyst®
Microfused™ Essential Oils
Actifibe® Prebiotic

STRONG ANIMALS®

Call 1-844-354-7705 or visit StrongAnimals.com

SCCL

SCIENCE ◆ NATURE ◆ CARE

Bovine IgG

Calf's Choice Total® Gold

Immunity with an extra boost of energy

All natural bovine colostrum

High Immunity

- IgG molecules are readily absorbed for maximum immune protection.
- > 85% IgG1 - The antibody most effective in protecting calves against diarrhea and pneumonia.
- Broad spectrum of antibodies with demonstrated efficacy in 3 continents.

High in Colostral Fat

- An important energy source required by calves immediately after birth.

Convenient

- Easily mixes in under 15 seconds!
- 3-year shelf life. Store at room temperature.

Natural Bovine Colostrum

- High in growth and antimicrobial factors; contains naturally high levels of IGF-1, EGF, lactoferrin, trypsin inhibitor and other colostral factors.
- Made from only bovine colostrum; no blood, whey, egg or other ingredients not naturally found in maternal colostrum.

Safe and Effective

- Free of disease causing organisms, such as: Tuberculosis, Brucellosis, Leucosis, Paratuberculosis (causing Johnes' disease), Salmonella, E. coli, others.
- Each serial is tested in calves for safety and efficacy.

www.sccl.com
support@sccl.com
1-866-242-3185

High Immunity and Colostral Fat

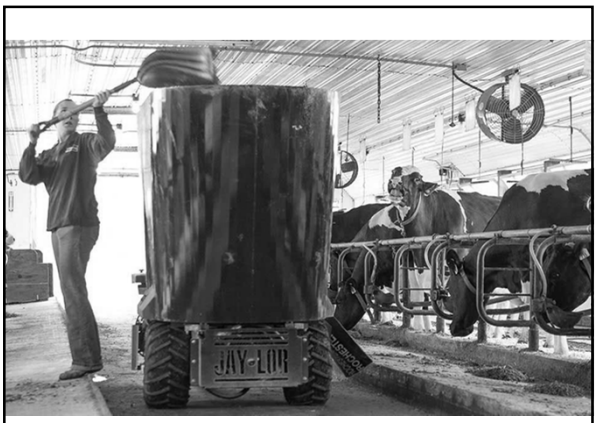
"At Rocky Mountain Holsteins, every calf receives SCCL's Colostrum Replacer within two hours of birth and this antibody protection results in extremely healthy calves who grow rapidly and without disease complications - one of the best management practices anyone could adopt!"

David Chalack
Rocky Mountain Holsteins;
Cochrane, Alberta

Feeding the preweaned calf

Dr. Pete Erickson
Professor of Dairy Management and
Extension Dairy Specialist

Fairchild Dairy Teaching and Research Center,
University of New Hampshire, Durham



Burley-DeMerritt Organic Dairy Research Farm, UNH, Lee, NH

- Five C's" of Successful Calf Rearing
- Colostrum
- Cleanliness
- Consistency
- Calories
- Comfort

Dr. Sheila McGuirk, U of WI School of Veterinary Medicine

- Total cost associated with raising dairy replacements is 15 to 25% of the total cost to operate a dairy.
- 2014 U of WI update (Hoards Dairyman, September) for 40 calf raising operations av. cost of $5.31/day from birth to 61 days and custom raisers av. $3.16/day (weaned at 45 days of age).
- Knowing true costs of raising heifers is critical.
- Chester-Jones (2015)

- Av cost post weaning in WI to pre-fresh was $1,323 or $2.04/day (648.5 days). Dairy operations averaged 24 months for first freshening. Custom raised heifers freshened at 23 months.
- Knowing true costs of raising heifers is critical.

Chester-Jones (2015)

Colostrum

- First secretion after parturition
- Provides calf with Ig
- First source of water
- Calves are born with 3% body fat

- Colostrum basics* (Fetrow, 2009)
- Quality -> 50 g/L IgG;
- Quantity–
- 4 quarts (10% BW)- possibly more (2 qts more)
- Quickness – < 6 h
- Cleanliness-
- < 100,000 cfu/ml;
- Feed < 1-2 h
- or refrigerate < 48 h

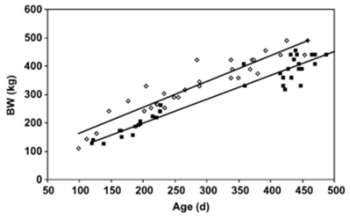
Why is colostrum important?

- 7.8 % of preweaned calves die. Primarily due to diarrhea (NAHMS,2007)
- Almost 20 % of calves have failure of passive transfer (FPT) (serum IgG <10 g/L) (NAHMS,2007)
- 60% of the colostrum produced in the US fails to meet minimum standards (Morrill et al., 2012)

- Increased IgG uptake has been correlated with increased milk yield 8.5kg of ME milk/ 1 g/L IgG increase(DeNise et al., 1989)
- Reduced morbidity and mortality
- Increased ADG

- 37 Brown Swiss heifers fed 2 L of good quality (> 50g/L colostrum) vs. 31 Brown Swiss heifers fed 4L of good quality colostrum
- Veterinary costs $/calf = 24.51 for 2L, 14.77 for 4L
- Age of conception 2L = 14 mos, 4L – 13.5 mos.
- ADG 2L 1.8 lb/d, 4L = 2.27 lb/d (P<0.001)
- Faber et al., 2005

Faber et al., 2005



University of New Hampshire

- Milk yield 2L Lactation 1 = 17,305 lb
- Milk yield 4L Lactation 1 = 16,595 lb (P>0.05)
- Milk yield 2L Lactation 2 = 18,008 lb
- Milk yield 4L Lactation 2 = 20,983 lb (P<0.05)

- Feeding 2L more resulted in better overall performance!!

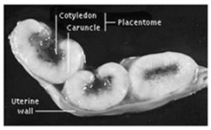
To Improve colostrum management:

1) Improve the quality (IgG) fed.
2) Increase the quantity of colostrum provided.
3) Feed colostrum to the calf as soon after birth as possible.

•Davis and Drackley (1998)

NEONATAL CALVES

- Born hypogammaglobulinemic
  - Synepitheliachorial placenta
  - Immune system is not fully developed until 8 weeks of age



Colostrum Quality

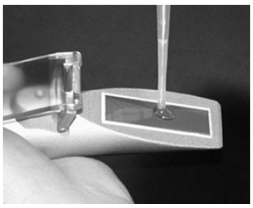
- Good quality colostrum contains greater than 50 g IgG/L
- Fair 25 g – 50g IgG/L
- Poor < 25 g IgG/L

- Colostrum contains other Ig including IgA (3.9 g/L and IgM 4.2 g/L)

Measuring colostrum quality on the farm

Brix Refractometer

University of New Hampshire



Brix values and IgG values

• Brix %	IgG (g/L)	Quality
• <15	0-28	Poor- Fair
• 15-20	28-50	Fair
• 20-30	50-80	Good
• >30	>80	Excellent

How should colostrum be fed?

- In the US about 2/3 of the dairy producers either use a nipple bottle or an esophageal feeder.
- 1/3 still allow the calf to nurse their dam- not recommended.
- Besser et al. (1991) found that 61.4% of dairy calves that were allowed to nurse failed to attain passive transfer (24 h IgG < 10g/L).

Using an Esophageal feeder and a nipple bottle (Elizondo-Salazar et al. 2011)

- 40 calves
- Colostrum tested 74.92 g/L
- Fed 3.8 L with a nipple bottle remaining colostrum was provided by an esophageal feeder with 1.5 -2 h after birth

Treatment and blood parameters (24h) of calves fed colostrum by a nipple bottle or both. (Elizondo-Salazar et al.,2011)

Item						**SEM**
Calves	13	6	7	7	7	
Nipple, L	3.8	2.84	1.89	0.95	0	
Tube fed,L	0	0.95	1.89	2.84	3.8	
Serum IgG, g/L	23.4	24.5	25.2	24.0	25.8	1.79
AEA,%	35.3	34.6	35.0	31.8	35.2	2.87

Heat stress

- Tao et al (2012)
- Cows were exposed to cooling (sprinklers and fans) or heat stress (no sprinklers or fans)
- Calves (12 cooled dams , 9 heat stressed dams)
- All fed 3.78 L maternal colostrum

Birth weight, colostrum IgG, 28 d serum IgG, weaning weight

Variable	Heat stress	Cooling	P =
Birth weight, kg	36. 5	42.5	<0.01
Colostrum IgG, g/L	86.8	77.3	0.36
28d serum IgG, g/L	10.6 +/-1.7 g/L	15.8 +/- 1.5 g/L	0.03
Weaning weight, kg	65.9	78.5	0.04
Estimated 24h IgG, g/L	16	25	

Cold Stress

- Norwegian data- Gulliksen et al (2008) indicated that cows calving in the winter months produced colostrum with lower IgG than any other season of the year.
- Cows calving in December, January and February produced colostrum that averaged <50 g/L

- In contrast, Conneely et al (2013) in Ireland indicated that colostrum quality was highest in autumn and lowest in early Spring
- Breed effects
- Environmental effects

New Data from UNH

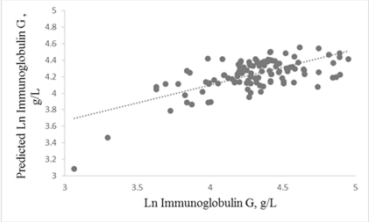
- Developed an equation to predict colostrum quality using previous cow DHI data (accepted J. Dairy Sci.)
- Used 111 Holstein cows from 9 NH dairy farms
- Needed to be at least first parity
- Needed to be on DHI
- Cabral et al., (J. Dairy Sci).

Equation

- LnIgG = 4.03864 – 0.05018 × PASWK + 2.28887 × LnFY - 2.15129 × LnFP - 2.25429 × LnPY + 2.10609 × LnPP + 0.14457 × LnPAR – 0.00025683 × PTAM + 0.01553 × D >; r^2 = 0.56
- There will be a quiz at the end!

What does this mean?

- Weeks on pasture was a negative
- Previous fat yield was a positive
- Previous fat percent was a negative
- Previous protein yield was a negative
- Previous protein percent was a positive
- Parity was positive
- PTA milk was negative
- Days above 73° F was positive



Feeding the dam

- Garcia et al (2014) fed 78 prepartum cows for 8 weeks
- Control (no supplemental fat)
- 1.7% Saturated Fat
- 2.0% Ca- salts of FA

•Calves born from cows fed supplemental fat had higher 24h serum IgG and a higher AEA

- Gao et al (2012) fed 3 different energy concentrations to prepartum cows for 3 weeks. High (6.48 MJ/kg), Medium (5.88 MJ/kg) and low (5.25 MJ/kg). Calves born from cows fed the higher energy diet had increased numbers of CD4+ cells (T- helper cells)
- Indicator of better immunity

Niacin and Colostrum Quality

- Prepartum cows were given 48 g/d of niacin beginning 4 weeks before freshening
- Results were that colostrum quality was improved by about 20% (increased IgG g/L)
- Aragona et al., 2016 J.Dairy Sci. 99:3529-3538.

Pasteurization

- Gelsinger et al (2014) collected colostrum over 2 years
- Split into 3 categories
- High (>90g/L), Medium (70 g/L), low (50 g/L)
- ½ was pasteurized (60 C for 30 min) and ½ was frozen.

Plasma IgG after pasteurization

Item	Unheated			Heated			*P-value*	
	H	**M**	**L**	**H**	**M**	**L**	**T**	**Q**
IgG1	22.4	17.4	12.9	26.4	21.5	15.4	0.03	0.01
IgG2	0.8	0.7	0.4	1.1	0.9	0.5	0.03	0.01
IgG	23.3	18.1	13.3	27.5	22.5	14.8	0.03	0.01
AEA,%	23.1	26.9	24.5	30.9	30.2	28.4	0.01	0.66

- Pasteurization increases IgG uptake.
- Gelsinger et al. (2014) speculate that it might be due to a reduction in absorption of other non-Ig colostral proteins.

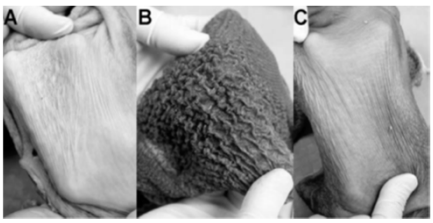
What if colostrum is poor quality or not produced?

- Use a LACTEAL based colostrum replacer!
- Follow manufacturer directions
- Typically try to get 200 g of IgG into the calf from these products by 6 h of life.
- Will not be as good as Mom's, but is a great substitute
- Colostrum supplements not effective on day 1
- Can be effective after day one added to Milk replacer

Milk and Starter Feeding Phase

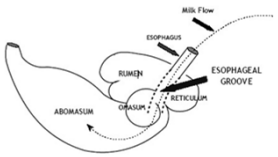
- Calves are born non-ruminants
- Must become a ruminant through the consumption of dry feeds
- Typically coarse starter grain
- Must consume milk or milk replacer

- Fermentation of grain results in the production of the VFA's primarily butyrate results in the production of papillae
- More VFA's are produced by coarse starter
- If a fine or pelleted starter is fed then feed hay



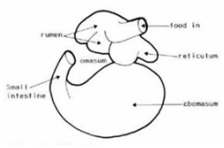
Comparison of rumen papillae development at 6 weeks in calves fed milk only (A), milk and grain (B), or milk and dry hay (C). Heinrichs -Penn State

- Calves fed milk or milk replacer due to the esophageal groove and the chemical composition of the milk or replacer preferentially shunt the milk or milk replacer to the abomasum.

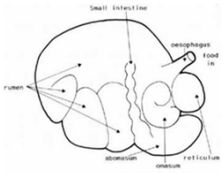


- Production of butyrate and propionate at the expense of acetate
- Forages maintain a higher ruminal pH and decrease the production of VFA
- The increased absorption observed with propionate and butyrate suggest their requirement for rumen development

Pre-ruminant Stomach



Ruminant Stomach



How the stomach changes over time

- Assume calf is fed dry feed and milk replacer or milk

Age	Abomasum	Forestomach
Birth -2 weeks	70%	30%
8 weeks	50%	50%
3-4 Months	25%	75%
Maturity	<10%	>90%

- Milk and Milk replacer
- Types
- Starters

Milk Replacer Types

- Should be all milk protein
- Can use some with SPC or Egg protein but must be < 50% of total protein
- Conventional MR 20-22% CP: 20% fat, feed at 4L/calf/d
- Accelerated range fro 26:16 to 28:20 there are some that are 32:30

Free Choice Water

- A MUST !!
- Bacteria that reside in the rumen need an aqueous environment.
- Water is an essential nutrient separate from milk

Where is there more life?

