Impacts of Distillers Grains in Cheese Quality

Stephanie Clark, PhD; Donald Beitz, PhD; PhD, Vaishnavi Manimana Sankarlal (MS)
Eric Testroet (PhD candidate), Matthew O'Neil (PhD student)

IOWA STATE UNIVERSITY
Food Science and Human Nutrition

PROBLEM

- **Cheese producer complaints of unwanted gas formation ("late blowing" in cheese)**
  - Source of problems *hypothesized* to be distillers grains
    - Heat-resistant spores

http://www.realagriculture.com/

TWO CONTROLLED STUDIES

- **Milk composition and cheese quality: investigating the impact of distillers dried grains with solubles (DDGS)**
- **Reduced fat DDGS feeding: Investigating impact on milk composition and cheese quality**

Investigator and M.S. student at Lincoln Way Energy, Iowa

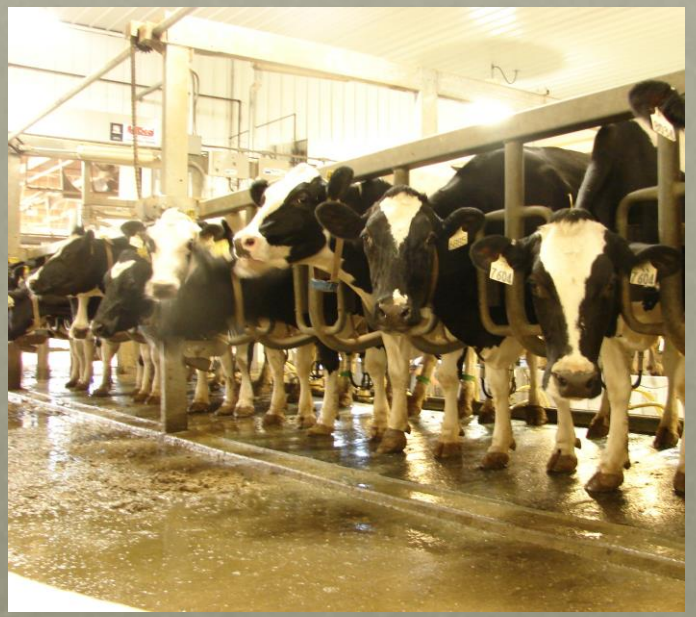
STUDY DESIGN

- 24-36 mid-lactation multiparous Holstein dairy cows received each of 2 or 3 diets
  - **Total mixed ration (TMR)** (both studies)
  - 10% of dry matter in TMR as 10% DDGS (1st study)*
  - **20% of DM in TMR as 20% DDGS***
    - Mean 13% fat (1st study)
    - Mean 6.5% fat (2nd study)
- **Isoenergetic, isonitrogenous diets**
  - Contained similar available amino acid concentrations
  - Individual Calan® gate feeding
    - feed intake recorded

*in place of soybean meal

STUDY DESIGN

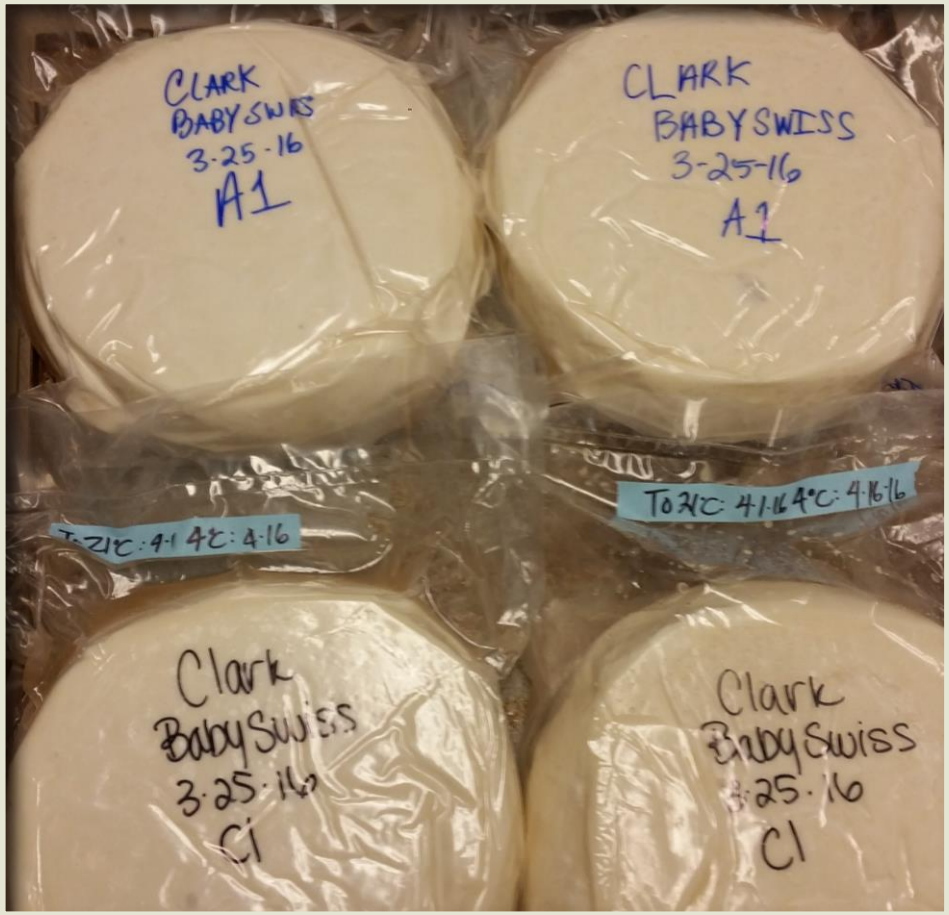
- **Cross-over design**
  - 2 treatment periods (35 days)
  - Each cow served as her own control
- **Milk collected for analysis**
  - Weekly
  - Individual cows
    - Proximate analyses
      - Fat, protein, total solids, lactose
    - Fatty acid analysis



