Project Title: Effects of Heat Stress on Blood Metabolites and Milk Quality in Lactating Holstein and Jersey Cows

Introduction: Regulating heat stress caused by high ambient temperatures and humidity has become a challenge for dairy producers in the southeastern United States. Dairy cows are most susceptible to heat stress during periods of high temperature humidity index (**THI**) due to the cows' diminished ability to utilize evaporative cooling in these conditions (West, 2003). Heat stress poses a variety of problems for dairy cows including decreased immune function (Dahl, 2020), decreased milk yield, (Zhao, 2019) and increased somatic cell count (Hammami, 2013). High somatic cell counts can be an indication of mastitis (DeVires, 2012) caused by bacterial pathogens shed in the milk (Olatoye, 2018). Additionally, heat stress alters the metabolic profile, energy balance, and health of affected cows (Soriani, 2013). Although many studies have focused on the effects of heat stress on milk quantity and quality, few have centered on the possible connection between heat stress, milk quality and metabolism. By evaluating the metabolic profile of these cows in tandem with their milk quality, a connection may be established between changes in blood metabolites and diminished quality of milk among heat stressed cows. This connection could foster a better understanding of why milk quality and quantity suffer under heat stress conditions and give more specific insight to negate these effects.

Objective: The objective of this study is to determine the effects of heat stress on blood metabolites including serum calcium, phosphorus, magnesium, glucose, cholesterol, and albumin as well as various aspects of milk quality including somatic cell count, milk bacterial load, and milk production of lactating Jersey and Holstein cows.

Methodology: Two groups of cows (6 Holsteins, 6 Jerseys; 12 total) will be selected and evaluated during 3 experimental periods (1 without heat stress, 2 with heat stress). During each

period, blood samples will be collected from the coccygeal vein of each cow. These samples will be centrifuged to obtain serum and cooled to -20°C until analysis. A milk sample will also be obtained from each cow and analyzed for somatic cell count (**SCC**). If the SCC exceeds 350,000 cells/mL, the sample will be plated on a tri-plate agar to determine the quantity and species of bacteria present. Additionally, the daily milk yield of each cow will be recorded throughout the study. With this data, we will evaluate the effects of heat stress on metabolic profile and milk quality. Furthermore, we will determine any connections between heat stress, changes in metabolic profile, and milk quality. Data will be analyzed using the Mixed Model in SAS with fixed effects of treatment and breed and random effect of cow.

Description of Duties: (Student's Name) will collect and process blood and milk samples. She will collaborate with Dr. Hollis to determine THI, SCC, prepare agar plates, read bacterial cultures, and analyze data. (Student's Name) will then complete a statistical analysis of the data with Dr. Hollis to determine if heat stress alters the metabolic profile or milk quality of lactating Holstein and Jersey cows. This is the first URECA submission for (Student's Name).

Role of Mentor: Dr. Hollis will assist with cow selection, sample collection, and data analysis. She will teach (Student's Name) how to properly collect blood and milk samples, prepare blood samples for storage and testing, conduct somatic cell counts, and perform milk cultures. Dr. Hollis will also assist with data analysis and interpretation.

Significance of Project: I believe this project will be an excellent opportunity to improve my skills in both conducting research and handling cattle specifically in a research setting. This study will also allow me to work closely with experts in the field, which could increase my potential career opportunities.

References:

Dahl, G., Tao, S., Laporta, J., 2020. Heat stress impacts immune status in cows across the life cycle. Front. Vet. Sci.7:116. doi: 10.3389/fvets.2020.00116

DeVires, T. J., Aarnoudse, M. G., Barkema, H. W., Leslie, K. E., von Keyserlings, M. A. G., 2012. Associations of dairy cow behavior, barn hygiene, cow hygiene, and risk of elevated somatic cell count. J. Dairy Sci. 95:5730-5739. doi:10.3168/jds.2012-5375

Hammami, H., Bormann, J., M'hamdi, N., Montaldo, H. H., Gengler, N., 2013. Evaluation of heat stress effects on production traits and somatic cell score of Holsteins in a temperate environment. J. Dairy Sci. 96:1844-1855. doi:10.3168/jds.2012-5947

Olatoye, O., Amosun, A., Ogbu, U., Okunlade, Y., 2018. Bulk tank somatic cell count and associated microbial quality of milk from selected dairy cattle herds in Oyo State, Nigeria. Ital J Food Saf. 7(2):7130. doi:10.4081/ijfs.2018.7130

Soriani, N., Panella, G., Calamari, L., 2013. Rumination time during the summer season and its relationships with metabolic conditions and milk production. J. Dairy Sci. 96:5082-5094. doi:10.3168/jds.2013-6620

West, J. W., 2003. Effects of heat-stress on production in dairy cattle. J. Dairy Sci. 86:2131-2144.