- Feed these up to and over 1.5 kg of powder/d
- All calves get free choice starter
- I prefer coarse starter vs. pelleted starter
- Stimulates rumen development

UNH Data

- Chapman et al., 2016
- 24 newborn Holstein heifer calves
- Daily DMI
- Weekly BW and skeletal measures
- N efficiency during the 5 th week
- ½ weaned at d 42 fully weaned at d 49
- Followed for 1 wk after

Nutrient analysis of control, and moderate protein milk replacer, and starter grain

Nutrient	Control MR	MMR	Starter
DM,%	98.2	98.2	90.1
CP,%	19.9	26.3	20.7
Fat, %	20.7	18.6	2.8
ADF,%	-	-	7.6
NDF,%	-	-	16.0
Starch, %	-	-	32.3
Ash, %	5.3	5.9	7.5

Preweaning Growth data

Item	C	MMR	HMR	SE	TRT	Week	Int
MR int (lb)	0.97	1.47	1.85	0.01	<0.001	<0.001	<0.001
Starter (lb)	1.18	0.67	0.47	0.15	0.01	<0.001	0.003
DMI (lb)	2.16	2.13	2.32	0.15	0.65	<0.001	<0.001
FE ADG/DMI	0.45	0.56	0.57	0.03	0.02	0.04	0.01
Water (lb)	0.75	0.90	0.57	0.22	0.61	0.12	0.27
ADG (lb)	0.93	1.32	1.64	0.11	0.002	<0.001	0.01
WH (in)	32.0	32.2	32.6	0.12	0.01	<0.001	0.06
HH (in)	33.3	33.3	34.2	0.45	0.001	<0.001	0.35
BHBA (mM)	0.18	0.16	0.15	0.006	0.003	<0.001	0.01

Nitrogen Efficiency

Item	Treatment			SE	*P*
	C	MMR	HMR		
N intake (g/d)	51.5	54.9	52.8	3.72	0.80
Urine output (kg/d)	2.10^{c}	3.23^{b}	4.43^{a}	154.6	<0.001
N urine output, (g/d)	12.1^{b}	17.0^{a}	18.2^{a}	1.26	0.021
N in urine (%)	0.55	0.52	0.4	0.059	0.21
Fecal DM output, (g/d)	333^{a}	243^{ab}	214^{b}	29.3	0.034
N Fecal output, (g/d)	13	10.7	11	1.28	0.41
N in feces (%)	3.93^{b}	4.73^{ab}	5.21^{a}	0.27	0.014
N retention (g)	27.3	22.5	24.3	1.56	0.13
N efficiency (%)	52.7^{a}	46.7^{b}	44.4^{b}	1.19	0.011

Accelerated vs Conventional Milk Replacer

- 36 Holstein Heifer calves
- Birth until d 56
- Half the calves were "visited" twice more (4X/d)

Preweaning Milk replacer study

Item	Treatment[1]				SE	P =		
	C0	C1	A0	A1		Visit	MR	Int
Initial BW, lb	96.6	86.6	91.3	95.3	3.90	-	-	-
MR, lb/d	1.0	1.0	2.41	2.40	0.01	0.39	< 0.001	0.51
Starter, lb/d	1.09	0.89	0.52	0.52	0.13	0.46	0.006	0.43
Water, lb/d	3.2	2.42	4.63	4.59	0.64	0.51	0.007	0.56

Item	C0	C1	A0	A1	SE	Visit	MR	INT
ADG, lb	0.91	0.89	1.41	1.36	0.19	0.85	0.01	0.93
ADG/DMI	0.41	0.39	0.53	0.49	0.04	0.35	0.007	0.90

Overall performance

	Treatment[1]					P =		
Measurement	C0	C1	A0	A1	**SE[2]**	Visit	MR	INT
DMI lb/d	2.93	2.58	3.18	3.31	0.20	0.56	0.02	0.23
ADG, lb/d	**1.23**	**1.16**	**1.53**	**1.55**	**0.1**	**0.79**	**0.001**	**0.61**
Water intake, lb/d	5.51	4.48	6.61	6.68	0.64	0.46	0.008	0.33
Final Weight, lb	162	158	178	180	5.86	0.83	0.002	0.69
ADG/DMI	0.36	0.38	0.47	0.48	0.03	0.57	0.001	0.84

Weaning

- Several methods
- ½ pound of starter for 3 consecutive days
- Cut out second feeding of Milk replacer or milk for the weaning week
- Typically 6-8 weeks

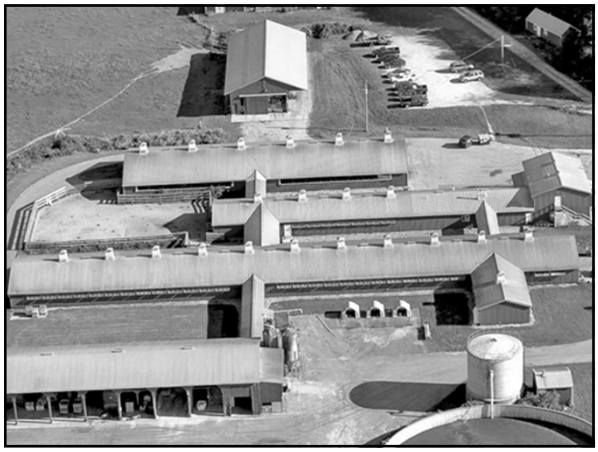
Conclusion

- Colostrum is the key
- ASAP
- Remember they have a very näive immune system
- Keep them dry clean out of drafts
- Milk and Milk Replacers many different ways to feed

- Provide clean, fresh water at all times
- Don't Forget to dip navels- new recommendation is twice

- THANK YOU

Questions



REDUCING COLD STRESS IN YOUNG STOCK

Rearing Young Stock for Dairy and Beef Production workshop

November 9-10, 2016

By: Kim Clark, Dairy Extension Educator, UNL &
Paul Kononoff, Dairy Extension Specialist, UNL

WHAT IS STRESS?

Stress is an adaptive change or nonspecific response initiated by an internal or external environmental stimulus

- Stress can alter the steady state of the body by causing harmful responses interfering with health, comfort, or well-being of the animal
- Stress is not inherently harmful to an animal; it can be beneficial
  - ie: fight-or-flight response
  - Abnormal stress is harmful
    - Too much, too long

Nutritional Requirements of Beef Cattle, 2016

WHAT ARE SOME STRESSORS?

Stimulus = Stressor
Response = Stress

- Social Stressors
- Feed and water deprivation
- Introduction to new feeds
- Weaning
- Extreme weather changes
  - Changes in thermoneutral zone

Nutrient Requirements of Beef Cattle, 2016

THERMONEUTRAL ZONE

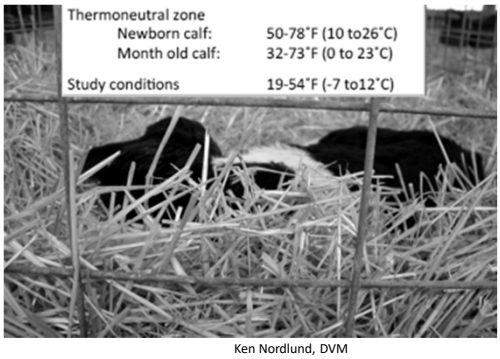
- The range of environmental temperatures over which the heat produced by a `warm-blooded' animal remains fairly constant. Hence, it is the range in which the animal is `comfortable', having neither to generate extra heat to keep warm nor expend metabolic energy on cooling mechanisms, such as panting. Animals adapted to cold environments tend to have broader thermoneutral zones than ones living in hot environments.

Encyclopedia.com. 27 October 2016

THERMONEUTRAL ZONE SHIFTS

- Age
- Amount of feed intake
- Amount of subcutaneous fat
- Length and thickness of hair coat

Dairy NRC, 2001



Ken Nordlund, DVM
Dairyland Initiative Workshop, February 14, 2014

NEWBORN CALF

- 3% body fat
- Thermoneutral zone is 50 and 78°F (newborn calf)
  - This range shifts as the calf grows
  - Temperatures outside the thermoneutral zone means the calf is using additional body energy so the animal can remain in the thermoneutral zone.

If extra energy is required outside the thermoneutral zone, what is sacrificed?

N EXTENSION

GROWTH

	Calves gaining 1.0 lb/day				Calves gaining 1.5 lb/day			
Body Weight lb	NE_m[1] Mcal	NE_g[2] Mcal	ME[3] Mcal	CP lb	NE_m[1] Mcal	NE_g[2] Mcal	ME[3] Mcal	CP lb
55	0.96	0.70	2.24	0.34	0.96	1.14	2.92	0.48
65	1.09	0.75	2.46	0.34	1.09	1.21	3.18	0.49
75	1.21	0.79	2.67	0.35	1.21	1.28	3.43	0.49
85	1.33	0.82	2.87	0.36	1.33	1.34	3.66	0.50
95	1.45	0.85	3.06	0.36	1.45	1.39	3.88	0.51
105	1.56	0.88	3.25	0.37	1.56	1.44	4.10	0.51
115	1.67	0.91	3.42	0.37	1.67	1.49	4.30	0.52
125	1.78	0.94	3.60	0.38	1.78	1.53	4.50	0.53
150	2.04	1.00	4.01	0.39	2.04	1.63	4.97	0.54
200	2.53	1.11	4.77	0.42	2.53	1.81	5.84	0.57

Source: Adapted from *Nutrient Requirements of Dairy Cattle*, 2001.
[1]NE_m = net energy for maintenance.
[2]NE_g = net energy for gain.
[3]ME = metabolizable energy.

Extension.psu.edu

N EXTENSION

GROWTH RATE

- Weight gain during the first 50 days of life affects milk yield as an adult
  - Average daily gain of 2.2 pounds in the first 50 days yields an additional 1,800 pounds of milk in the first lactation

Soberon et al., J. Dairy Sci., 2012

N EXTENSION

WHAT ROLE DOES AMBIENT TEMPERATURE PLAY?

TABLE 10-5 Effect of Environment on Energy Requirement of Young Calves[a]

Environmental Temperature		Increase in Maintenance Energy Requirement (kcal of NE_m/day)		Maintenance Energy Requirement (kcal of ME/day)[b]		Increase in ME Required for Maintenance	
°F	°C	Birth to 3 wk of age[c]	>3 wk of age[d]	Birth to 3 wk of age[c]	>3 wk of age[d]	Birth to 3 wk of age[c]	>3 wk of age[d]
68	20	0	0	1,735	1,735	0	0
59	15	187	0	1,969	1,735	13	0
50	10	373	0	2,203	1,735	27	0
41	5	560	187	2,437	1,969	40	13
32	0	746	373	2,671	2,205	54	27
23	−5	933	568	2,905	2,437	68	40
14	−10	1,119	746	3,139	2,671	95	54
5	−15	1,306	933	3,373	2,905	94	68
−4	−20	1,492	1,119	3,607	3,139	108	81
−13	−25	1,679	1,306	3,834	3,373	121	94
−22	−30	1,865	1,492	4,066	3,607	134	107

[a]Calculated for calf weighing 45.35 kg (100 lbs; 17.35 $kg^{0.75}$). Extra heat production = 2.15 $kcal/kg^{0.75}$ per day for each degree decrease in environmental temperature (°C) below lower critical temperature (Schiama, 1983). Because heat production is in terms of net energy (NE), metabolizable energy (ME) was computed as ME = NE/0.8.
[b]Maintenance energy requirement 100 $kcal/kg^{0.75}$ per day.
[c]Calves from birth to 3 wk of age have lower critical temperature in range of 15–25°C. Data above were calculated on basis of lower critical temperature 20° C.
[d]Data for calves older than 3 wk of age were calculated on basis of lower critical temperature 10° C.

Dairy NRC, 2001

N EXTENSION

HOW DO WE MAINTAIN GROWTH IN WINTER MONTHS?

- Add a third feeding
- If feeding twice:
  - add 1/3 more volume
  - Calves may not be able to consume that much in one feeding
- Add supplemental fat (first 14 days)

N EXTENSION

WHY AVOID COLD STRESS?

- The calf uses more energy to stay warm thus decreasing growth rate
- Cold stress can decrease the immune system
  - Scours, pneumonia, navel infection

Time of year	Morbidity	Mortality
Summer	13%	3%
Winter	52%	21%

Godden et al., 2005

N EXTENSION

WHEN DOES COLD STRESS HAPPEN?

- North wind
- Sudden temperature drop
- Wet bedding
- Wet calf
- Lack of bedding/heat absorbant bedding
- Cold drafts in buildings

N EXTENSION

SIGNS OF COLD STRESS

- Shivering
  - Warming of the muscles to maintain body temperature
  - More lost energy
- Decreased feed and water intake
- Lowered body temperature <102°F

N EXTENSION

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
  - Provide a wind block
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION

Calf jackets = ~ 1 unit Nesting Score

Ken Nordlund, DVM
Dairyland Initiative Workshop, February 14, 2014

MAINTAIN BODY TEMPERATURE

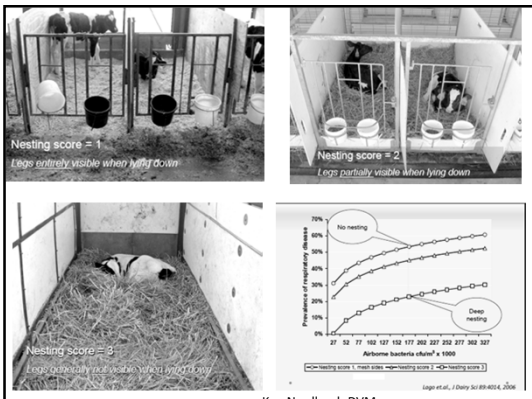
- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION

MAINTAIN BODY TEMPERATURE

- Feed body temperature milk and water (102°F)
- Face calf hutches to the south
- Use calf jackets
- Add additional straw, husks, or shavings.
  - Determine nesting score
  - Bedding must be dry
  - Wet bedding causes loss in body heat
  - Include drainage below the bedding; this pulls the moisture away
- Move indoors

N EXTENSION



Ken Nordlund, DVM
Dairyland Initiative Workshop, February 14, 2014

Ken Nordlund, DVM
Dairyland Initiative Workshop, February 14, 2014

Photo from TheDairyMom.blogspot.com

Photo from WisconsinDairyFarmer.com

SUMMARY

- Energy requirements for maintenance increases as temperature drops
- Add a 3rd feeding
- Feed a fat supplement
- Calves develop fat reserves as they age
- Face hutches to the south
- Use calf jackets
- Bedding should have a nesting score of at least 2

N EXTENSION

Calf Nutrition- Postweaning and Starter Feeding

Dr. Pete Erickson
Professor of Dairy Management and Extension Dairy Specialist
University of New Hampshire

Outline

- How many heifers do you need?
- What does it cost to raise a dairy heifer?
- Breeding size for dairy heifers
- What is the correlation between calf growth and milk yield?
- New updates on calf starter composition
- Precision Feeding heifers
- Bunk and water space
- UNH Research
- Conclusions

- Heifers are either the third or second most costly enterprise on a dairy farm
- Most farms have TOO many heifers!
- Why do we have so many heifers?
- They are a sizable cost to any enterprise

How many heifers do you need?

- The answer is – It depends
- Questions
  1) Are you expanding your dairy
  2) If not, the following questions apply to you.
     a) How many cows do you have? (A)
     b) What is your cull rate? (B)
     c) What is your calf mortality rate? (C)
     d) What is your age of first calving? (D)

- Number of calves on the farm = 2× (A×(B/100)×(C+1.0)×(D/24)
- Example: You own a 100 cow dairy with a 35% cull rate, a 5% heifer mortality rate and a 26 age at first calving.

- Calves = 2×[(100cows ×0.35)× (1.05) ×(26/24)) = 80 calves
- Cost of raising calves =$2.50/days × 80 calves × 780 days = $156,000

- MOST HERDS HAVE TOO MANY HEIFERS

What if you changed your heifer management

- Age of first calving = 22 months (UNH Average)
- Calf mortality = 2% (UNH average)
- Number of heifers = 2×[(100cows ×0.35)×(1.02)]×(22/24)) = 66 calves
- Cost of raising calves =$2.50/days × 66 calves × 660 days = $108,900
- By improving management this farm saved $47,100 over two years.
- This does include increased lifetime milk!!

How many heifers can you expect per year?

- Equation = Herd size × 12/calving interval × calf sex ratio × (1-mortality rate) × 24/ Age at first calving
- Same 100 cow herd
- Calving interval is 13 months
- Historically 55% of the calves born in a year are heifers
- Mortality rate is 5%
- Age at first calving is 26 months
- Number of heifers = 100 × 12/13 × 0.55 × 0.95 × 24/26 = 44 heifer calves year

What if they reduce their age of first calving to 22 months and reduced their mortality to 2%

- Number of heifers = 100 × 12/13 × 0.55 × 0.98 × 24/22 = 54 heifer calves year
- Based on the earlier equation -They could sell 108-66 =42 heifers!!
- Which ones do you sell??
- Goodling, R.C., 2012. Herd data key to managing dairy replacement heifers. Penn State Extension

When to breed a heifer

- For a Holstein heifer 48 inches at the withers
- This should be about 13 months of age.
- Heifer should weigh 55% of mature body weight at breeding age
- Should calve at 85% mature body weight
- To plot your specific herd Penn State has an Excel sheet which can be found at http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth/customized-dairy-heifer-growth-chart

From VA-MD Veterinary School

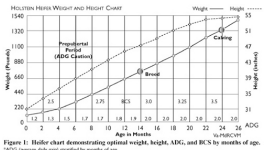


Figure 1: Heifer chart demonstrating optimal weight, height, ADG, and BCS by months of age.
*ADG (average daily gain) stratified by months of age.
*BCS (body condition score) stratified by growth periods.

Is there a relationship between calf performance and future milk yield

- We know that colostrum intake has a positive effect.
- Some studies suggest that first lactation milk production increases 850 pounds for every 1 pound increase in ADG (Soberon et al., 2012). Other studies do not support this relationship (at least to that point)
- Recently Gelsinger et al., (2016) compared this response over nine experiments

- They used 9 studies with 21 treatment groups
- Observations were that milk replacer intake was negatively correlated to starter intake – as milk replacer intake increased starter intake was lower (difficult weaning)
- They observed that calves that consumed at least 100 g of starter along with milk or milk replacer produced 306 more pounds of milk in their first lactation

How can we get there?

- Starter composition
- Recently a lot of data on starter composition
- Traditionally calf starter was a molasses based, steam flaked corn, rolled oats, and protein pellet
- Recent research suggests that level of molasses and physical form of the grains can impact calf performance.