CHEESE STUDY DESIGN

- **Pooled milk taken to ISU CCUR pilot plant for processing**
  - Allowed 3-week acclimation to diets
    - Weeks 4 & 5
- Pooled milk
  - Baby Swiss cheese production
    - 24-hour process
  - 6 cows per “batch”
    - 2 batches per day
    - At least 12 distinct batches of cheese

RESULTS


CLARK
BABY SWISS
3-25-16
A1
CLARK
BABY SWISS
3-25-16
A1
To 2°C: 4-1 4°C: 4-16
To 2°C: 4-16 4°C: 4-16
Clark
Baby Swiss
3-25-16
C1
Clark
Baby Swiss
3-25-16
C1

STUDY 1: FULL-FAT DDGS MILK PROXIMATE ANALYSIS

Component	0% DDGS	10% DDGS	20% DDGS
Fat	3.45[a]	2.94[b]	2.67[b]
Lactose*	5.07[b]	5.15[a]	5.17[a]
Protein	3.58[b]	3.62[ab]	3.65[a]
Solids non-fat	9.33[b]	9.47[ab]	9.55[a]

[a, b] Values not sharing the same superscript, within a row, differ significantly ($p < 0.05$)

* Lactose determined by algorithm built into LactiCheck device (difference mathematically exaggerated?). NOTE: lactose measured chemically in study 2.

