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Benchmarking & Describing California Dairy Sustainability Metrics

A survey invitation will be hitting San Joaquin Valley dairy mailboxes soon! The California Dairy Research Foundation has funded a project to establish baseline energy and water usage on-farm. An additional part of the project will identify the potential for pipeline extension and/or conversion from flush to scrape manure management systems to improve on-farm nitrogen balances. The information gathered will be important to identify opportunities for improved efficiencies now and in the future. This will be the first survey looking at critical sustainability metrics and on-farm management practices in California. It should take less than 10 minutes of your time. You do not need to identify yourself for your answers to be included. Thanks, in advance, for your cooperation in this important area.

If you have any questions, don't hesitate to contact us: Deanne Meyer (dmeyer@ucdavis.edu) or Jennifer Heguy (jmheguy@ucdavis.edu)

Betsy Karle, UCCE Dairy Advisor, Now Serving Additional Counties in the Sacramento Valley & Northern California

Betsy Karle has expanded her dairy program to encompass Sacramento, Solano, Yolo, Colusa, Sutter, Yuba, Glenn, Butte, Tehama, Shasta, and Siskiyou counties. Her program serves dairy producers and allied industry by conducting research and educational activities that inform on-farm management decisions. Her primary research interests are in dairy calf management, animal health, and environmental stewardship. Current projects include colostrum management, dehorning, pre-weaned calf housing, antibiotic stewardship practices, and alternative manure management practices (AMMP) evaluation. If you have feedback on research and education priorities or would like to get in touch with Betsy, she can be reached at bmkarle@ucanr.edu or 530-865-1156.

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Newsletter Editor:
Jennifer Heguy
UCCE Dairy Advisor
jmheguy@ucdavis.edu
(209)525-6800

Why Sour Cows Won't Make Sweet Milk

Russ Hovey - UC Davis, Anna Sadovnikova - UC Davis & Yani Garcia - University of Sydney

It is no news that stressed cows produce less milk. This stress comes in different forms - heat stress, metabolic stress, reproductive stress, or stress from mastitis. It might seem intuitive that all these influences would cause a high-producing cow to produce less milk - but the question that has remained is not if she will produce less, but why...?

A high-producing cow's udder drives who she is - in just 24 hours, her udder will extract 7lb of glucose from her blood supply that supports the synthesis of lactose and milk fat she will produce into milk. She will also pump some 6,000 gallons of blood through her udder per day to get the job done, and she will extract over 12 gallons of water from that blood to move into milk.

So how does stress suppress milk output? Less blood flow? Less nutrients being sent to the udder? Or is the udder somehow the victim of a changed mental state, reduced digestion, or a drop in feed intake?

To get to the bottom of these questions, a study was conducted at UC Davis to determine how the udder responds to stress, as recently published in Frontiers in Genetics. In this case, however, cows were not stressed from an environmental stressor - rather we injected cows with a single dose of dexamethasone (DEX), a potent form of a stress hormone known as a glucocorticoid. We then monitored their milk production and blood glucose levels over time. The DEX treatment acutely suppressed milk production by approximately 50%. Of note, this reduction in yield occurred while the protein and fat content in milk remained the same (or increased). But there was a pronounced drop in the lactose content of the milk. After a short effect, both yield and lactose output then returned to normal.

Our underlying question was how the udder responded during this hypothetical stress event, and what were the root causes behind the drop in milk production? To answer this, we biopsied each quarter of the udder before and during the response to DEX to capture a small piece of udder tissue. Tissue samples were then analyzed using a method called RNA Sequencing, which allowed the profile for all the genes, some 20,000 of them that are normally "expressed" during milk synthesis, to be analyzed. By examining for any changes across all these genes, we could determine exactly how the milk-producing epithelial cells in the udder were responding to DEX, and the underlying causation.

The outcome from that analysis was very clear-cut. Several genes encoding key molecules in the lactose synthesis pathway were turned down, then restored once the effect of DEX passed. Central to these was a gene coding for the protein alpha-lactalbumin, which is the rate-limiting component for how lactose is made from glucose and galactose. Consistent with the milk composition data above, genes for other pathways involving milk fat and protein synthesis were unchanged. These findings clearly indicate there was a specific suppression of lactose synthesis by the udder in response to a stressor such as DEX.