Molasses level

- Lesmeister and Heinrichs (2005)
- Fed 46 Holstein calves
- 4 L of milk replacer/d (20 %CP, 20% fat)
- Calf starter containing roasted corn,oats and a premix pellet with either 5% or 12 % liquid cane molasses
- Background –some cases adding molasses increases weight gain in growing beef cattle due to more intake, but the opposite was true in dairy cattle due to depressed intakes

- This range in molasses concentration is commonly used in starter

Item	5% cane molasses	12% cane molasses	*P*
Starter intake, week 1-6, (lb/d)	1.12	0.87	<0.05
ADG, week 1-6 (lb/d)	0.99	0.86	<0.1
Final body weight, lb	138.5	131.1	

Results

- Adding additional molasses to 12% negatively affected calf performance.
- It is recommended to keep molasses in starter at 5%

Particle size and preference

- Terre et al. (2016)
- Conducted three experiments on particle size and processing of grains in calf starter.
- They used three studies two with 63 calves and one with 37 calves. Calves entered the study at 10d of age
- Experiment 1 evaluated calf performance based on taste preference feeds contained canola (not preferred protein source), soybean meal (preferred protein source), wheat highly preferred energy source or oats poorly preferred energy source

- They observed a slight improvement in feed efficiency in calves fed wheat and soybean meal compared to calves fed wheat and canola or oats and soybean meal as the primary protein and energy sources of their starter. No other differences

Experiment 2

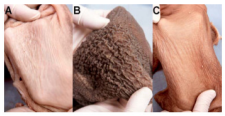
- Calves were given a choice of starter containing whole grains or steamed rolled grains.
- Results indicated that calves preferred starter containing whole grains during week 1 and steam-rolled grains during week 2, 4 and 5

Experiment 3

- Calves were fed essentially the same starter but one had whole grains, while the other had steam rolled grains
- Starter consumption was higher preweaning when calves received the whole grains during week five and six, all other performance measures were similar. Weaning was at week six. No differences post weaning

- Studies indicate that adding whole grains to starters increase starter intake
- Recommend Starter containing whole corn and oats along with a pellet and 5 % molasses improves intake
- Starter should be about 18% CP as fed

What about hay?



Comparison of rumen papillae development at 6 weeks in calves fed milk only (A), milk and grain (B), or milk and dry hay (C). Heinrichs -Penn State

- If you feeding a pelleted starter (no whole or rolled grains)
- Add finely chopped hay to improve rumen retention time
- Should be free choice, but not as a replacement for starter

How much ADG is needed for dairy heifers?

- Conventional information states 1.8 pounds/day
- As greater gains may result in fat deposition in the mammary gland during the allometric growth period up to 9 months of age (irreversible).
- These data did not consider what the gain was comprised of.
- At UNH it is routine for our heifers to gain close to 2.5 pounds/day without getting fat.
- Need to consider what we are feeding these animals

What I don't want to see!!

Following the target growth system of BAMN

- What is the mature body weight of cows in the herd?
- Multiply mature weight by 0.82 (0.85 Heinrichs)
- What is your desired age at first calving? (22 months I hope!!)
- Multiply mature weight by 0.55 to get weight of heifers at breeding

Mature body weight, lb	AFC, mo	Current age	Target wt breeding	Target wt post calving	Age at first breeding	ADG
1000	22	4	550	820	13	1.2
1400	22	4	770	1150	13	1.8
1800	24	4	990	1475	15	1.9

Precision feeding heifers - Heinrichs-Penn State

- Feed represents the single largest cost on any dairy farm
- Heifers either the second or third greatest cost
- Feed efficiency is rarely discussed in the dairy world unlike beef or swine industries.
- Recently we started to evaluate milk production efficiency, but rarely do we evaluate heifer feed efficiency

Facts about precision feeding

- The more digestible the ration the more efficient the heifer will be in utilizing the nutrients in the diet.
- The greater the DMI fed as a percent of body weight the lower the feed efficiency
- The more efficient the heifer the less nutrient waste (manure)
- Free choice forages are not fed
- The diet is fed as a TMR and fed once daily

Nutrients (how to precision feed heifers)

Protein

- Pre-pubertal heifers (up to 9 months) 14-15% CP of a DMI of 2.15% BW (a 500 pound heifer would be fed 10.75 pounds of DM/d)
- Post pubertal heifers should be fed 13-14% CP on A DMI of 1.65% BW
- Diets should contain 30-35% soluble protein. MCP synthesis is adequate
- Hi Bypass feeds are not necessary RUP is of limited value to the heifer,
- But if high RUP feeds are more economical than they can be used.

- Maximum protein efficiency is obtained when heifers are fed diets containing 14-15 % CP

Energy and fiber

- Heifers should be fed diets for about 1.8 pounds of gain per day
- Or using metabolic body size- 130 kcal of ME/BW(to the 0.75 power)
- Typically 70-90% forage (but used to help meet protein and energy requirements)- not free choice

Vitamins and mineral

- Supplementation of vitamins and minerals are the same as in conventionally fed heifers

Monitor weights

- Use scales
- Weigh tapes to track gains
- Every time a heifer is handled she should be weighed (at least monthly)
- Weigh heifers at the same time each day you weight (gut fill)
- If needed adjust feed intake patterns

Grouping

- Group heifers of the same size
- 200 pounds of weight variation
- (about 2-4 month variation in age)
- After breeding the number can be increased to 300 pound variation

Bunk space

- Using this feeding method and overcrowding heifers will not work
- Since heifers are limited in feeding , They MUST be able to access the bunk all at one time!
- From 4 months to 22 months of age heifers will need 14- 24 inches of bunk space
- Try to use headlocks
- If bunk space is a problem try splitting the feedings into two relatively close together so the bigger heifers will eat first (7 and 9 am)

What to expect

- At the start- lots of noise
- This will last for about 10-14 days
- This is due to the reduction in rumen size and gut size needed to accommodate reduced feed intake.
- As long as heifers are gaining at the recommended weight (1.8 pounds/day), they are adequately fed.

Transitioning to the pre-fresh pen

- Precision fed heifers can enter the prefresh pen and receive those diets beginning at 30-45 days before calving with no adverse effects on calf birth weight, dystocia or metabolic problems.
- Rumen and gut volume will increase dramatically when the heifers are put on the prefresh diet .

Nutrient Recommendations for the precision fed heifer (Heinrichs)

Age, mos	BW, lbs	DMI, lbs/d	ME, Mcal/d	CP, lbs/d	NDF,%
4	250	5.72	7.8	0.9	23
6	350	7.45	10.1	1.1	24
7	450	9.07	12.2	1.4	26
9	550	10.62	14.1	1.6	27
11	650	12.11	16.0	1.8	28
13	750	13.55	17.9	2.0	29
14	850	14.95	19.6	2.2	30
16	950	16.32	21.3	2.4	30
18	1050	17.65	23.0	2.6	31
20	1150	18.96	24.6	2.8	32
21	1250	20.24	26.2	2.9	33
23	1350	21.50	27.7	3.1	33

Bunk Space and waterers

- Ranges from 14 inches to 2 feet based on size. All heifers need to be able to eat at the same time
- Headlocks are great (a boss cow can control eight feet of bunk space- probably heifers too)
- Water space 1 waterer per 20 animals, 2 waterers per pen

Stall and pack requirements

- Weaned calf needs 30 sq feet of bedded pack
- 4-8 month old needs 40 sq ft
- 8-12 month old needs 50 sq ft or a 69 by 36 inch stall
- 12-16 month old needs 60 sq ft or a 84 by 40 inch stall
- 16-20 month old needs 70 sq ft or a 96 by 43 inch stall
- 20 to precalving needs 80 sq ft or a 102 by 45 inch stall
- 2-4 week precalving heifer needs 120 sq ft or a 108 by 48 inch stall

UNH Research

- Cinnamaldehyde (essential oil)
- Possible replacement for ionophore
- Reduces coccidiosis in poultry
- Our data (Chapman et al., 2016) no positive or negative effects when compared to control and monensin in 12 week old heifers

- Na-butyrate supplementation- Polish data indicates that adding to preweaned calf diets increases rumen development
- We are investigating the supplementation of Na-butyrate to 3 month to six month old heifers
- Wet Brewer's Grains in heifer diets (limited data) plan on starting in the Spring

Conclusions/ Take home messages

- Do you have too many heifers
- Can you improve your heifer management?
- Establish goals of freshening at 22 mos of age
- There appears to be a relationship between DMI around weaning to future milk production- optimize this by keeping your calves healthy
- Consider limit feeding follow the recommendations here and work with UNL staff to accomplish this
- Make sure calves have enough living space

Thank You!!

Development, growth rate targets, and feeding strategies for growing heifers

Jill Anderson, Ph.D.
Assistant Professor, Dairy and Food Science Dept, SDSU

University of Nebraska- Extension Workshop
November 9 and 10, 2016

South Dakota State University
College of Agriculture and Biological Sciences

Outline

- Overall Goals/Importance
- Development
- Growth Targets
- Feeding Strategies
  - Ad libitum TMR – high forage
  - Limit Feeding/Target feeding
  - Component feeding

South Dakota State University
College of Agriculture and Biological Sciences

Overall Objectives

- Heifers must grow at an optimal rate so they are large enough to:
  - Breed on time
  - Avoid calving problems
  - Produce large amounts of milk – reach genetic potential

South Dakota State University
College of Agriculture and Biological Sciences

Importance of a successful calf & heifer management program

- Investment
  - approx. $1,500-2,000 to raise a heifer to 24 mo. of age (bid portion of this is feed costs)
  - Delay in entering the milking herd costs (>$2.00/d beyond 24 mo.) plus no milk $
- Genetic potential of calves and heifers
  - Should be better than for the average cow presently in the herd
  - Future of the herd
  - Want to feed and manage properly to reach genetic potential

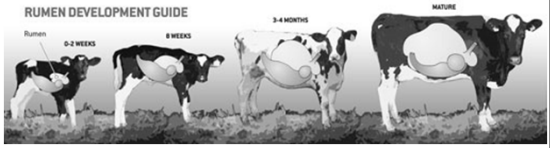
South Dakota State University
College of Agriculture and Biological Sciences

Development of Heifers 4 months – 2 years old

- Not just changes in body size
  - **Digestive system**
  - **Puberty/Reproduction**
  - **Mammary**

South Dakota State University
College of Agriculture and Biological Sciences

Digestive System Development



http://www.techproindia.in/wws/wp-content/uploads/2015/07/WWS-E-news-July-2015-Its-all-about-Rumen.pdf

South Dakota State University
College of Agriculture and Biological Sciences

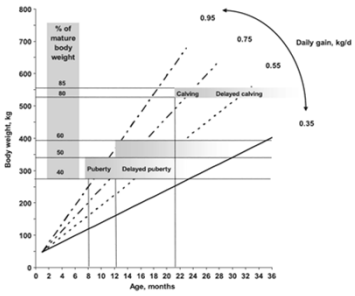
Digestive System

- Size changes → differences in passage rate
  - Consumption capacity
  - Efficiency of utilizing forage?
    - How should diets change with age?

Puberty

- What is puberty?
  - Many definitions
  - Often defined as when the heifer becomes cyclic or has begun to regularly ovulate
  - Usually occurs around 8-10 months of age

Puberty and ADG



S1 Schematic representation of the effects of various daily gains prior to puberty on puberty onset, service and calving ages

Le Cozler et al, 2008

Factors that affect puberty

- Age
- Body Weight
- Breed/genetics
- Environment
- Body composition
- Nutrition

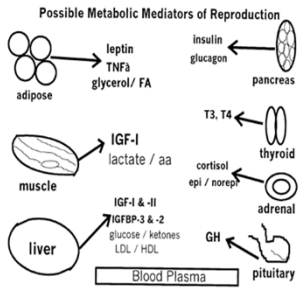


Fig. 1. Summary of the possible metabolic mediators of reproduction. IGF = insulin-like growth factor; TNFα = tumor necrosis factor (TNF)-α; T_3 = triiodothyronine; T_4 = thyroxine; Epi = epinephrine; NOREPI = norepinephrine; FA = fatty acids; aa = amino acids; GH = growth hormone; LDL = low density lipoprotein; HDL = high density lipoprotein; and IGFBP = insulin-like growth factor binding protein.

Spicer, 2001

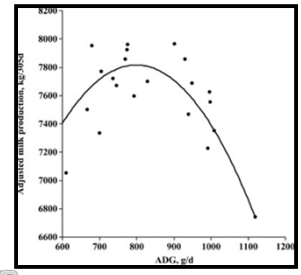
Puberty - Why is it important?

- May affect age at breeding
- Fertility at breeding
- Related to mammary development
  - Steroid hormones → secondary sex characteristics

Milk yield potential

- Meta-Analysis to Assess Effect of Prepubertal Average Daily Gain of Holstein Heifers on First-Lactation Production. Zanton and Heinrichs. 2005. J. Dairy Science 88:3860-3867
- Combined data from 8 studies on Holstein Heifers
- All data from within 15 years (1990-2005)
- 21 levels of ADG
- 21 heifers per level (n=21)

Influence of ADG on Milk yield



Found that 0.8 kg/d or 1.76 lbs/d of ADG resulted in most milk yield

WHY???

Mammary Growth

Isometric

approx. 3 months of age

Allometric

(duct formation)

Puberty

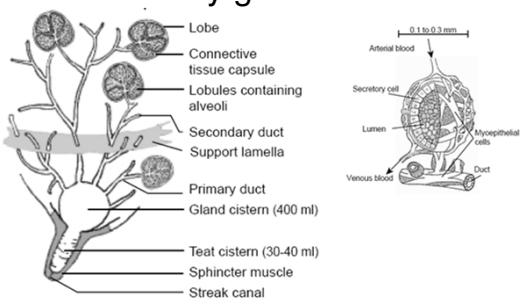
Isometric

Gestation

Mammary Structure

- White adipose tissues – Mammary Fat Pad
- Parenchymal tissues
  - Epithelial structures
    - Ducts (formed during prepubertal growth)
    - Alveoli (formed during gestation)
- Stromal tissues
  - Connective tissues, fibroblast, endothelial cells associated with vascular structures

Mammary gland structure

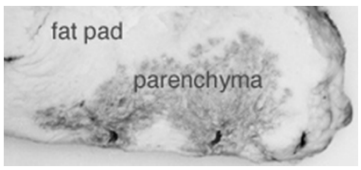


See Figure 2.

Mammary Growth Periods

- Basic structures formed in utero, non-epithelial structures formed (cardiovascular, stroma)
- Birth to 3 months: isometric, only non-epithelial tissues
- 3 months to puberty: allometric, epithelial structure form and invade fat pad
- Puberty to conception: isometric, but limited development
- Gestation: Large amount of growth, alveoli and epithelial branches develop on pre-formed ducts

Prepubertal heifer mammary gland



Over conditioning may lead to more fat deposition in the fat pad of the mammary gland.

South Dakota State University
College of Agriculture and Biological Sciences

Regulation of mammary growth and development

- Still not fully understood
- Key players are thought to be:
  - Ovary secretions – estrogen
  - Growth Hormone and IGF-I
- Other growth factors and hormones

South Dakota State University
College of Agriculture and Biological Sciences

Rate of gain affects hormones too…

- GH acts on mammary tissues via IGF-I –stimulates epithelial growth
- High rate of gain has been shown to reduce GH, but increase IGF-I
- Hypothesized that sensitivity of mammary tissue to IGF-I is reduced at high ADG due to locally produced BP, in particular IGFBP-3 and perhaps other GF

(Sejrsen et al., 2000)(Akers et al., 2000)

South Dakota State University
College of Agriculture and Biological Sciences

How does this relate to management?