Zhao, S., Min, L., Zheng, N., Wang, J.,2019. Effect of heat stress on bacterial composition and metabolism in the rumen of lactating dairy cows. Animals. 9:925. doi:10.3390/ani9110925

Timeline for Project*:

*Milk yield data recorded from Afimilk database

March

- Cow selection
- Data sheet creation
- Blood collection and processing training
- Milk collection training
- SSC and plating training

April

Session 1

- Calculate THI and begin when THI is below 72 for 3 consecutive days.
- Collect blood and milk samples from previously selected cows.
- Process blood samples and send to lab.
- Complete SSC and culture plating if indicated.
- Complete datasheet

May

Session 2

- Calculate THI and begin when THI is between 72 and 88 for 3 consecutive days.
- Collect blood and milk samples from previously selected cows.
- Process blood samples and send to lab.
- Complete SSC and culture plating if indicated.
- Complete datasheet

June

Session 3

- Calculate THI and begin when THI is between 79 and 89 for 3 consecutive days.
- Collect blood and milk samples from previously selected cows.
- Process blood samples and send to lab.
- Complete SSC and culture plating if indicated.
- Complete datasheet

July and August

- Analyse and interpret data
- Complete final report

Budget Justification

Supplies are being requested for the following:

Requested supply funding from URECA:

1. Blood serum vacutainer collection tubes – $127.90/100-pack
2. Cassettes for somatic cell count test for milk samples - $184.25 per box of 72.

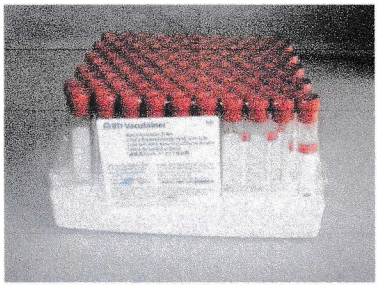
TOTAL: 312.15

Paid for by Dr. Hollis' start-up funds:

1. Blood sample analysis – $12.00/sample x 36 samples = $432.00
2. Milk collection tubes – $118.00/case of 500
3. Tri-plate agars - $3.15 each x 45 (+$20 shipping) = $161.75

TOTAL: $711.75

	Amount
Funds requested from URECA	300.00
Remaining funds to be covered by department (Dr. Hollis' start-up funds)	723.90
Total Project Estimated Cost	**$1023.90**



BD Vacutainer™ Venous Blood Collection Tubes: Vacutainer Plus™ Glass Serum Tubes, Silicone-Coated, with Conventional Stopper

edge

Use for serum determinations in chemistry, serology and immunohematology

Manufacturer: BD 366430

Catalog No. 02-685A

$127.90 / Pack of 100

$959.50 / Case of 10 PK

edge

⚠ Due to product restrictions, please to purchase or view availability for this product.

Description

- Sterile vacuum blood collection tubes for serum determination
- Spray-coated silica interior
- With conventional tube stopper

Evacuated Tubes Simplify Blood Collection

- Blood is drawn directly from the vein into the evacuated sterile collection tubes
- Only one venipuncture is needed to draw multiple samples
- Tubes can be changed while needle and plastic holder remain in place on patient's arm
- Closures are color coded

Specifications

Capacity (Metric)	16 x 100mm; 10.0mL	Closure Type	Conventional
Material	Glass	Additive	Silicone coated
Color	Red		

Middle Tennessee Dairy Service, Inc.

8003 Old Woodbury Pike
Readyville, TN 37149

615-893-2526

Invoice

Date	Invoice #
1/23/2019	

Bill To

MTSU Dairy Unit
Cope Admin. Bldg. - Room 106
Attn: Accounts Payable
Murfreesboro, TN 37132

Ship To

MTSU Dairy Unit
Cope Admin. Bldg. - Room 106
Attn: Accounts Payable
Murfreesboro, TN 37132

Memo	P.O. Number	Terms	Sales Person	Account #
		Due by 22nd	5	MTSU

Item Code	Quantity	Description	Price Each	Amount
92865881	1	DCC, Cassette, 8x/72	184.25	184.25

Accounts Over 30 Days Subject to 18% Interest & Attorney Fees.

Keeping Your Dairy Profitable!

Total $184.25

E-mail: mtds@midtndairy.com

Fax #: 615-893-1131

For information on COVID-19 see the following: CDC link | SHS Link | Test Site Locator

Metabolic Profile – Lactating Herd

Biochemistry profile for groups of 10-15 clinically normal heifers or cows greater than 14 days in milk. Profile includes calcium, phosphorus, magnesium, albumin, BUN, glucose, cholesterol, sodium, potassium, chloride, and beta-hydroxybutyrate.