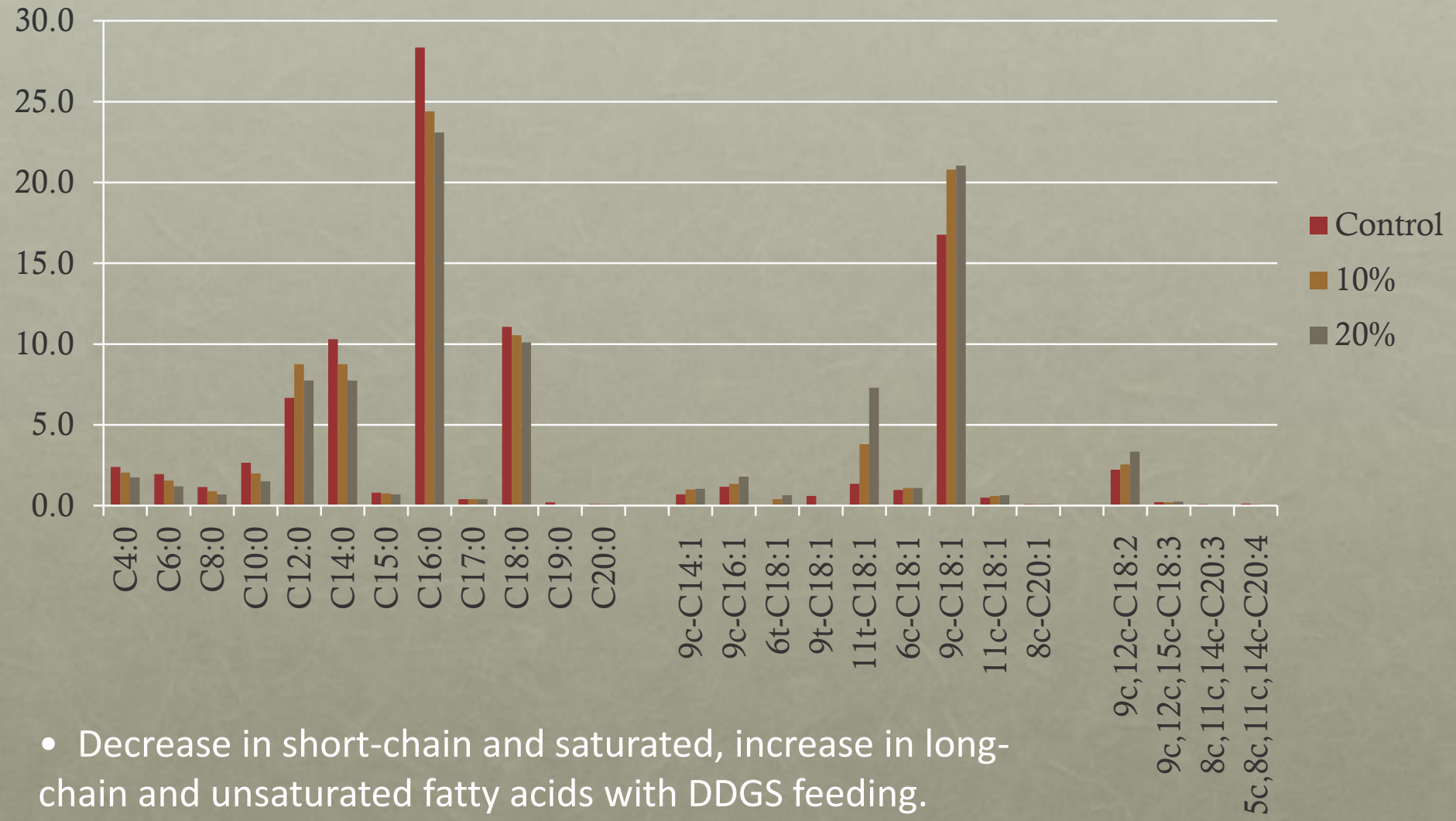
STUDY 1: FULL-FAT DDGS CHEESE PROXIMATE ANALYSIS

LEVELS	0% DDGS	10% DDGS	20% DDGS
Cheese pH	5.15	5.14	5.13
Moisture	41.28	41.67	41.36
Fat	30.18	29.70	29.50
Fat in solids	51.37	50.92	50.33
Protein	23.83	23.60	24.13

No significant differences found based upon diet or period ($P > 0.05$)

NOTE: All cheeses within typical standard of identity for Baby Swiss Cheese

Study 1: Fatty Acid Composition of Baby Swiss Cheese from Full-Fat DDGS



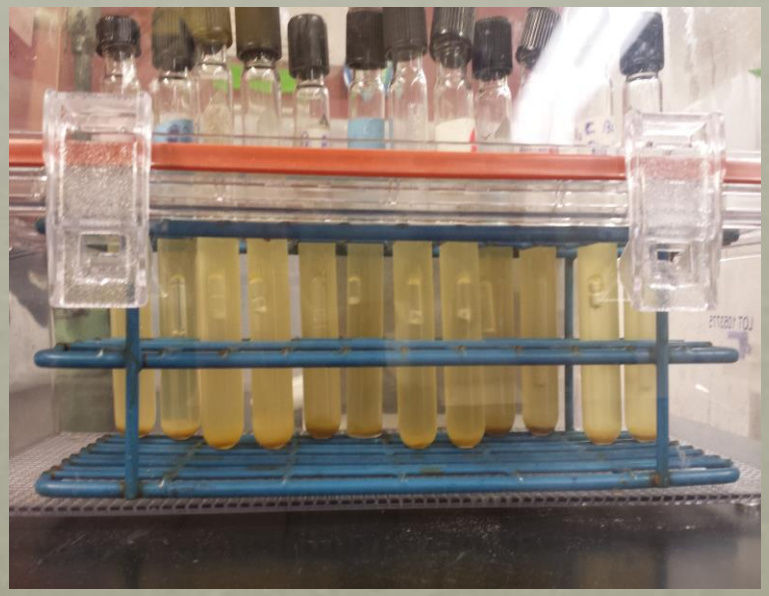
- Decrease in short-chain and saturated, increase in long-chain and unsaturated fatty acids with DDGS feeding.