South Dakota State University
College of Agriculture and Biological Sciences

Holstein Heifer Targets

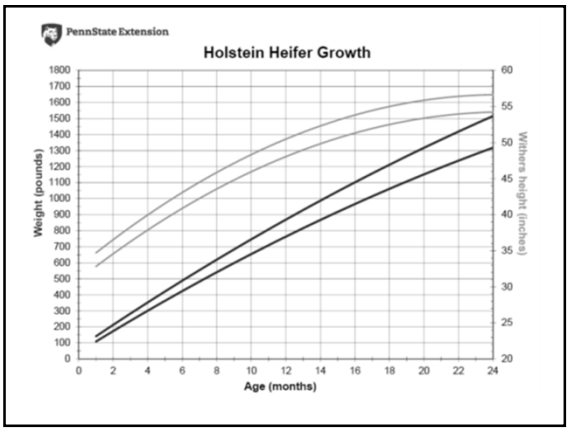
- Size when to breed: ~ 55% of expected mature weight (1,500 lbs * 0.55 = 825)
- Want to calve at ~82% of expected mature weight (1,500 lbs * 0.82 =1,230)
- Age when to breed: 13-15 months
- Age at calving 22-24 months

South Dakota State University
College of Agriculture and Biological Sciences

Monitoring Heifer Growth

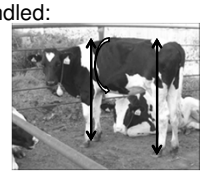
- **Weight:** goal just under ADG of 2 lbs (especially around and before puberty)
- **Height**: goal 50 inches at 13 months – 55 inches at calving (measure at top point of withers)
  - Ideally monitor weight and height measurements
- **Body Condition Scores:** Avoid fat heifers!
- Useful charts to track progress: http://extension.psu.edu/animals/dairy/nutrition/heifers/monitoring-heifer-growth

South Dakota State University
College of Agriculture and Biological Sciences



Body Measurements

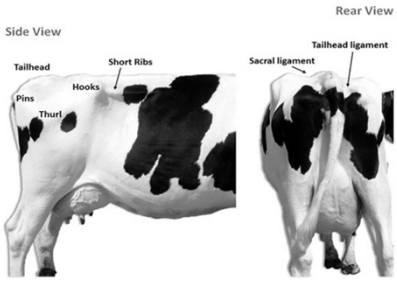
- Every couple months or when handled:
  - Body weights
  - Heart girth – weight tape if no scale
  - Wither height
  - Hip height



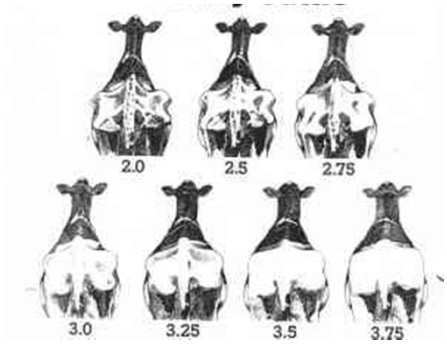
- Recommend observing (every 2 weeks) body condition score (BCS) on scale of 1 (emaciated) to 5 (obese) - (Wildman et al., 1982)

South Dakota State University
College of Agriculture and Biological Sciences

Body Condition Scoring



South Dakota State University
College of Agriculture and Biological Sciences



South Dakota State University
College of Agriculture and Biological Sciences

Elanco Body Condition Scoring Guide

How do we achieve these targets?

South Dakota State University
College of Agriculture and Biological Sciences

Feeding Strategies

Overall Goal: Assure you are meeting heifer nutrient requirements while avoiding over feeding energy.

1. Ad libitum TMR
2. Limit-feeding/Target-feeding
3. Component feeding

All three strategies can work effectively, but each have pros and cons...
(Housing system also may affect practicality too!)

South Dakota State University
College of Agriculture and Biological Sciences

Ad libitum TMR feeding

- Total Mixed Ration
- Very common
- Must be high forage
  - Bulk density/gut fill of forage assures energy intake will not be excessive
- Feed for 5-10% refusals
- Recommended for older heifers – especially as approaching calving

South Dakota State University
College of Agriculture and Biological Sciences

Ad libitum TMR

- **Pros**
  - More flexibility on group uniformity
  - Better rumen health – more stable
  - Bunk space less of a concern as feed is always available

South Dakota State University
College of Agriculture and Biological Sciences

Ad libitum TMR

- **Cons**
  - Have wasted feed each day
  - Less efficient nutrient digestion/utilization
  - Some heifers may overeat and get over conditioned

South Dakota State University
College of Agriculture and Biological Sciences

Example TMR Feed Ingredients
(10-months old)

Ingredients	% DM Basis	% As Fed
Grass Hay	34.91	24.76
Corn Silage	33.96	53.59
Corn, ground	10.01	7.02
DDGS	5.01	3.51
Soybean meal	13.53	9.49
Limestone	0.81	0.51
Heifer Smart	1.00	0.63
Salt	0.50	0.32
Energy booster	0.27	0.17

Schossow and Anderson, unpublished

South Dakota State University
College of Agriculture and Biological Sciences

Example TMR Nutrient Composition:
(10-months)

Nutrient, % DM	Control
Dry Matter, %	63.11
Crude Protein	14.7
Rumen degradable protein	9.4
Rumen undegradable protein	5.3
Neutral Detergent Fiber	40.0
Acid Detergent Fiber	23.5
Non-fibrous Carbohydrate	37.1
Ether Extract (Fat)	3.0
Calcium	0.82
Phosphorus	0.34
Sulfur	0.21
ME Mcal/Kg DM	2.36
NEg Mcal/Kg DM	0.88

Schossow and Anderson, unpublished

Limit-Feeding

- More nutrient dense diets fed at a set amount to meet requirements – also usually TMR
- Most research conducted using corn and soybean based diets (show some later with DDGS)
- Slower rate of passage, resulting in increased ruminal degradation and nutrient utilization
- Improved feed efficiency even when high-forage diets are fed

South Dakota State University
College of Agriculture and Biological Sciences

Tamminga et al., 1979; Loerch, 1990; Hoffman et al., 2007; Zanton and Heinrichs, 2007

Limit-Feeding

- Can adjust the rate of feeding
- Does not negatively impact growth in dairy heifers (Zanton and Heinrichs, 2007)
- Lactation performance is maintained or improved in limit-fed heifers (Hoffman et al., 2007)

South Dakota State University
College of Agriculture and Biological Sciences

Limit-feeding

- **Pros**
  - Nutrient utilization and feed efficiency
  - No feed waste
  - More regulated or controlled rates of gain – less likely to get over conditioned heifers

South Dakota State University
College of Agriculture and Biological Sciences

Limit-feeding

- **Cons**
  - Must weigh heifers frequently to monitor ADG
  - Need to frequently (every week or two weeks) adjust the amount fed
  - Need adequate bunk space (up to 24'' for older heifers)
  - Works best when heifers are grouped by age and uniform in size
  - Heifers need adjustment and may show signs of hunger
  - Most consider type of bedding

South Dakota State University
College of Agriculture and Biological Sciences

Example Limit-Fed Rations

Formulated two age groups for ADG of 1.8 pounds/day.

Ingredient, % of DM	Lower Forage 4 Months	Lower Forage 23 Months	Higher Forage 4 Months	Higher Forage 23 Months
Fed at % BW	**2.23**	**1.56**	**2.39**	**1.63**
Grass Hay	8	15	20	25
Corn Silage	12	25	30	35
Whole Shelled Corn	40.75	31.25	18.70	18.25
Soybean Meal	9	0	8	3
Distiller's Grains	7	15	10	10
Wheat Middlings	10	10	5	5
Molasses	10	0	5	0
Urea	0.50	0.75	0.30	0.75
Mineral Mixture	3	3	3	3

http://extension.psu.edu/animals/dairy/nutrition/heifers/heifer-feeding-and-management/precision-feeding-dairy-heifers-strategies-and-recommendations

Example Limit-Fed Rations

Example rations formulated for ADG of 1.8 pounds/day.

Ingredient, % of DM	Lower Forage 4 Months	Lower Forage 23 Months	Higher Forage 4 Months	Higher Forage 23 Months
Body weight, pounds	250	1350	250	1350
DMI, pounds/d	5.56	21.00	5.98	22.08
DMI, % BW	2.23	1.56	2.39	1.63
ME, Mcal/pound DM	1.25	1.17	1.16	1.12
CP, %	16.05	14.62	15.04	14.09
SP, % CP	29.22	38.43	30.26	40.26
RUP, % CP	32.44	36.16	33.31	32.00
NDF, %	22.43	33.87	34.93	39.97

http://extension.psu.edu/animals/dairy/nutrition/heifers/heifer-feeding-and-management/precision-feeding-dairy-heifers-strategies-and-recommendations

Example Limit-Fed Ration

(fed at 2.45% BW to 4.5-10.5 months)

Item, % DM	Control
Grass Hay	39.79
Corn Silage	24.86
Ground Corn	15.91
SBM	8.95
SoyPlus	8.95
Limestone	0.40
Premix	0.78
Salt	0.36

Anderson et al., 2015

South Dakota State University
College of Agriculture and Biological Sciences

Component Feeding

- Give a grain mix or pellet once or twice a day at a limited amount and then allow ad libitum intake of hay/forage or pasture.

South Dakota State University
College of Agriculture and Biological Sciences

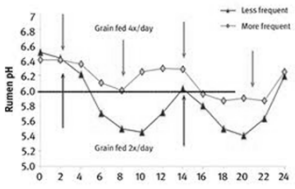
Component Feeding

- **Pros**
  - Less time at feeding – little or no mixing
  - Less feeding equipment
  - Easy to adjust grain mix or pellet allowance

South Dakota State University
College of Agriculture and Biological Sciences

Component Feeding

- **Cons**
  - Rumen pH/health
  - Efficiency of nutrient utilization?
  - Need adequate feeder space



South Dakota State University
College of Agriculture and Biological Sciences

Example Component Fed Rations

Item, % DM[1]	CON	DDG
Grass hay- estimated	68.5	68.5
DDGS	0.0	30.0
Ground corn	12.0	0.0
SBM	8.12	0.0
Expellers SBM	6.27	0.0
Soyhulls	3.65	0.0
Vitamins and Minerals[1]	1.5	1.5

[1]Contained: 50% vitamin and mineral mix, 25% calcium carbonate, and 25% salt.

Grain Mixes – fed at 0.8% of BW – Hay Ad libitum

(Manthey et al., 2016)

South Dakota State University
College of Agriculture and Biological Sciences

Other general recommendations

- Avoid too much dietary starch → fat heifers
- A little bit of dietary fat is a good thing, may help reproductive and mammary development
- It is better to slightly overfeed protein than to underfeed protein

South Dakota State University
College of Agriculture and Biological Sciences

What are the take home points?

South Dakota State University
College of Agriculture and Biological Sciences

Conclusions

- Heifers are developing
  - Digestive system, puberty, mammary gland
- Monitor your heifers' growth and progress – Weight, Height, BCS
- Many ways to feed heifers – avoid over feeding energy

South Dakota State University
College of Agriculture and Biological Sciences

Dairy Beef: Performance and Carcass Characteristics

Andrea Watson
Department of Animal Science
University of Nebraska-Lincoln

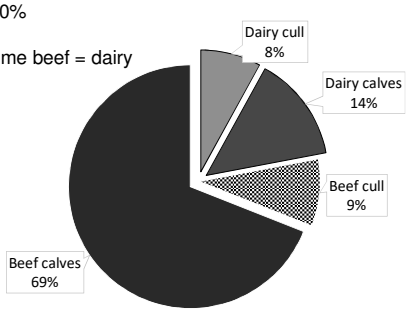
Dairy Beef

- A good start is key
  - Colostrum
  - Vaccinations
  - Environment
- Historical
  - Overly large carcasses
  - Odd shaped ribeye
  - Resulting in poor quality
    - No longer true!
    - Can be overcome with good management

Dairy Industry (2015)
22% of US beef production = > 5 billion pounds of beef

Holsteins = 86-90%

30-35% of all Prime beef = dairy



Boetel. 2016. Impacts of the dairy industry on beef markets.

- Quality grade
  - To predict the tenderness, juiciness, and flavor of beef

Relationship between marbling, maturity and carcass quality grade[1].

Degrees of Marbling	Maturity[2] A[3] 9 to 30 months	B 30 to 42 months	C 42 to 72 months	D 72 to 96 months	E more than 96 months
Slightly abundant	PRIME				
Moderate			COMMERCIAL		
Modest	CHOICE				
Small					
Slight	SELECT		UTILITY		
Traces					
Practically devoid	STANDARD			CUTTER	

Figure 2: USDA Beef Grading chart.

1. Assumes that firmness of lean is comparably developed with the degrees of marbling and that the carcass is not a "dark cutter."
2. Maturity increases from left to right (A through E).
3. The A maturity portion of the Figure is the only portion applicable to bullock carcasses.

Kenny Eng "How are Holsteins different?"

- Gentle and playful
  - Don't leave as bulls!
- Easily bored
  - More sorting of feed
  - More buller issues
  - More dust
- Increased risk for bloat, acidosis, liver abscesses
  - Less risk for founder, respiratory
- More heat tolerant
  - Less cold tolerant
- Increased feed and water intake
  - Pens wetter, more manure
- Difficult to chase an animal that insists on following you
- Suicidal tendencies

Kenny Eng "How are Holsteins different?"

- Relatively small gene pool
  - Predictable performance
- High quality beef
  - Size/shape of ribeye
  - Fat cover/marbling
- Easily age and source verified
- Price of feed critical
  - 3 tons of feed to finish vs < 2

- + 25 lb HCW
- + 0.85 in^2 REA
- Same # of steaks/loin
- + 0.23 g of steaks/lb HCW
- Increase in REA depth

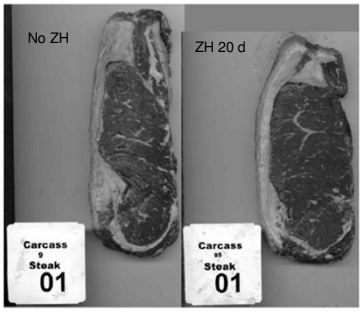


Fig. 2. Typical anterior-most steaks from top-loins (*M. Longissimus lumborum*) of calf-fed Holstein steers fed zilpaterol hydrochloride for 0d (left) and 20 d (right). These images represent mean LMA^{-HCW} values for each treatment. The identification tags are 66.675 × 69.85 mm. Note the narrow and angular shaped steak on the left as compared to the increased muscle depth illustrated in the steak shown at the right.

Lawrence et al., 2011. Meat Science 88:209.

	Holstein Select	Holstein Choice	Charolais cross-bred Choice
Loins, n	24	22	23
Juiciness[1]	5.0	5.3	5.2
Tenderness[1]	5.5	5.9	5.8
Flavor[1]	5.8	5.9	5.7
Overall[1]	5.5	5.8	5.7
Shear force, kg	3.6	3.4	3.6

[1]On a scale of 1-8 with 5 being slightly juicy, tender, or agreeable.

No differences in beef quality/palatability

Schaefer et al., 1986. J Anim Sci. 63:432.

	Beef Steers				Holstein Steers			
	< 300	4-500	6-800	>900	< 300	4-500	6-800	>900
% of animals	1.0	12.7	77.0	9.3	63.6	13.2	16.3	6.8
Out weight, lb	1108	1161	1266	1382	1245	1296	1318	1424
Days on feed	316	234	159	104	370	284	192	125

Duff and McMurphy, 2007. Vet Clin Food Anim. 23:281-297.

	Beef Steers				Holstein Steers			
	< 300	4-500	6-800	>900	< 300	4-500	6-800	>900
% of animals	1.0	12.7	77.0	9.3	63.6	13.2	16.3	6.8
Out weight, lb	+137 lbs	1	1266	1382	1245	1296	+42 lbs	
Days on feed	+54 days 316	234	159	104	370	284	+21 days 192	125

Duff and McMurphy, 2007. Vet Clin Food Anim. 23:281-297.

	Beef Steers				Holstein Steers			
	< 300	4-500	6-800	>900	< 300	4-500	6-800	>900
% of animals	1.0	12.7	77.0	9.3	63.6	13.2	16.3	6.8
DMI, lb/d	14.5	16.6	20.4	23.6	15.0	18.3	21.4	23.5
ADG, lb	2.46	2.75	3.22	3.22	2.62	2.78	2.94	2.64
Feed:Gain	5.92	6.10	6.39	7.67	5.75	6.66	7.42	9.43

Duff and McMurphy, 2007. Vet Clin Food Anim. 23:281-297.

	Beef Steers				Holstein Steers			
	< 300	4-500	6-800	>900	< 300	4-500	6-800	>900
% of animals	1.0	12.7	77.0	9.3	63.6	13.2	16.3	6.8
DMI, lb/d	14.5	16.6	20.4	23.6	15.0	18.3	21.4	23.5
ADG, lb	2.46	2.75	3.22				2.94	2.64
Feed:Gain	5.92	6.10	6.39	7.67	5.75	6.66	7.42	9.43

2.9% improvement

23% worse

Duff and McMurphy, 2007. Vet Clin Food Anim. 23:281-297.

	Beef Steers				Holstein Steers			
	< 300	4-500	6-800	>900	< 300	4-500	6-800	>900
% of animals	1.0	12.7	77.0	9.3	63.6	13.2	16.3	6.8
Cost of gain, $/lb	0.53	0.53	0.53	0.59	0.54	0.57	0.61	0.75
Death Loss, %	4.81	2.82	1.17	0.75	4.08	2.98	1.65	0.92
Vet Med, $/hd	21.29	20.40	12.20	8.69	18.90	15.10	11.40	6.34

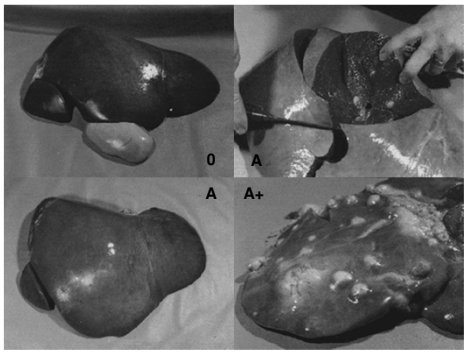
Duff and McMurphy, 2007. Vet Clin Food Anim. 23:281-297.