What might such a strategy achieve? Put simply, the likely outcome is the sparing of glucose in the cow's body and routing it away from the udder's needs. This was also evident in these cows as a short-term increase in the cow's circulating glucose level after DEX. Recent data from the literature indicate that a cow requires approximately 2.2 lb of blood glucose to mount an immune response during mastitis (where she will use about 7 lb per day to produce milk). Therefore, it makes sense that a stressor such as a glucocorticoid can direct glucose needs to the highest priority; in times of disease, the immune system's requirements can be met in preference over milk production. In times of stress or disease, the synthesis of lactose is directed to go on hold.

At the same time, these findings have also opened new insights to how milk components are synthesized, and specifically emphasize that lactose synthesis is independent of milk fat and protein synthesis. We see these findings as also opening the door for new opportunities to control the regulation of different components in milk.

The take home message - be sweet to the dairy cow so she can put all her glucose into her sweet milk!

For full study details, or to see the data presented graphically, please visit the full paper by clicking here, or scanning the QR code with your camera.

How Do Crossbred Angus-Holstein Steers Compare to Purebred Holstein Steers in the Feedlot?

Brooke Latack – UCCE Imperial, Riverside, and San Bernardino & Pedro Carvalho – AgNext, Colorado State University

The Imperial County in California houses over 380,000 head of cattle on feed every year. Most of these cattle are Holstein coming from the California dairy industry. In recent years, there has been an increase in the use of beef semen on dairy cows and heifers, creating an increasing number of beef-on-dairy crossbred cattle. These crossbred cattle are being brought to the feedlots instead of straight Holstein bull calves. This change is being seen not just in the Imperial Valley but all over the US. The National Association of Animal Breeders indicated that there was an increase of 718,000 beef semen units sold for use on dairies from 2021 to 2022. Moreover, a recent survey of California dairies indicated that 81% of respondents used beef semen on their dairy cows (Pereira et al, 2022). While the use of beef semen on dairy animals is increasing due to its potential financial benefit to the dairy farmer, there are not much data to show how those beef-on-dairy offspring will perform in the feedlot. Therefore, our objective was to identify the productivity of Holstein steers versus Angus-Holstein crossbred steers in the feedlot.

Methods:
Sixty purebred Holstein and 60 Angus-Holstein crossbred steers were brought to the UC Desert Research and Extension Center in Holtville, CA at approximately 286 lbs. Cattle were fed a steam-flaked corn-based diet and management was similar to local commercial feedlots. Weights were measured monthly and carcass data were collected at the end of the feeding period (328 days).

Results:
Feedlot growth performance – Overall final weight and average daily gain were not different between the two breeds (**see table on page 4**). However, Angus-Holstein crossbred steers had a 3% less dry matter intake, leading to a gain-to-feed ratio that was 5% greater than the purebred Holstein steers.

Carcass characteristics – Compared to the purebred Holstein steers, the crossbred Angus-Holstein steers had heavier hot carcass weights, greater dressing percentages, greater back fat thickness, larger ribeye area, greater marbling score and greater preliminary yield grade. See the table on page 2 for details. There was no difference between breeds for liver abscesses, pinkeye, or morbidity. ***Continues on page 4…***

Finished purebred Holstein steer (left) and crossbred Angus-Holstein steer (right) one day before harvest

	Holstein	Angus-Holstein
Feedlot growth performance		
Final weight (lbs)	1346	1364
Average daily gain (lbs/d)	3.23	3.28
Dry matter intake (lbs/d) ‡	17.7	17.1
Gain to feed ratio‡	0.182	0.192
Carcass characteristics		
Hot carcass weight (lbs) ‡	825	850
Dressing percentage‡	61.4	62.3
Back fat thickness (in) ‡	0.22	0.36
Ribeye area (in^2) ‡	12.3	13.5
Marbling score‡	4.5	5.4
Preliminary yield grade‡	2.6	2.9
Health		
Liver abscess (%)	5.0	2.0
Pinkeye (%)	12.5	23.3
Morbidity (%)	6.3	7.5

‡ Denotes statistical differences ($P \leq 0.05$) between breeds

Take home:
Angus-Holstein crossbred steers were more feed efficient and had improved carcass characteristics compared to purebred Holstein steers. More research is needed to build larger data sets on the performance of crossbred dairy steers. Currently, we are researching the difference in performance of Angus-Holstein and Charolais-Holstein steers, the two most popular beef breeds to use on dairy cattle, in the feedlot.