Full-fat DDGS cheese sensory analysis

- Baby Swiss cheese characteristics
  - Typical Swiss cheese aroma, including propionic and lactic acid aroma.
  - Glossy round eyes were rarely found.
  - Slits, pin holes, and cracks were evident in all cheeses.
  - Blindness was sometimes exhibited, within 1/2 inch of cheese surface.
  - Body/texture was less rubbery and more soft than expected.
- No diet treatment effect
  - *Suggests either all cheeses were contaminated, and/or cheese pressing (moisture removal) issues.*

STUDY 1: FULL-FAT DDGS MICROBIOLOGY

Sample	Gas formation
TMR	Yes
DDGS	No
Milk	Yes
Cheese	Yes
Manure	Yes



Manure samples showing gas formation

- Results confirm milk contamination was an issue
  - TMR or the cow environment was the source for gas-forming spores, *not* DDGS
  - *Antimicrobials effect of DDGS?*

ANTIMICROBIAL TESTING OF DDGS^

- 17 antibiotics quantified
  - All below detection limit in DDGS and milk
- No antimicrobial effect of DDGS against:
  - 5 spoilage microorganisms
  - 3 pathogenic organisms (plus 1 Listeria surrogate)
  - 2 lactic acid bacteria used in cheese making
- Take-home: this source of DDGS can be used as livestock feed without the fear of inadvertent feeding of antibiotics

^Sankarlal, Testroet, Beitz and Clark. 2015. Short communication: No antimicrobial effects from one source of commercial dried distillers grains with solubles. J. Dairy Sci. 98: 8554-8559.

STUDY 1: CONCLUSIONS

- Feeding 10% and 20% DDGS decreased % fat but increased polyunsaturated fatty acids, % SNF, % lactose and % protein in milk.

- The DDGS source used for this research did not contain spore-forming, gas-producing bacteria or antimicrobial properties.
- Gas-forming bacteria found in cheese likely originated from TMR, or the cow environment, rather than DDGS.
- Feeding DDGS did not cause late blowing defects in cheese.

FOLLOW-UP QUESTIONS

- **How does milk of cows fed reduced-fat DDGS differ from milk of cows fed TMR?**
- Does milk production, metabolic profile, and/or feed efficiency of cows fed reduced-fat DDGS differ from cows fed TMR?*
- **Does cheese made from milk of cows fed reduced-fat DDGS differ from cheese from cows fed TMR?**

*Come see Corn Utilization Technology Conference posters, this June 6-8, St. Louis, MO

STUDY 2: REDUCED-FAT DDGS MILK PROXIMATE ANALYSIS#

Component	Control TMR	20% RF DDGS	P-value
Fat	3.70	3.63	0.18
Lactose	4.73	4.70	0.78
Protein	3.05[a]	3.15[b]	<0.0001
Total solids	12.32	12.37	0.58