Considerations

- Type of diet
- Age
  - Shorter backgrounding period
  - Start on finishing diet sooner
- Feed additives
  - β-agonist
- Compared to beef cattle
  - Lower dressing % (GI tract and bone vs carcass)
  - Less muscling (greater marbling at lower weight)
  - Less efficient at putting on fat (leaner at finished weights)
  - Increased lean trim value
- Hide value (thinner, larger, no brands)

Lawrence et al., 2011. Meat Science 88:209.
Siemens, 1996.

Liver Abscess Classification



Courtesy of Elanco Animal Health

Total Liver Abscesses (%), Tylan fed Cattle

	Steers	Heifers	Holsteins
2010	15.2	14.1	29.0
2013	17.4	15.5	50.9
2016	17.8	16.5	35.6

[1]Elanco Animal Health. Data on file. Dr. Casey Maxwell, Elanco Sr. Technical Consultant

Total Liver Abscesses (%), Tylan fed Holsteins

	Central Plains	High Plains	Southwest
2010	33.4	19.3	15.8
2013	71.0	58.4	17.6
2016	53.4	46.4	24.9
	CO, KS	OK, NM, TX	AZ, CA

[1]Elanco Animal Health. Data on file. Dr. Casey Maxwell, Elanco Sr. Technical Consultant

Yield Grade

- Prediction of red meat yield
  - 12th rib fat thickness, % KPH fat, HCW, Ribeye Area
  - YG 1 = >52% yield
  - YG 5 = <45% yield
  - Premiums (YG 1 and 2)
  - Discounts (YG 4 and 5)
- Yield Grade
  - Explains 40% of variation in red meat yield for beef cattle
  - 0% for Holstein cattle

Ty Lawrence
West Texas A&M University

Yield Grade

- KPH (Kidney Pelvic and Heart fat)
  - Typically estimated/standard values, not measured
- 12th rib backfat
  - Good relationship for beef cattle
  - No relationship for Holsteins
- HCW
  - Limited relationship
  - Better in Holstein than beef breeds
- Ribeye area
  - Best measure for estimating YG in beef or Holstein breeds

Ty Lawrence; West Texas A&M University

Summary

- Almost ¼ of U.S. beef production
  - >30% of all prime
  - High quality beef
- Manage differently than beef cattle
  - Diet, β-agonist, implant, age…
    - Acidosis leading to liver abscesses
  - Feed price important!
  - Environment
    - Thinner hide, less hair cover and external fat
    - Heat vs cold stress
- Marketing
  - Emphasize quality, not yield grade

Questions?

University of Nebraska Lincoln

beef.unl.edu
dairy.unl.edu

Utilizing Distillers Grain and Other Alternative Protein Sources in Growing Heifer Rations

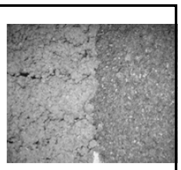
November 9 and 10, 2016
University of Nebraska Extension
Workshop: Rearing young stock for dairy and beef production

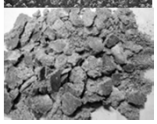
Jill Anderson, Ph.D. Assistant Professor
Dairy and Food Science Department
SDSU

South Dakota State University
College of Agriculture and Biological Sciences

Outline

- Feeding Distillers
  - Different types of distillers grains
  - Using distillers grains in different feeding strategies for heifers
- Other proteins sources
  - New oilseed meals





South Dakota State University
College of Agriculture and Biological Sciences

Feeding Distillers Grains

- Abundance of research on feeding distillers grains (DG) to mature dairy cattle and beef cattle
- Limited info on feeding DG to growing dairy heifers
  - → Main goal for today: share our research findings to-date from SDSU

South Dakota State University
College of Agriculture and Biological Sciences

Feeding Heifers Distillers Grains

- What type of DG?
  - Wet vs Dry
  - Low fat DDGS vs traditional DDGS
- What should you feed it with?
- How much can you feed to growing heifers?

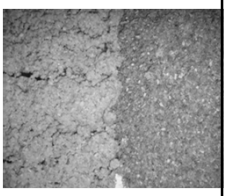
Types of DG

(Nutrient composition examples)

Items, % DM	DDGS (2006)	DWGS (2006)	DWGS (2010)	DDGS (2012)	DDG-HP (2012)	RFDDGS (2013)
DM, %	88.37	31.80	28.9	89.0	94.5	96.1
CP	33.16	34.42	30.4	30.6	41.6	32.8
NDF	31.71	36.79	32.1	32.1	26.2	24.4
ADF	15.54	19.72	16.2	10.0	8.3	12.6
EE	9.67	10.75	10.9	15.2	4.3	8.67
Ash	4.17	3.88	4.9	4.75	2.22	4.82
Sulfur	0.90	0.90	-	0.58	0.83	0.74

Must know what you are feeding!

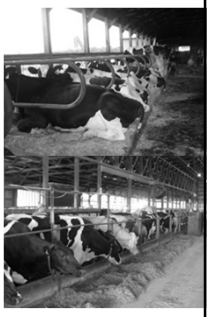
Wet vs. Dried



- Wet:
  - Harder to store
  - Improves mixing of diet
  - Winter feeding?
- Dried:
  - Digestibility impacted by drying?
  - Easier to store – more like other grains
  - More cost effective to ship

Wet vs. Dried

- Limited research in dairy heifers
- Been some studies with lactating cows (Anderson et al., 2006)
  - Need to account for moisture in ration
  - Worked well at 10 or 20% of diet
- Research on feeding DWGS to heifers
  - Ensiled with Soyhulls (SH) (Anderson et al., 2009)
  - Ensiled with Corn Stalks (CS) (Anderson et al., 2015)



South Dakota State University
College of Agriculture and Biological Sciences

DWGS Heifer Studies

- SH or CS compliment nutrient profile of WDGS by being low in CP, fat, and high in fiber
- Ensiled in silo bags and then conducted trials with feeding heifers
  - Palatability
  - Growth
  - Gain:Feed

South Dakota State University
College of Agriculture and Biological Sciences

DWGS & SH Experiment Design

- DWGS and SH ensiled at
  - 53.2%:46.8% on DM basis
  - or 70:30 as-fed basis.
- 24 heifers (8 hd/treatment) (150 d of age) fed for 8 wk
  - Control
  - Low DWGS & SH blend (24%) (**LWSH**)
  - High DWGS & SH blend (48%) (**HWSH**)

South Dakota State University
College of Agriculture and Biological Sciences

Diet Formulations

Item, % DM	Control	LWSH	HWSH
Brome Grass Hay	50.00	50.00	50.00
WDGSH Blend	**0**	**24.43**	**48.62**
Corn , cracked	**35.93**	**17.93**	**0**
SBM	**12.71**	**6.36**	**0**
Min & Vit Pre-mix	0.86	0.86	0.86
Limestone	0.50	0.50	0.50
Vit E	0.03	0.03	0.03

South Dakota State University
College of Agriculture and Biological Sciences

Diet Nutrient Compositions

Item, % DM	Control	LWSH	HWSH
DM, % diet	89.76	79.32	69.20
CP	16.16	17.28	18.12
NDF	34.78	45.38	54.80
Ash	9.87	8.31	9.24
NFC	37.19	25.78	13.23
Starch	26.75	14.35	2.02
ME, Mcal/Kg	2.54	2.49	2.44
NEg, Mcal/Kg	1.03	0.99	0.94

South Dakota State University
College of Agriculture and Biological Sciences

Performance

Item	Control	LWSH	HWSH	SEM	P-value (Linear)
Age, Initial	150	150.3	148.1	-	-
BW, Initial, Kg	183.0	184.1	185.4	11.25	0.67
BW, Final, Kg	252.3	253.6	256.4	12.33	0.59
ADG, Kg/d	**1.24**	**1.24**	**1.27**	**0.05**	**0.67**
DMI, Kg/d	**6.78**	**6.56**	**5.76**	**0.34**	**<0.01**
Gain:Feed	**0.186**	**0.193**	**0.233**	**0.015**	**0.02**
BCS, initial	3.33	3.27	3.38	0.15	0.60
BCS, final	3.63	3.51	3.51	0.09	0.10

No differences among treatments for frame measurements

South Dakota State University
College of Agriculture and Biological Sciences

DWGS & CS Experiment Design

- Two bag silos were made of WDGS:CS
  - 66.7:33.3 as-fed basis or 43.1:56.9 DM basis
  - Untreated (UNT)
  - Treated (TRT): 1/1000 kg with SiloKing®GPX
- 9 Holstein, 3 Brown Swiss (185± 26 d)
  - (4 hd/treatment)
- 6 weeks of feeding treatment diets:
  - Control (C), UNT, and TRT
  - CO diet limit fed, UNT and TRT diets were fed ad libitum

South Dakota State University
College of Agriculture and Biological Sciences

Diet Formulations

Ingredient, % of DM	CON	UNT & TRT
Grass/Alfalfa Hay	69.7	-
Grain Mix*	30.3	-
WDG-CS blend (U or T)	-	99.0
Min and Vit Pre Mix	-	1.0

* Grain mix contains 47.62% steam-flaked corn, 33.33% LOL–Intense calf diet 22B60, 9.56% rolled oats, 3.33% dry molasses, 1.43% liquid molasses, and 4.76% fish meal.

South Dakota State University
College of Agriculture and Biological Sciences

Diet Composition

	Treatment		
Item[1]	CON[2]	UNT	TRT
DM	**88.3**	**43.9**	**44.2**
CP	20.8	19.3	18.2
ADF	26.7	34.8	36.4
NDF	**39.9**	**54.0**	**54.6**
Starch	12.9	3.3	2.8
EE	**2.09**	**4.96**	**4.88**
Ash	9.28	10.82	11.41
NFC[3]	**32.7**	**13.1**	**13.0**
ME, Mcal/kg	**2.35**	**2.31**	**2.31**
NEg, Mcal/kg	**0.86**	**0.86**	**0.86**

[1] % DM unless otherwise indicated.
[2] Nutrient analyses was conducted on hay and concentrate mix individually and used for calculation of dietary concentrations.
[3] NFC = 100- (NDF + CP + EE + Ash) (NRC, 2001).

Gain: Feed

Item	Treatment			SEM	*P-values*
	CON	UNT	TRT		Treatment
Age, initial	189.5	208.5	204.0	-	-
BW, Kg	252.7	259.9	255.5	5.54	0.67
ADG[1], kg/d	0.95 ± 0.91	1.16 ± 0.55	1.02 ± 0.30	-	NS
DMI, Kg	5.51[a]	4.60[b]	4.61[b]	0.145	<0.01
Gain:Feed	**0.183[c]**	**0.267[a]**	**0.234[b]**	**0.008**	**<0.01**

[1] Calculated using regression analysis of body weight measurement by days of feeding.
[abc] Values within row with unlike superscripts differ by *P < 0.05*.
No significant Trt X Week effects

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

South Dakota State University
College of Agriculture and Biological Sciences

Body Frame Sizes

Item, cm	Treatment			SEM	*P- values*
	CON	UNT	TRT		Treatment
Wither height	115.1	114.8	114.1	0.38	0.19
Hip height	120.7	120.7	119.6	0.37	0.06
Body length	102.4	103.7	102.0	0.87	0.39
Heart girth	141.8	141.7	140.6	0.80	0.54
BCS	2.82	2.86	2.92	0.047	0.29

No significant Trt X Week effects

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

South Dakota State University
College of Agriculture and Biological Sciences

Conclusions of Ensiling Trials

- Feeding the ensiled WDGS blends resulted in similar heifer frame growth compared to Control fed heifers
- Heifers fed the WDGS blends had improved G:F compared to Control fed heifers
  - high ADG on WDG&SH study
- Including silage additive in the ensiled WDGS-CS improved total tract digestibility of nutrients (data not shown)

South Dakota State University
College of Agriculture and Biological Sciences

DDGS vs Low Fat DDGS?
Effects of feeding fat from distillers grains on growth, metabolic profile, and later performance of dairy heifers.
(Anderson et al., 2015a, 2015b, 2015c)

Feeding Fat

- Not well-researched in dairy heifers
- Conflicting results in ruminant research:
  - Negative impacts on fiber utilization
  - Improved feed efficiency
  - PUFA may improve mammary development (McFadden et al., 1990; Thibault, et al., 2003)
  - PUFA may help reproduction in cattle (Funston, 2004; Ambrose et al., 2006, Martin et al., 2007)
  - Some beef studies have found breed-dependent responses on reproduction (Lammoglia et al., 2000)

South Dakota State University
College of Agriculture and Biological Sciences

Dietary Fat from DDGS?

- Feeding fat in replacement of starch may cause changes in metabolic profile that could alter development and performance
  - Increase plasma lipids and metabolic hormones?
  - Alter onset of puberty?
  - Alter mammary development?

South Dakota State University
College of Agriculture and Biological Sciences

Experimental Design

- Three treatment diets:
  - Control (C): soybean products and corn
  - Low-Fat (LFDG): low fat DDG and corn
  - High-Fat (HFDG): traditional DDGS
- Thirty-three Holstein heifers (133 ± 18 days old)
- 24 week feeding period

South Dakota State University
College of Agriculture and Biological Sciences

Diet Formulations (fed at 2.45% BW)

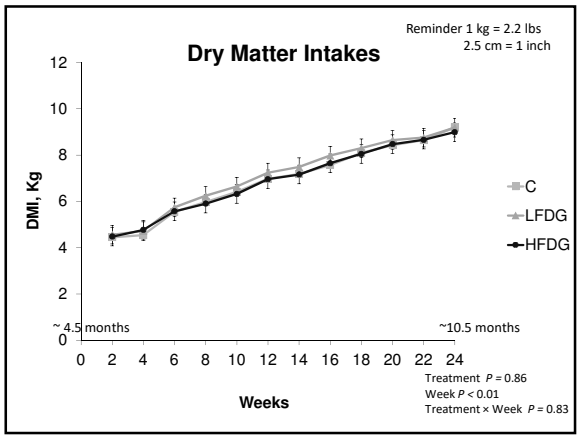
Item, % DM	Control	LFDG	HFDG
Grass Hay	39.79	39.78	39.79
Corn Silage	24.86	24.86	24.86
DDGS	-	-	33.80
DDG HP	-	21.88	-
Ground Corn	15.91	11.93	-
SBM	8.95	-	-
SoyPlus	8.95	-	-
Limestone	0.40	0.40	0.40
Premix	0.78	0.78	0.78
Salt	0.36	0.36	0.36

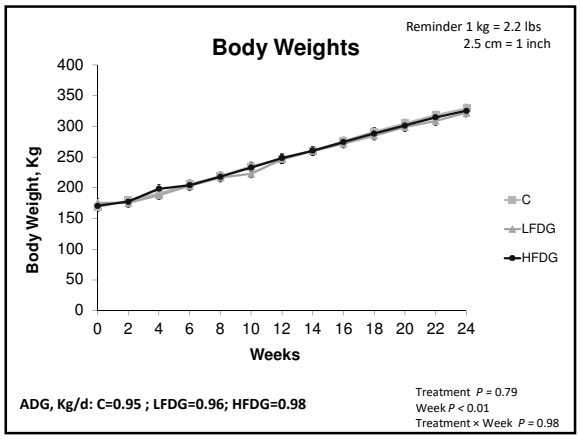
South Dakota State University
College of Agriculture and Biological Sciences

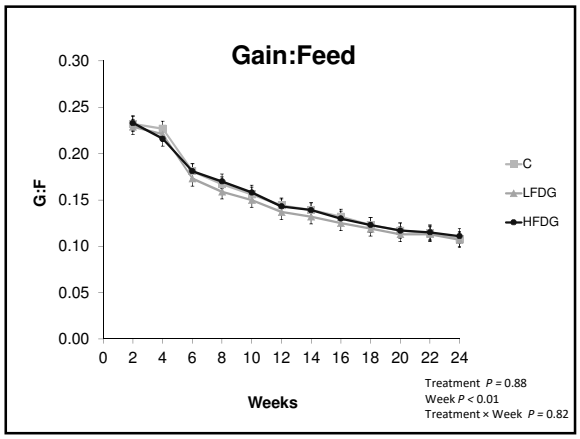
Diet Composition (Analysis)

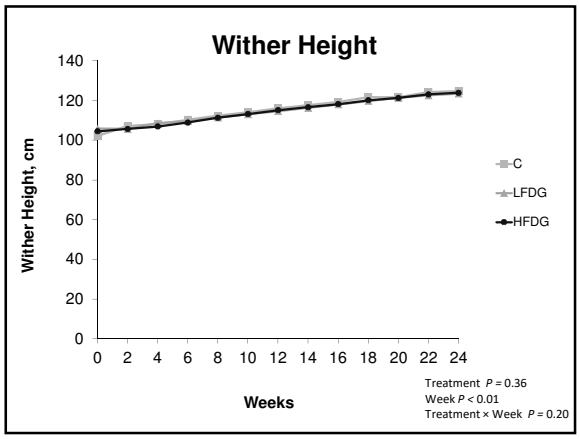
	Treatment		
Item[1]	C	LFDG	HFDG
DM[2], %	71.0	71.8	70.7
Ash[2]	7.02	6.29	7.20
CP[2]	15.8	16.3	16.7
ADF[2]	23.6	24.0	25.2
NDF[2]	42.2	44.5	48.6
EE[2](diethyl)	**2.91**	**3.08**	**7.00**
Oil[3] (com. Lab)	**1.97**	**2.22**	**4.72**
NFC[2,4]	32.1	29.9	20.6
Starch[3]	**20.4**	**19.0**	**8.3**
ME[5], Mcal/Kg DM	2.48	2.45	2.46
NEg[5], Mcal/Kg DM	0.97	0.96	0.96

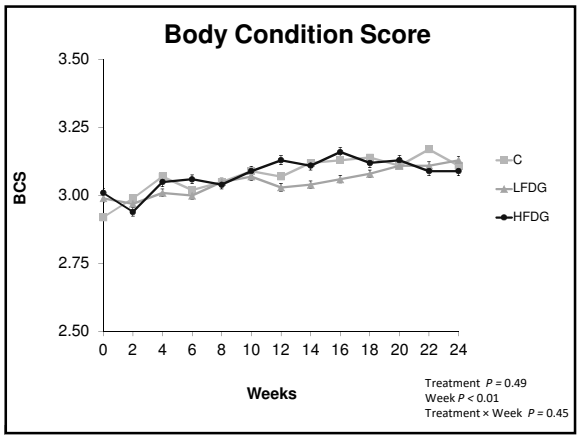
[1] % DM, unless otherwise indicated.
[2] Results from analysis of monthly composites.
[3] Results from analysis of four-month composites.
[4] % NFC =100 - (% Ash + % CP + % NDF + % EE) (NRC, 2001).
[5] Values are calculated based on inputting sample nutrient analysis into ration formulations in the Dairy NRC computer program (2001).