Study Invitation: Impact of Selective Dry Cow Therapy Implementation in California Dairy Farms

The UC Davis Dairy Health, Reproduction, and Microbiome team invites collaborators to join us in assessing the impact of selective dry cow therapy (SDCT) in California dairy programs. Our focus will be on mastitis incidence and somatic cell count, health, fertility, and cost-effectiveness. Mastitis is the most widespread and costly disease in the dairy industry, leading to an annual loss of $1.7 billion. A large proportion of antibiotics in the sector are used for mastitis prevention as part of blanket dry cow therapy (BDCT) practices. Consequently, recent research explored SDCT programs that use non-antibiotic treatments, such as teat sealants, for cows with lactation SCCs below 200,000 cells/mL, among other criteria. That research indicates SDCT can be effectively implemented on appropriate dairy farms with good udder health.

However, the studies evaluating the impact of SDCT have been carried out in European, Canadian, and Midwest US research farms, which face different challenges compared to California. Factors like California's hot, dry summers, cool, rainy winters, and open dry lot dairies create a unique environment compared to the free-stall barns and other enclosed facilities used in previous SDCT studies. These differences in climate and facilities have been shown to influence the type and incidence of pathogens in dairy herds.

Therefore, it is crucial to examine the effects of adopting SDCT in California dairy farms concerning udder health, antimicrobial usage, antimicrobial resistance, and overall dairy farm sustainability. Our main goal is to investigate the influence of dry-off protocols used by California dairies on aspects such as mastitis incidence, SCC, culling, lactation, reproductive performance, and cost-effectiveness.

Inclusion study farm criteria:

- Dairies need to have >1000 cows per herd.
- Actively practicing a variation of selective dry cow therapy or blanket dry cow therapy.
- Either dry lot or free-stall barn housing facilities.

What would the study participants receive in exchange for sharing the information about the dry cow program and data? We will work with your dairy team to learn about the current dry-off program, collect your information and data, perform a comprehensive analysis of your dairy's milk quality program, and provide guidance on potential aspects to optimize milk quality based on takeaways from the study and current benchmark in the industry. Farms will remain anonymous, and data will not be shared with anyone.

Please contact Tana Almand (tjalmand@ucdavis.edu) or Fabio Lima (falima@ucdavis.edu) if you are interested in learning more about the study.

Using Milking Robots to Identify Cows at Risk of Mammary Infection at Dry-Off

Emmanuel Okello – UC Davis & UCANR

If we can predict which cows are at risk of mammary infection at dry-off, we could limit dry cow antibiotic therapy to only those high-risk cows and reduce unnecessary antibiotic use. The automatic milking system (AMS), or milking robots, provides multiple parameters that can help us identify and treat these high-risk cows, a strategy commonly known as selective dry cow therapy (SDCT). In the SDCT method, cows with intramammary infections, or at increased risk for intramammary infections during the dry period and early during the subsequent lactation, receive intramammary antimicrobial infusion and teat sealant. Normal and low-risk cows receive only internal teat sealants at dry-off.

To explore how AMS parameters can predict high-risk cows, UC Davis scientists conducted a study on 218 cows enrolled from two commercial dairy herds in California that use AMS. Various parameters were evaluated, including average daily milk yield, mastitis detection index (MDI), somatic cell count (SCC), milking frequency, milking duration, milk flow rate, teat-end vacuum level, pulsation rate, pulsation ratio, liner slip ratio, and liner compression ratio to identify cows at risk of intramammary infection at dry-off.

Take home messages:

1. Automatic milking system (AMS) generated data can help identify cows at risk of intramammary infection at dry-off and guide the implementation of SDCT.
2. Cows with SCC greater than 200,000 cells/mL have a higher risk of intramammary infection at dry-off than those with SCC less than 200,000 cells/mL.
3. Cows with a higher milking frequency and shorter milking duration have a lower risk of intramammary infection at dry-off.
4. By implementing SDCT on high-risk cows, operators can reduce the use of antimicrobial drugs in dairy farms.

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