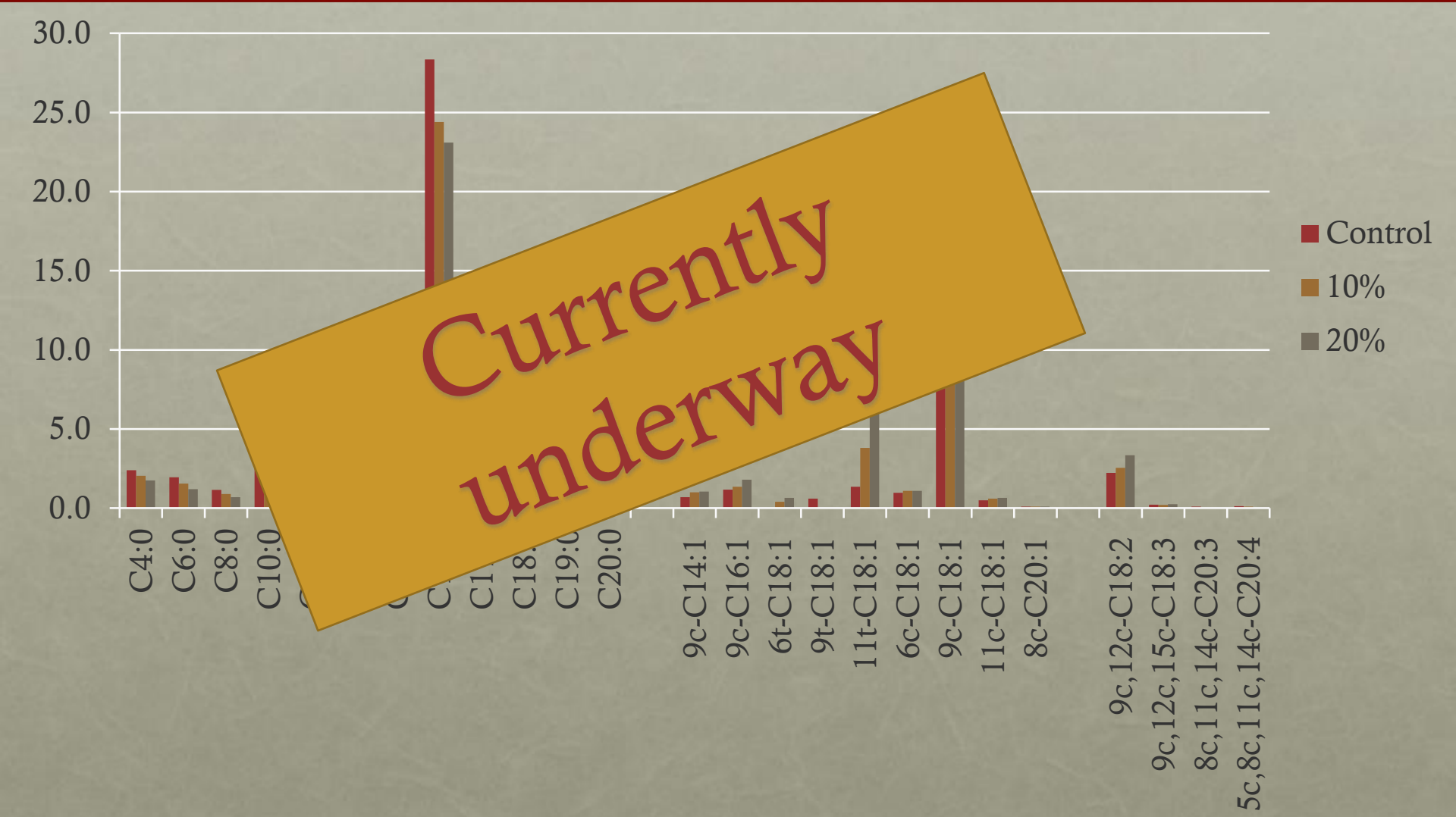
#Analyses conducted at Dairyland Laboratories, Inc.

[a, b] Values not sharing the same superscript, within a row, differ significantly ($p < 0.05$)

Additional notes:

- total milk fat, total protein, and total lactose production per day (kg/d) ALSO did not differ by diet ($p > 0.05$).
- milk urea nitrogen was lower when cows were fed DDGS ($p < 0.05$); better protein utilization.

STUDY 1: FATTY ACID COMPOSITION OF BABY SWISS CHEESE FROM FULL-FAT DDGS



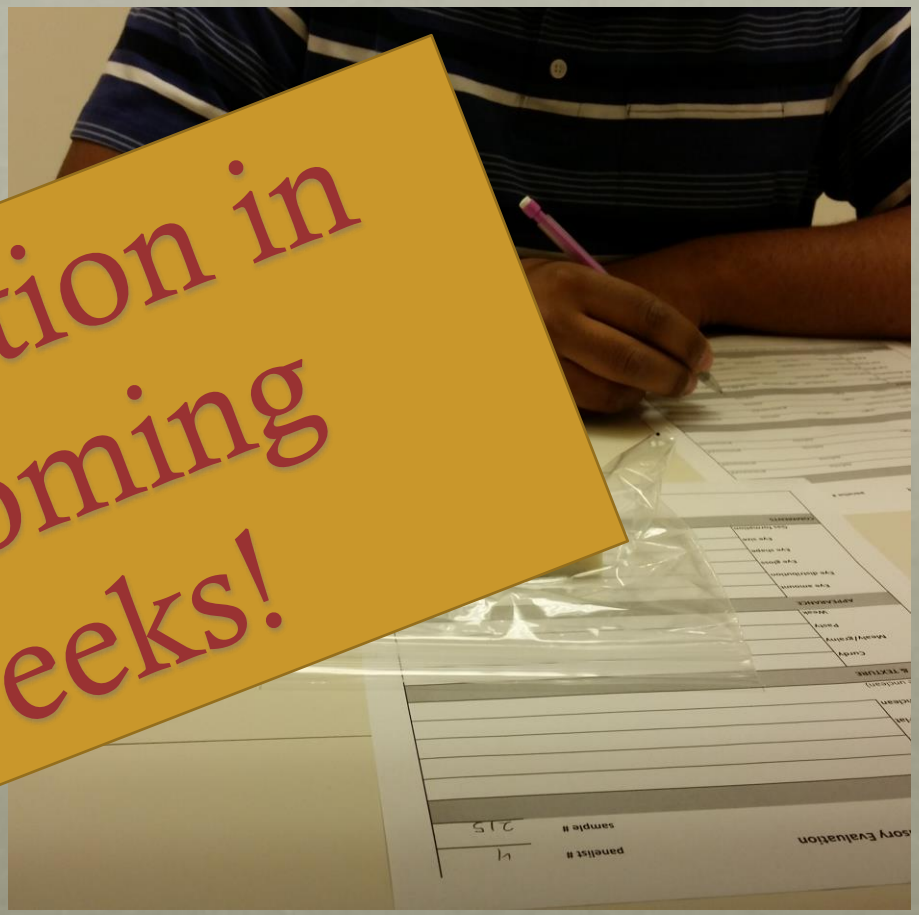
Study 2: Reduced-Fat DDGS Cheese Proximate Analysis^