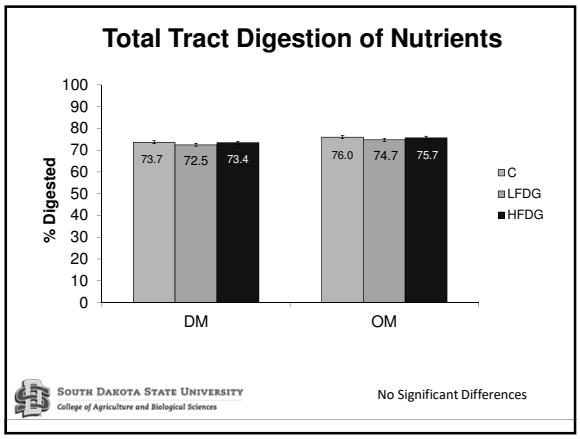

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch
Dry Matter Intakes
DMI, Kg
12
10
8
6
4
2
0
~ 4.5 months
~10.5 months
0 2 4 6 8 10 12 14 16 18 20 22 24
Weeks
C
LFDG
HFDG
Treatment P = 0.86
Week P < 0.01
Treatment × Week P = 0.83

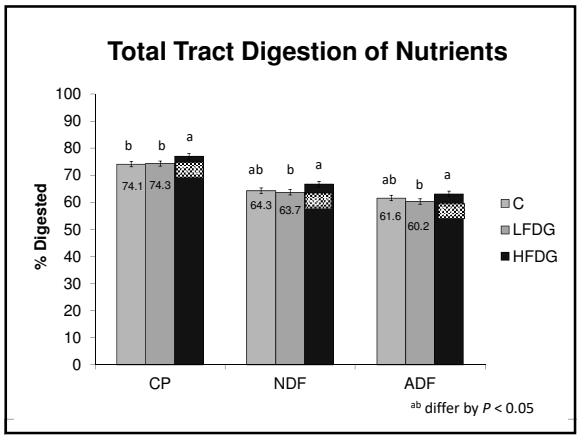

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch
Body Weights
Body Weight, Kg
400
350
300
250
200
150
100
50
0
0 2 4 6 8 10 12 14 16 18 20 22 24
Weeks
C
LFDG
HFDG
ADG, Kg/d: C=0.95 ; LFDG=0.96; HFDG=0.98
Treatment P = 0.79
Week P < 0.01
Treatment × Week P = 0.98


Gain:Feed
G:F
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24
Weeks
C
LFDG
HFDG
Treatment P = 0.88
Week P < 0.01
Treatment × Week P = 0.82


Wither Height
Wither Height, cm
140
120
100
80
60
40
20
0
0 2 4 6 8 10 12 14 16 18 20 22 24
Weeks
C
LFDG
HFDG
Treatment P = 0.36
Week P < 0.01
Treatment × Week P = 0.20


Body Condition Score
BCS
3.50
3.25
3.00
2.75
2.50
0 2 4 6 8 10 12 14 16 18 20 22 24
Weeks
C
LFDG
HFDG
Treatment P = 0.49
Week P < 0.01
Treatment × Week P = 0.45

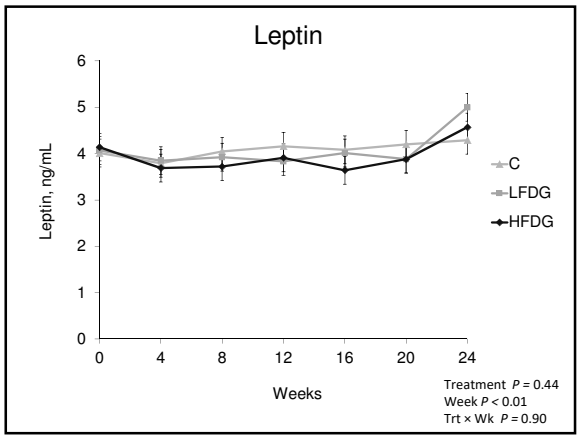

Total Tract Digestion of Nutrients
% Digested
100
90
80
70
60
50
40
30
20
10
0
73.7
72.5
73.4
76.0
74.7
75.7
DM
OM
C
LFDG
HFDG
South Dakota State University
College of Agriculture and Biological Sciences
No Significant Differences



Short-Term Energy Status

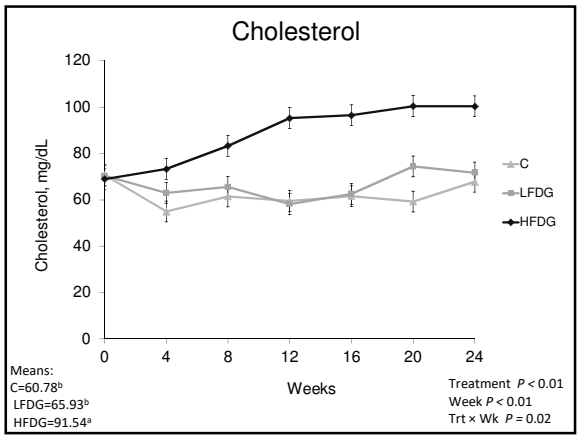
- Short term energy status similar among treatments (Glucose, NEFA, BHBA, Insulin, IGF-1)
- Energy from forage utilization and fermentation may offset differences in dietary fat and starch provided by concentrate mixes

South Dakota State University
College of Agriculture and Biological Sciences



Long-Term Energy Status

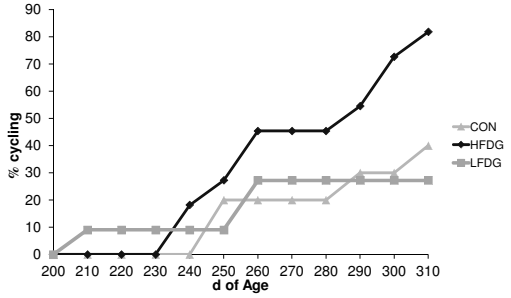
- Leptin indicates similar long-term energy status
- No differences in body fat (white adipose) deposition among treatments
- Leptin maybe more affected by total amount of dietary energy versus form of energy source



Cholesterol

- Other studies have also found that feeding increased dietary fat to heifers increased plasma cholesterol (Park et al., 1983; Talavera et al., 1984; Thomas et al., 1997; Lammoglia et al., 2000)
- Cholesterol is precursor to steroid hormones
  - Progesterone more than Estradiol (Talavera et al, 1985)

Puberty



SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences

Puberty

- Results indicate that puberty occurred at younger ages and lower BW in HFDG fed heifers
- BW and ADG were similar among treatments
- Leptin indicates body fat deposition were similar
- Possibly related to Cholesterol → Steroid hormones?
- Small heifer numbers – more research needed!

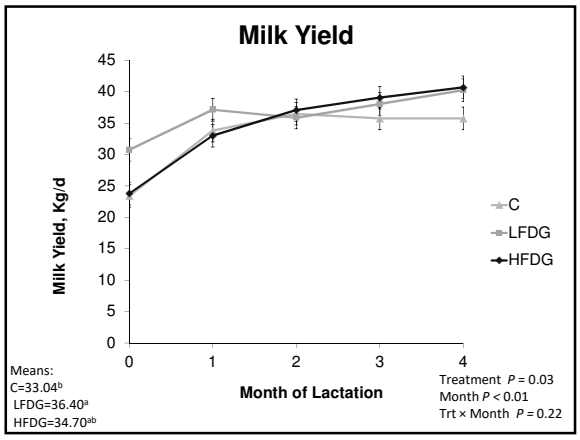
SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences

Post-trial

- Heifers were managed in general herd
- Data was collected from herd health and DHIA records
- Body measurements were obtained at 3 wk prepartum and at parturition

Post-trial

Item	Treatments				*P-values*
	CON	LFDG	HFDG	SEM	
AI Services	2.11	2.89	1.78	0.37	0.11
Age at conception, d	455	483	444	17.0	0.27
Age at parturition ,d	733	764	728	17.4	0.30
Body Measures: At parturition					
BW, Kg	634.3	620.6	590.3	31.46	0.20
Wither height, cm	145.8[a]	147.6[a]	143.1[b]	1.13	0.03
Hip height, cm	150.6	149.9	147.8	1.29	0.29
Heart girth, cm	203.8	206.2	201.8	1.89	0.28
Body length, cm	144.3[a]	141.2[ab]	138.0[b]	3.02	0.01
BCS	3.29	3.12	3.23	0.114	0.13
Calf BW, kg	40.81	41.60	41.64	1.688	0.93
Calving problems, n[1]	1	2	2	-	-
Successfully transitioned[2], n[3]	9	9	9	-	-



Post-trial

- Reproductive performance was similar
- Despite earlier puberty, milk production was maintained in the heifers fed the HFDG diet compared to CON fed heifers
- In LFDG: Slightly older at calving → improved milk production?

South Dakota State University
College of Agriculture and Biological Sciences

Study Summary

- Feeding either DG type maintained frame growth and ADG
- Plasma lipid profiles may be altered by increased dietary fat from DDGS which may affect development
- Long term performance parameters were maintained by feeding DG compared to traditional feeds like corn and soybean products

South Dakota State University
College of Agriculture and Biological Sciences

How much DDGS can you feed in limit-fed diets?

Evaluation of growth performance, nutrient utilization, metabolic profile, and onset of puberty in dairy heifers fed distillers dried grains in replacement of forage in limit-fed rations.

(Angela Manthey, Ph.D)

South Dakota State University
College of Agriculture and Biological Sciences

Experimental Design

- **Three treatment diets:**
  - 30 % DDGS : 68.5 % Grass Hay (**30DG**); 2.65% BW
  - 40 % DDGS : 58.5 % Grass Hay (**40DG**); 2.50% BW
  - 50 % DDGS : 48.5 % Grass Hay (**50DG**); 2.35% BW
    - All had 1.5 % mineral mix
- **Experimental design:**
  - 48 heifers – 16 per treatment
  - Fed from 7 to 11 months of age (Calan Gates)
  - 2 wk adaptation, 16 wk feeding
  - Trial ran from Sept 2013-Sept 2014

South Dakota State University
College of Agriculture and Biological Sciences

Formulated Diets

Ingredients, % DM	30DG	40DG	50DG
DDGS	30.0	40.0	50.0
Grass Hay	68.5	58.5	48.5
Vitamin and Minerals Mix	1.5	1.5	1.5
Kg/d fed to a 250 Kg Heifer			
DM fed as % of BW	2.65	2.50	2.35
Estimated DMI	6.63	6.25	5.88
DDGS	1.99	2.50	2.94
Grass Hay	4.54	3.66	2.85
Vitamin and Minerals Mix	0.099	0.094	0.088

Reminder 1 kg = 2.2 lbs

South Dakota State University
College of Agriculture and Biological Sciences

Diet Formulation

Nutrient, % DM[1]	30DG	40DG	50DG
DM, % diet	87.50	87.50	87.50
CP	**16.50**	**19.40**	**21.30**
NDF	52.80	48.30	45.20
EE	**3.5**	**4.0**	**4.5**
NFC	23.40	25.90	27.50
Sulfur, g/d	**00.38**	**00.45**	**00.51**
ME, Mcal/kg DM	02.24	02.36	02.48
NE_G, Mcal/kg DM	00.79	00.880	00.970

[1]Based on Dairy NRC software (2001).

South Dakota State University
College of Agriculture and Biological Sciences

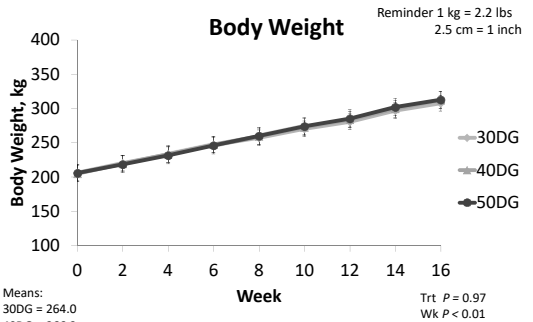
Diet Nutrient and Energy Intake

Item[1]	30DG	40DG	50DG
CP, kg/d	1.09	1.19	1.26
EE, kg/d	0.20	0.23	0.26
ME, Mcal/kg DM	14.700	14.800	14.700
NE gain, Mcal/kg DM	5.25	5.59	5.78

[1] Actual diet nutrient and energy intake.