Special Instructions

This profile is designed for herd level investigation and monitoring of management and/or nutritional driven risk factors for disease or suboptimal performance in lactating dairy cattle. It is designed to be done on groups of 10-15 clinically normal heifers or cows greater than 14 days in milk.

Groups of lactating heifers should be evaluated separately from groups of lactating cows.

This test requires a minimum of 8 samples on a single accession. A reference mean spreadsheet will not be generated for group submissions with fewer than 10 samples.

The Chemistry Profile-Ruminant, Electrolyte & Macromineral Profile, Energy Profile, or Liver Profile should be utilized on clinically abnormal individual animals.

Turnaround time may vary on large submissions.

Price $12.00

Schedule

Lab	Schedule	Turnaround time
College Station	Monday, Tuesday, Wednesday, Thursday, Friday	3—4 days

Thermo Scientific™ Capitol Vial Veterinary Specimen Collection and Transport Vials

Thermo Scientific™ Capitol Vial Veterinary Specimen Collection and Transport Vials made of polypropylene are translucent in color for easy visibility.

Manufacturer: Thermo Scientific™
CNLL500

Catalog No. 14-377-822

$118.00 / Case of 500

Qty Check Availability

Description

Constructed of polypropylene, the Thermo Scientific™ Capitol Vial Veterinary Specimen Collection and Transport Vials are translucent in color for easy visibility.

- Used commonly for infection control of mastitis
- Vials are manufactured in Class 10,000 cleanrooms to insure sterility of the containers prior to use
- Collect and transport biopsies and urine and blood samples

Specifications

Description	Polypropylene; 0.37 oz. (11 mL); 500/Cs.
Diameter (Metric) Inner	20 mm
Volume (Metric)	11 mL
Length (English)	2.08 in.
Volume (English)	0.37 oz.
Diameter (English) Inner	0.78 in.
Material	Polypropylene
For Use With (Application)	For mastitis test
Length (Metric)	53 mm
For Use With (Equipment)	Mastitis Test

Documents

Product literature

Easy Culture Order Form University of Minnesota Veterinary Diagnostic Laboratory
Laboratory for Udder Health 1333 Gortner Avenue St. Paul MN 55108

Orders may be placed by:
Phone: 612-625-7053
Fax: 612-624-4824
Email: mastlab@umn.edu

Orders are shipped out Monday-Wednesday to ensure packages are not in transit over weekends.
Orders for **In-stock** items received **prior to 9:00am** will ship same-day.
We guarantee 8 weeks from receipt of TRI, BI, Factor™, 4Cast™ and Focus™ plates prior to expiration.
We guarantee 4 weeks from receipt of MacConkey and Blood plates prior to expiration.

MinnesotaEasy™ MTKT media has a new name: MinnesotaEasy™ Focus™
Now Introducing MinnesotaEasy™ 4Cast plate: To be used to screen cows prior to dry-off.

Prices below do not include shipping charges, which will be billed to the customer.

Item	Unit Price	Quantity	Total Price
MinnesotaEasy® Culture System Handbook-English	$0.00		$0.00
MinnesotaEasy® Culture System Handbook-Spanish	$0.00		$0.00
MinnesotaEasy® 4Cast Quick Start Guide	$0.00		$0.00
4Cast™ Plate (4-Section Selective Dry Cow Therapy) (18ml/plate)	$2.25		
Tri-Plate (Factor™-MacConkey-Focus™) (18ml /plate)	$3.15		
Bi-Plate (Factor™-MacConkey) (18ml /plate)	$2.00		
Factor® Plate (18ml/plate)	$1.75		
Focus™ Plate (18ml/plate)	$1.75		
MacConkey Plate (18ml/plate)	$1.20		
Blood Plate (18ml/plate)	$1.20		
Coagulase Tube-Individual Tube (0.5ml/tube)	$1.75		
Bottle of 15 ml dehydrated Coagulase Plasma	$32.00		
Pack of 125 Sterile 5ml Tubes	$25.00		
Pack of 100 Sterile Swabs	$1.50		
Box of 100 Sterile Swabs (2/pk)	$11.00		
Pack of 50 Sterile Inoculating Loops	$5.00		
Milk Sample Mailer (holds 75 2oz vials + large ice packs)	$8.00		
Milk Sample Mailer (holds 10 2oz vials + small ice pack)	$8.00		
2 oz Milk Vials	$0.30		
TOTAL:			

Customer Shipping Information:	Customer Billing Information:
Company:	**Company:**
Contact :	**Contact:**
Address:	**Address:**
Phone:	**Phone:**
Email:	**Email:**

Replacement Policy: If you received plates that are damaged or become contaminated prior to the expiration date, please contact the Laboratory for Udder Health at 612-625-7053 and we will ship replacement plates to you at no charge. You may be asked to supply information about the lot number and the nature of the contamination for QC purposes.