Component	Control TMR	20% R[illegible]DDGS
Cheese pH		
Moisture		
Fat		
Fat in solids		
Protein		

Begins next week!

^Analysis conducted by collaborators at South Dakota State University after 60 days aging

Reduced-fat DDGS cheese sensory analysis^



Evaluation in upcoming weeks!

^ 14 specific quality attributes evaluated by trained panelists (>5 hr training) at Iowa State University after 60 days aging.

Reduced-Fat DDGS Cheese Sensory Analysis

- Appearance (to date)
  - All cheeses:
    - a lot of small eyes (overset)
    - some irregular-shaped eyes
  - Some cheeses:
    - Slits (atypical gas formation)
      - Microbial analysis yet to be conducted
  - Differences in cheese appearance do not seem to be associated with one particular diet

Reduced-fat DDGS cheese sensory analysis

- Aroma and Flavor (to date)
  - Typical for baby Swiss
    - nutty aroma and flavor
    - slightly bitter
- Body a
  - Typica
    - firi
- No apparent effect of diet on aroma, flavor, body or texture

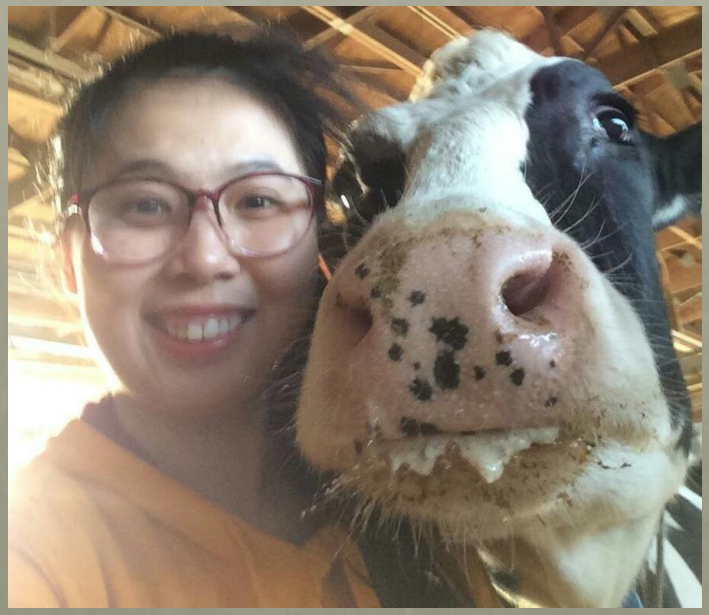
Ongoing in coming weeks!

STUDY 2: CONCLUSIONS

- **Reduced-fat DDGS can be effectively fed at a 20% (dry matter) inclusion rate without having negative effects on:**
  - Milk composition (fat, protein, lactose)
  - Production of milk components (lb/day)
  - Baby Swiss cheese appearance
  - Baby Swiss cheese aroma and flavor
  - Baby Swiss cheese body and texture

OVERALL CONCLUSIONS

- **Reduced-fat DDGS appears to be MORE suitable for dairy cattle TMR supplementation than full-fat DDGS.**



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