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

South Dakota State University
College of Agriculture and Biological Sciences

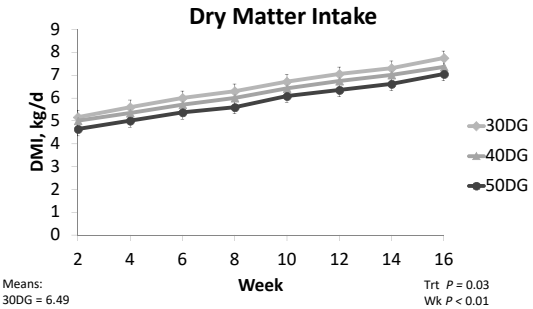


Means:
30DG = 264.0
40DG = 266.2
50DG = 266.4

ADG, kg/d: 30DG = 0.91, 40DG = 0.96, and 50DG = 0.95. *P* = 0.67

Trt *P* = 0.97
Wk *P* < 0.01
Trt × Wk *P* = 0.72
L = 0.82; Q = 0.91

South Dakota State University
College of Agriculture and Biological Sciences

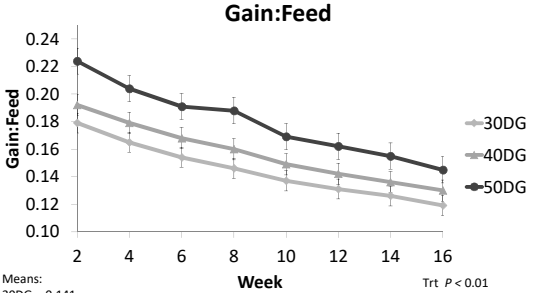


Means:
30DG = 6.49
40DG = 6.21
50DG = 5.84

Trt *P* = 0.03
Wk *P* < 0.01
Trt × Wk *P* = 0.97
L < 0.01; Q = 0.84

South Dakota State University
College of Agriculture and Biological Sciences

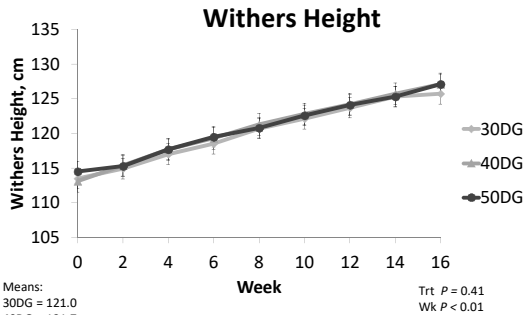
Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch



Means:
30DG = 0.141
40DG = 0.156
50DG = 0.172

Trt *P* < 0.01
Wk *P* < 0.01
Trt × Wk *P* = 0.09
L < 0.01; Q = 0.93

South Dakota State University
College of Agriculture and Biological Sciences

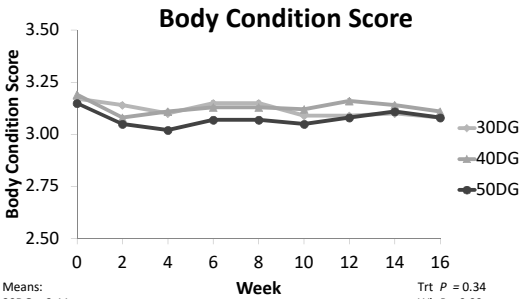


Means:
30DG = 121.0
40DG = 121.7
50DG = 121.6

Trt $P = 0.41$
Wk $P < 0.01$
Trt × Wk $P = 0.88$
L = 0.28; Q = 0.44

Reminder 1 kg = 2.2 lbs
2.5 cm = 1 inch

South Dakota State University
College of Agriculture and Biological Sciences



Means:
30DG = 3.11
40DG = 3.12
50DG = 3.07

Trt $P = 0.34$
Wk $P = 0.09$
Trt × Wk $P = 0.14$
L = 0.24; Q = 0.37

South Dakota State University
College of Agriculture and Biological Sciences

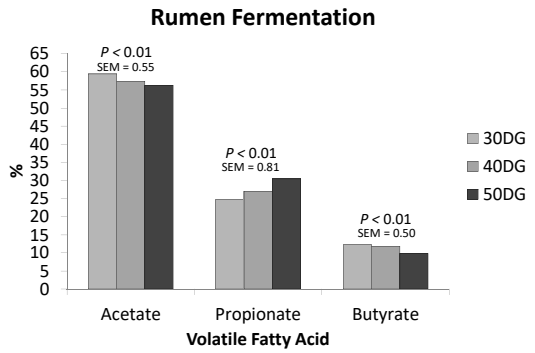
Rumen Fermentation

	Treatment[1]				*P-value*[2]				
Item	30DG	40DG	50DG	SEM	Trt	Wk	Trt × Wk	L	Q
pH	6.67	6.54	6.52	0.087	0.42	0.10	0.46	0.22	0.60
NH_3-N, mg/dL	**15.36**	**17.04**	**19.27**	**0.850**	0.03	0.52	0.25	**<0.01**	0.84
Total VFA, mM	73.1	73.2	74.2	2.430	0.93	0.09	0.08	0.73	0.88

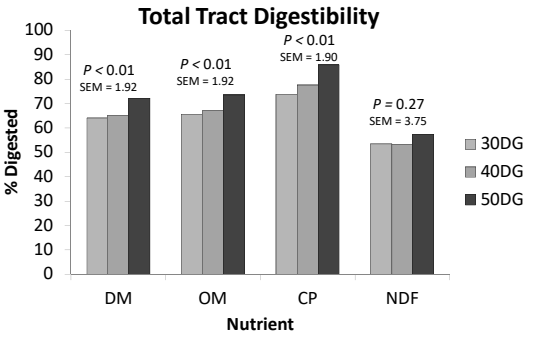
[1]30% dietary inclusion rate of DDGS (30DG); 40% dietary inclusion rate of DDGS (40DG); 50% dietary inclusion rate of DDGS (50DG).

[2]Significance of effects for treatment (Trt), week (wk), treatment × week (Trt × wk), and linear (L) and quadratic (Q) orthogonal contrasts.

South Dakota State University
College of Agriculture and Biological Sciences



SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences

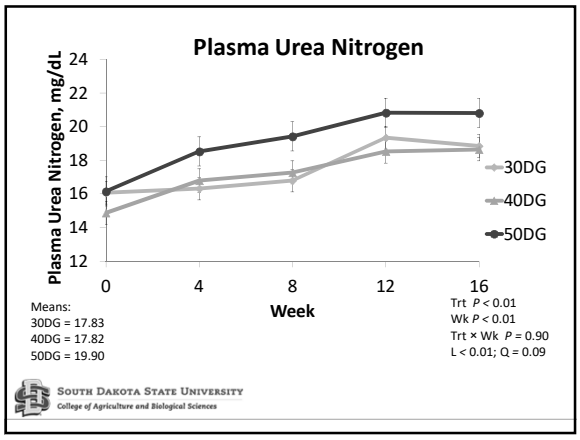


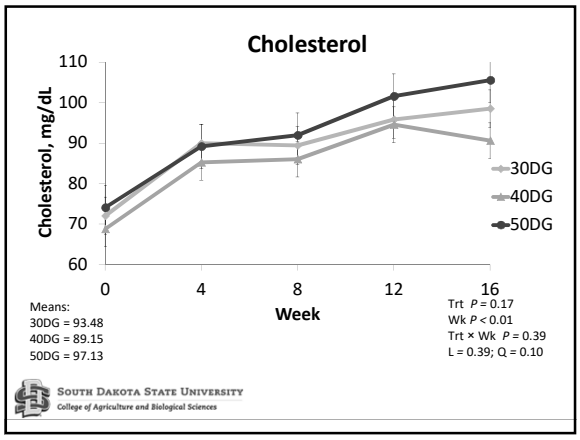
SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences

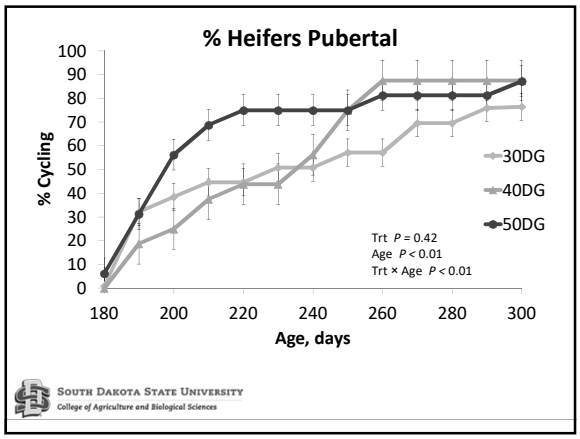
Plasma Metabolites and Hormones

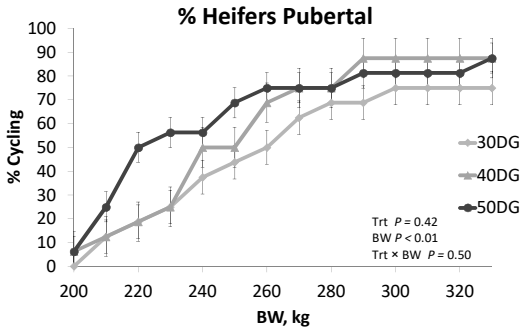
- **No differences in**
  - Glucose
  - Insulin
  - IGF-1
  - Leptin
  - Triglycerides
- Shifts in plasma fatty acid profile

SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences


Plasma Urea Nitrogen
Plasma Urea Nitrogen, mg/dL
24
22
20
18
16
14
12
0
4
8
12
16
Week
30DG
40DG
50DG
Means:
30DG = 17.83
40DG = 17.82
50DG = 19.90
Trt P < 0.01
Wk P < 0.01
Trt × Wk P = 0.90
L < 0.01; Q = 0.09
South Dakota State University
College of Agriculture and Biological Sciences


Cholesterol
Cholesterol, mg/dL
110
100
90
80
70
60
0
4
8
12
16
Week
30DG
40DG
50DG
Means:
30DG = 93.48
40DG = 89.15
50DG = 97.13
Trt P = 0.17
Wk P < 0.01
Trt × Wk P = 0.39
L = 0.39; Q = 0.10
South Dakota State University
College of Agriculture and Biological Sciences


% Heifers Pubertal
% Cycling
100
90
80
70
60
50
40
30
20
10
0
180
200
220
240
260
280
300
Age, days
30DG
40DG
50DG
Trt P = 0.42
Age P < 0.01
Trt × Age P < 0.01
South Dakota State University
College of Agriculture and Biological Sciences



South Dakota State University
College of Agriculture and Biological Sciences

Post study - Reproductive Performance

	Treatment[1]				*P-value*[2]		
Item	30DG	40DG	50DG	SEM	Trt	L	Q
Age at first service, d	411.5	413.6	399.0	5.13	0.09	0.08	0.19
Age at conception, d	412.6	413.3	434.8	25.8	0.51	0.31	0.59
AI service, no.	1.80	1.61	2.17	0.75	0.52	0.45	0.39
Age at calving, d	698.2	682.9	715.2	25.1	0.34	0.44	0.20

[1]30% dietary inclusion rate of DDGS (30DG); 40% dietary inclusion rate of DDGS (40DG); 50% dietary inclusion rate of DDGS (50DG).
[2]Significance of effects for treatment (Trt) and linear (L) and quadratic (Q) orthogonal contrasts.

South Dakota State University
College of Agriculture and Biological Sciences

Study Summary

- Can feed DDGS at very high inclusion rates to dairy heifers
  - Maintained growth performance
  - Improves gain to feed
  - Changes in metabolic profile and some shifts in puberty
  - Limited effects on post-trial performance
- Note: Need to be aware of drinking water Sulfur content

South Dakota State University
College of Agriculture and Biological Sciences

Component Feeding Distillers grains

Growth performance, rumen fermentation, nutrient utilization, and metabolic profile of heifers limit-fed distillers dried grains with ad libitum forage

(Angie Manthey, Ph.D.)

Experimental Design

- **Two treatment diets:**
  - Corn and soybean product concentrate mix (**CON**)
  - Distillers grains concentrate mix (**DDG**)
  - Both treatments fed ad libitum grass hay
- **Twenty-four heifers (18 Holstein, 6 Brown Swiss)**
  - Randomized Complete Block Design
  - Blocks of 2 heifers by breed, size, and age
  - 12/treatment diet
- **4 month feeding period**
  - 2 wk adaptation, 16 wk feeding
  - Fed from 6 to 10 months of age

South Dakota State University
College of Agriculture and Biological Sciences

Diet Formulation

Item, % DM[1]	CON	DDG
Grass hay- estimated	68.5	68.5
DDGS	0.0	**30.0**
Ground corn	**12.0**	0.0
SBM	**8.12**	0.0
Expellers SBM	**6.27**	0.0
Soyhulls	**3.65**	0.0
Vitamins and Minerals[1]	1.5	1.5

[1]Contained: 50% vitamin and mineral mix, 25% calcium carbonate, and 25% salt.

South Dakota State University
College of Agriculture and Biological Sciences

Diet Intake Composition

	Treatment			*P-values*[2]
Nutrient, %	**CON**	**DDG**	**SEM**	**Trt**
DM	89.20	89.800	0.100	<0.01
CP	15.60	15.000	0.400	0.26
NDF	55.60	62.400	0.800	**<0.01**
ADF	31.50	33.100	0.530	0.04
EE	02.21	04.450	0.095	**<0.01**
NFC	29.20	19.900	0.400	**<0.01**
Starch	10.80	01.630	0.420	**<0.01**

[1]Based on heifer intakes.
[2]Trt × wk interactions were insignificant.

South Dakota State University
College of Agriculture and Biological Sciences

Nutrient Intake Amount

	Treatment			*P-values*
Nutrient, kg/d	**CON**	**DDG**	**SEM**	**Trt**
CP	0.97	0.97	0.027	<0.67
NDF	**3.62**	**4.15**	**0.199**	**<0.07**
ADF	2.04	2.21	0.114	<0.33
EE	**0.14**	**0.29**	**0.007**	**<0.01**
NFC	**1.85**	**1.33**	**0.052**	**<0.01**
Starch	**0.66**	**0.10**	**0.014**	**<0.01**

[1]Based on heifer intakes.
[2]Trt × wk interactions were insignificant.

South Dakota State University
College of Agriculture and Biological Sciences

Body Weight and Feed Efficiency

	Treatment			*P-values*	
Item	**CON**	**DDG**	**SEM**	**Trt**	**Trt × wk**
BW, kg					
Mean	269.3	266.3	09.84	0.83	0.57
Initial	229.9	229.6	04.01	0.92	
Final	320.8	317.7	10.11		
ADG, kg/d	**000.99**	**000.96**	**0 0.050**	**0.73**	**0.27**
DMI, kg/d					
Mean	006.40	006.62	00.26	0.57	0.63
Final	007.70	008.18	00.41		
Gain: Feed	**000.168**	**000.156**	**000.0099**	**0.39**	**0.24**

South Dakota State University
College of Agriculture and Biological Sciences

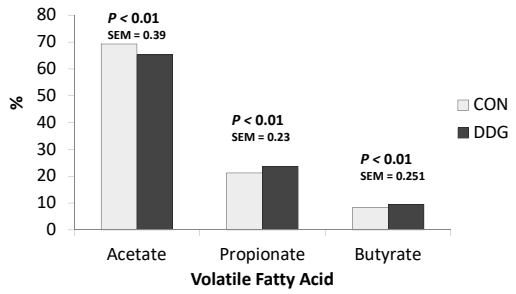
Frame Growth and BCS

	Treatment			*P-values*	
Item	**CON**	**DDG**	**SEM**	**Trt**	**Trt × wk**
Withers height, cm	119.20	119.20	0.390	0.97	0.28
Hip height, cm	123.30	122.80	0.380	0.37	0.68
Heart girth, cm	140.60	139.90	0.400	0.28	0.43
Paunch girth, cm	179.20	178.20	0.900	0.41	0.92
Body length, cm	117.50	117.30	0.920	0.86	0.77
Hip width, cm	036.70	036.20	0.710	0.65	0.95
BCS[1]	003.10	003.11	0.026	0.68	0.62

[1] Body Condition Score: 1= emaciated and 5=obese (Wildman et al., 1982)

South Dakota State University
College of Agriculture and Biological Sciences

Rumen Fermentation

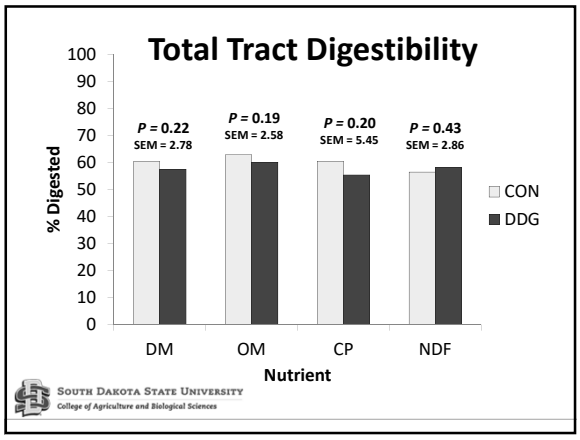


South Dakota State University
College of Agriculture and Biological Sciences

Metabolic Profile

	Treatment			*P-values*	
Item	**CON**	**DDG**	**SEM**	**Trt**	**Trt × wk**
Cholesterol, mg/dL	81.10	102.20	03.880	<0.01	0.45
Glucose, mg/dL	75.20	071.70	01.280	<0.07	0.81
Insulin, ng/mL	00.55	000.70	00.041	<0.01	0.15
PUN, mg/dL	12.50	011.60	00.310	<0.06	0.64
Triglycerides, mg/dL	19.60	021.00	00.950	<0.34	0.97

South Dakota State University
College of Agriculture and Biological Sciences



Study Conclusion

DDGS can be limit-fed as the primary concentrate ingredient with ad libitum grass hay to:

- Maintain growth performance and energy status
  - Despite changes in metabolic profile
- Maintain dry matter intake and gain: feed
- Maintain nutrient digestibility

South Dakota State University
College of Agriculture and Biological Sciences

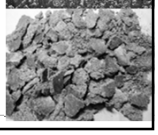
How do other types of alternative protein sources compare to the DDGS?

South Dakota State University
College of Agriculture and Biological Sciences

Introduction

Camelina (*Camelina sativa)* & Carinata (*Brassica carinata)*

- *Brassica* family includes canola, cabbage, mustard
- Non-food oil seeds – used for biodiesel production
- Good Agronomy characteristics for great plains
- Healthful fatty acids
- Co-product is value as animal feeds?
  - Good protein
  - Concern with glucosinolates

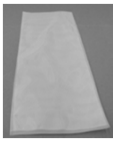


South Dakota State University
College of Agriculture and Biological Sciences

Materials and Methods

Rumen in situ

- Five grams of each sample were incubated in replicates
  - 10x20 cm dacron bags
  - Incubation time: 0, 2, 4, 8, 12, 24, and 48 h.
  - Hour 12 included six extra replicates for in vitro procedure



South Dakota State University
College of Agriculture and Biological Sciences

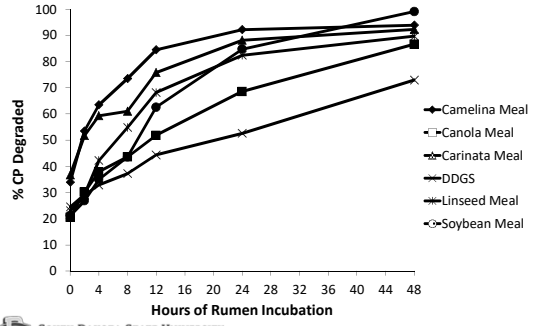
Test Feed Nutrient Composition

Item[1]	Camelina Meal*	Carinata Meal	Canola Meal	DDGS	Linseed Meal	Soybean Meal
DM, %	**92.3**	**92.9**	96.4	96.1	89.0	97.8
CP	**37.7**	**44.3**	44.0	32.8	39.0	51.1
Fat	**14.3**	**2.1**	2.8	8.7	4.0	1.8
NDF	**25.7**	**23.7**	28.1	24.4	27.1	9.0
Ash	**5.0**	**7.6**	7.8	4.8	6.5	6.8

[1] DM basis
*Mechanically-extracted

South Dakota State University
College of Agriculture and Biological Sciences

CP Rumen Degradation



South Dakota State University
College of Agriculture and Biological Sciences

CP Rumen Degradation

Item	Camelina Meal	Carinata Meal	Canola Meal	DDGS	Linseed Meal	Soybean Meal	SEM
Total CP, % DM	40.9	43.9	45.3	35.0	40.4	53.9	
CP dis., % CP							
A[1]	36.2[b]	40.7[a]	23.8[c]	24.9[c]	23.4[c]	19.3[d]	0.57
B[2]	56.4[c]	53.4[c]	76.0[ab]	71.2[b]	69.0[b]	80.7[a]	1.65
C[3]	7.4	6.0	0.1	3.9	7.6	0.0	1.73
K_d[4], % h	14.95[a]	7.64[b]	3.54[cd]	2.23[d]	7.30[b]	5.70[bc]	0.459
RDP[5], % CP	76.4[a]	70.5[b]	52.0[d]	44.1[e]	61.2[c]	58.4[c]	0.95

[1]Soluble CP; [2]Potentially degradable CP; [3]Undegradable CP; [4]Rate of CP degradation; [5]Ruminally degradable protein (RDP). [abcd] Values with unlike superscripts differ by *P < 0.05* using Tukey's Test.

South Dakota State University
College of Agriculture and Biological Sciences

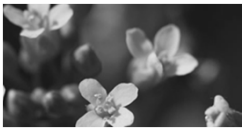
CP Intestinal digestibility

Item[1]	Camelina Meal	Carinata Meal	Canola Meal	DDGS	Linseed Meal	Soybean Meal	SEM
RUP[2]	23.6[e]	29.4[d]	48.0[b]	55.9[a]	38.8[c]	41.6[c]	0.95
IDP[3], % of RUP	80.9[b]	80.9[b]	70.9[c]	63.2[c]	81.6[b]	90.5[a]	2.61
IADP[4]	19.1[c]	23.8[c]	34.0[ab]	35.4[ab]	31.7[b]	37.6[a]	1.42
TDP[5]	**95.5[a]**	**94.4[a]**	**86.0[b]**	**79.5[c]**	**92.9[a]**	**96.0[a]**	**1.22**

[1] % of CP, unless otherwise noted; [2]Ruminally undegradable protein (RUP); [3]Estimated intestinal digestible protein (IDP) after 12h rumen incubation and pepsin-pancreatin digestion; [4]Intestinally absorbable digestible protein (IADP) = Rumen undegradable protein (RUP, % of CP) × intestinal CP digestion (% of RUP); [5]Total Digestible Protein (TDP) = RDP + IADP. [abcde] Values with unlike superscripts differ by *P < 0.05* using Tukey's test.

South Dakota State University
College of Agriculture and Biological Sciences

Evaluation of camelina meal as a feedstuffs for growing dairy heifers



(Rhea Lawrence, M.S)

South Dakota State University
College of Agriculture and Biological Sciences

Materials and Methods

Experimental Design

- **Forty two heifers – 33 Holstein, 9 Brown Swiss**
  - Start age 144.8 ± 22 d, BW 171.8 ± 24.3 kg
  - (4 heifers dropped)
- **Randomized complete block design**
  - Blocked by breed and age in groups of 3
  - Staggered start dates by block (June 2014- March 2015)
- **Experimental period**
  - 2 wk adaptation, 12 wk feeding
- **Three treatment diets: 10% of diet as test feed**

1)Camelina Meal 2)Linseed Meal 3)DDGS

South Dakota State University
College of Agriculture and Biological Sciences

Formulated Diets

Ingredients, % DM[1]	CAM	DDGS	LIN
Grass Hay	60.01	60.02	60.02
Corn, Ground	23.96	22.07	22.46
Camelina Meal	**10.00**	**-**	**-**
DDGS	**-**	**10.00**	
Linseed Meal	**-**		**10.00**
Soybean Meal	4.53	6.41	6.00
Vit and Min Pre-mix	1.00	1.00	1.00
Limestone	0.30	0.30	0.30
Salt	0.21	0.21	0.21

[1]Based on Dairy NRC software (2001). Fed at 2.65% of BW

South Dakota State University
College of Agriculture and Biological Sciences

Diet Nutrient Composition

Item, % DM [1]	CAM	SE	DDGS	SE	LIN	SE
DM	87.3	0.50	87.3	0.50	86.9	0.50
CP	**12.5**	**0.30**	**12.5**	**0.29**	**12.9**	**0.29**
NDF	44.9	0.51	44.9	0.48	44.8	0.48
ADF	25.4	0.47	24.8	0.48	25.6	0.44
EE	3.3	0.16	2.5	0.11	2.0	0.14
NFC	32.0	0.60	32.7	0.53	32.7	0.55
ME, Mcal/kg[2]	2.3	-	2.2	-	2.2	-
NEg, Mcal/kg[2]	0.80	-	0.75	-	0.76	-
Glucosinolates[3], mg/g	1.2		-		-	

[1] % DM unless otherwise indicated, based on results from analysis of monthly composites; [2] Calculated by nutrient analysis input into NRC formulation; [3]DDGS and LIN do not contain glucosinolates

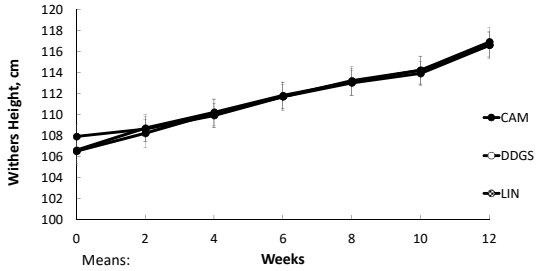
Intakes and Feed Efficiency

	Treatment				*P- values*		
Item	**CAM**	**DDGS**	**LIN**	**SEM**	**Trt**	**Week**	**Trt ×Week**
n	12	13	13				
Body Weight, Kg							
Mean	199.5[c]	205.4[b]	211.4[a]	2.85	<0.01	<0.01	0.97
ADG[1], Kg/d	**0.67**	**0.76**	**0.75**				
ADG[2], Kg/d	**0.65[y]**	**0.72[xy]**	**0.80[x]**	**0.044**	**0.10**	**<0.01**	**0.47**
DMI, Kg/d							
Mean	4.9[b]	5.1[a]	4.9[b]	0.15	0.02	<0.01	0.97
Gain: Feed	**0.14[b]**	**0.15[b]**	**0.17[a]**	**0.006**	**<0.01**		

[1]Calculated using regression analysis of body weight by day;
[2]Calculated using biweekly BW.

South Dakota State University
College of Agriculture and Biological Sciences

Withers Height

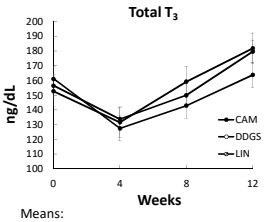


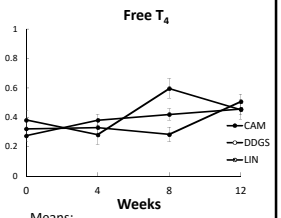
Means:
CAM = 112.3
DDGS = 115.5
LIN = 115.9

Trt *P* = 0.83
Wk *P*= < 0.01
Trt × Wk= 1.00

South Dakota State University
College of Agriculture and Biological Sciences

Metabolic Hormones





Means:
CAM = 144.7[y]
DDGS = 157.5[x]
LIN = 154.5[xy]

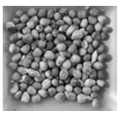
Trt *P* = 0.09
Wk *P*= < 0.01
Trt × Wk= 0.81

Means:
CAM = 0.44
DDGS = 0.42
LIN = 0.37

Trt *P* = 0.65
Wk *P*= 0.16
Trt × Wk= 0.24

South Dakota State University
College of Agriculture and Biological Sciences

Evaluation of carinata meal as feedstuffs for growing dairy heifers



Karla Rodriguez-Hernandez, Ph.D.

South Dakota State University
College of Agriculture and Biological Sciences

Materials and Methods

Experimental Design

- **24 Holsteins**
  - 6.5-10.5 months
- **Randomized complete block design**
  - Blocked by breed and age in groups of 2
- **Experimental period**
  - 2 wk adaptation, 16 wk feeding
- **Two treatment diets: 10% of diet as test feed**

  1)Carinata meal 2)DDGS

South Dakota State University
College of Agriculture and Biological Sciences

Carinata Meal

Ingredients, % DM	CRM	DDGS
Grass Hay	63.53	63.53
Corn, Ground	14.51	13.01
Carinata Meal	**10.00**	**-**
DDGS	**-**	**10.00**
Soybean Meal	10.51	12.01
Vitamin and mineral pre-mix	0.65	0.65
Calcium carbonate	0.40	0.40
Salt	0.40	0.40

Both diet were limit-fed at 2.65% of Body Weight.

South Dakota State University
College of Agriculture and Biological Sciences

Carinata Meal – Results

Item	CRM	DDGS	SEM	P- values
Body weight, **lbs**	595.0	592.8	3.1	0.60
Withers height, in	48.3	48.2	0.2	0.46
Body condition score	3.01	2.99	0.01	0.47
ADG, lbs/d	**1.84**	**1.82**	**0.07**	**0.76**
Dry Matter Intake, lbs/d	14.4	14.1	0.3	0.58
Gain: feed	0.131	0.130	0.004	0.93

Laboratory analysis still in progress – but initial growth performance shows potential

South Dakota State University
College of Agriculture and Biological Sciences

Conclusions- Oilseed Meals

- The protein in camelina meal and carinata meal is highly degradable and digestible (comparable to SBM) by dairy cattle
- Dairy heifers fed camelina meal had comparable growth performance to heifers fed linseed meal and DDGS at 10% of diet
- Glucosinolates appear to have some affect on thyroid hormones and may prevent camelina-fed heifers from having better performance
- Carinata meal can also be fed at 10% of heifers diets compared to DDGS

South Dakota State University
College of Agriculture and Biological Sciences

Overall Conclusions

What are the take home points?

South Dakota State University
College of Agriculture and Biological Sciences

Implications

- Distillers grains can be fed at high inclusions in dairy heifer rations and used in a variety of feeding strategies
- Dietary fat provided from distillers grains may be beneficial to developing heifers
- Distillers grains is a good source of RUP and TDP
- New oilseed meals are other potential protein sources for heifers and can be included at 10% of diet DM.

South Dakota State University
College of Agriculture and Biological Sciences

Acknowledgements

- Drs. Kalscheur, Garcia, Schingoethe, Hippen, Perry, and Clapper
- Students: Angie Manthey, Rhea Lawrence, Karla Rodriguez-Hernandez and others.
- This work was supported by:
  - SDSU Ag Experiment Station
  - AgriKing Inc. Fulton, IL
  - USDA-ARS Agreement No. 58-5447-7-322
  - SDSU ABS Undergraduate Research Awards
  - Minnesota Corn Research and Promotion Council (Minnesota Corn Growers) and MN AURI
  - South Dakota Oilseed Initiative

South Dakota State University
College of Agriculture and Biological Sciences

References

1. Anderson, J. L., D.J. Schingoethe, K.F. Kalscheur, and A.R. Hippen. 2006. Evaluation of dried and wet distillers grains included at two concentrations in the diets of lactating dairy cows. J. Dairy Sci. 89: 3133-3142.
2. Cao, Z.J., J. L. Anderson, and K.F. Kalscheur. 2009. Ruminal degradation and intestinal digestibility of dried or wet distillers grains with increasing concentrations of condensed distillers solubles. J. Anim Sci. 87: 3013-3019.
3. Anderson, J. L., K.F. Kalscheur, A.D. Garcia, D.J. Schingoethe and A.R. Hippen. 2009. Ensiling characteristics of wet distillers grains mixed with soybean hulls and evaluation of the feeding value for growing Holstein heifers. J. Anim Sci. 87: 2113-2123.
4. Anderson, J. L. 2012. Growth, nutrient utilization, metabolic profile, and long term performance of dairy heifers fed distillers grains. Ph.D. Dissertation. South Dakota State University.
5. Anderson, J. L, K.F. Kalscheur*, A.D. Garcia, and D.J. Schingoethe. 2015. Feeding fat from distillers dried grains with solubles to dairy heifers: I. Effects on growth performance and total tract digestibility of nutrients. J. Dairy Sci. 98: 5699-5708.
6. Anderson, J. L.*, K.F. Kalscheur, J.A. Clapper, G.A. Perry, D. H. Keisler, A.D. Garcia, and D.J. Schingoethe. 2015. Feeding fat from distillers dried grains with solubles to dairy heifers: II. Effects on metabolic profile. J. Dairy Sci. 98: 5709-5719
7. Anderson, J. L.*, K. F. Kalscheur, A. D. Garcia, and D. J. Schingoethe. 2015. Short Communication: Feeding fat from distillers dried grains with solubles to dairy heifers: III. Effects on post-trial reproductive and lactation performance. J. Dairy Sci. 98: 5720-5725.
8. Anderson, J. L., K. F. Kalscheur*, A. D. Garcia, D. J. Schingoethe, D. P. Casper, and D. H. Kleinschmit. 2015. Ensiling characteristics of distillers wet grains with cornstalks and determination of the feeding potential for dairy heifers. Prof. Anim. Sci. 31: 359-367.
9. Lawrence, R. D., J. L. Anderson, T. J. Vanderwerf, A. K. Manthey, K. F. Kalscheur, and D. P. Casper. 2014. Growth performance and total tract nutrient digestion for Holstein heifers precision-fed diets high in distillers grains with different forage particle size. J. Dairy Sci. 97: E-Suppl.1: 825 (Abstr. T299). (JAM ASAS/ADSA)
10. Lawrence, R. D. and J. L. Anderson. 2015. Ruminal degradation and intestinal digestibility of camelina and carinata meal compared to other protein sources. J. Dairy Sci. 98: Suppl. 2: 459 (Abstr. T416). (JAM ASAS/ADSA)

South Dakota State University
College of Agriculture and Biological Sciences

References (cont)

11. Lawrence, R. D., J. L. Anderson*, and J. A. Clapper. 2016. Evaluation of camelina meal as a feedstuff for growing dairy heifers. J. Dairy Sci. 99: 6215–6228.
12. Manthey, A. K., J. L. Anderson*, and G.A. Perry. 2016. Feeding distillers dried grains in replacement of forage in limit-fed dairy heifer rations: Effects on growth performance, rumen fermentation, and total tract digestibility of nutrients. J. Dairy Sci. 99:7206–7215.
13. Manthey, A. K., J. L. Anderson*, G.A. Perry and D.H. Keisler. *TBD*. Feeding distillers dried grains in replacement of forage in limit-fed dairy heifer rations: Effects on metabolic profile and onset of puberty. J. Dairy Sci. *In-review*.
14. Manthey, A. K, and J. L. Anderson. 2016. Growth performance of dairy heifers limit-fed distillers dried grains with ad libitum forage. J. Dairy Sci. 99: E-Suppl. 1: 669 (Abstract 1405). (JAM ASAS/ADSA)
15. Rodriguez-Hernandez, K. and J. Anderson. 10/24/2016. Carinata Meal: Potential as a feedstuff for growing dairy heifers. iGrow.org- Livestock – Dairy – Innovation/Research. http://igrow.org/livestock/dairy/carinata-meal-potential-as-a-feedstuff-for-growing-dairy-heifers/
16. Wild, B. J., J. L. Anderson, and A. D. Garcia. 2015. Ruminal degradability and intestinal digestibility of crude protein in sorghum distillers dried grains compared to soybean meal and corn co-products. J. Dairy Sci. 98: Suppl. 1:158 (Abstr. 355). (Midwest ASAS/ADSA)