2001

IMPACT OF SEASON AND HEAT STRESS ON SOMATIC CELL COUNTS

Brent A. Broaddus

University of Kentucky, babroa1@pop.uky.edu

Click here to let us know how access to this document benefits you.

Recommended Citation

https://uknowledge.uky.edu/gradschool_theses/180

This Thesis is brought to you for free and open access by the Graduate School at UKnowledge. It has been accepted for inclusion in University of Kentucky Master's Theses by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.
ABSTRACT OF THESIS

IMPACT OF SEASON AND HEAT STRESS ON SOMATIC CELL COUNTS

Infection data were obtained monthly from June, 1999 to September, 2000 at the University of Kentucky dairy. Quarter foremilk samples were collected for bacteriological determination and somatic cell counts (SCC). The Livestock Stress Index (LSI) estimated heat stress and is calculated by combination of temperature and humidity. For uninfected quarters the geometric mean SCC was 29,000 cells/ml. For infected quarters the geometric mean SCC was 213,000 cells/ml. Coagulase-negative staphylococci (CNS) infections comprised 61 percent of the total infected quarters with a geometric mean SCC of 155,000 cells/ml. Staphylococcus aureus infected quarters had a geometric mean SCC of 680,000 cells/ml. There were no significant correlations between log SCC and LSI when looking at the total sample period. However, evaluating October, 1999 through September, 2000, significant correlations were found for LSI and log SCC of uninfected quarters (P < 0.05) and infected quarters (P < 0.0001). All correlation coefficients were less than 0.12. The results suggest no marked changes in SCC were observed in uninfected quarters during hot summer weather. Hot summer weather may have a minor impact on SCC in infected quarters, but the effect is variable. Thus, infection status of the mammary gland, not heat stress, is the major factor determining SCC.

Keywords: Livestock Stress Index, Mastitis, Somatic Cell Count, Bovine
IMPACT OF SEASON AND HEAT STRESS ON SOMATIC CELL COUNTS

By

Brent Allen Broaddus

________________________________________
Director of Thesis

________________________________________
Director of Graduate Studies
RULES FOR THE USE OF THESES

Unpublished theses submitted for the Master’s degree and deposited in the University of Kentucky Library are as a rule open for inspection, but are to be used only with due regard to the rights of the authors. Bibliographical references may be noted, but quotations or summaries of parts may be published only with the permission of the author, and with the usual scholarly acknowledgments.

Extensive copying or publication of the theses in whole or in part also requires the consent of the Dean of the Graduate School of the University of Kentucky.
THESIS

Brent Allen Broaddus

The Graduate School
University of Kentucky
2001
IMPACT OF SEASON AND HEAT STRESS ON SOMATIC CELL COUNTS

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at the University of Kentucky

By
Brent Allen Broaddus
Lexington, Kentucky
Director: Dr. Robert J. Harmon, Professor of Animal Science
Lexington, Kentucky
2001
DEDICATION

I would like to dedicate this thesis to three individuals that have had a profound impact on my life and on my success thus far and for my success yet to come. Through their examples and faith they have shown to all that have known them that angels walk among us.

Benjamin H. McGuire

Hila E. Whiting

Richard L. Whiting
ACKNOWLEDGMENTS

I would like to express my gratitude and appreciation for my mother Cathy Barrett for all she has sacrificed to let me reach for my goals and obtain them. Without her unselfish nature and unconditional love and support this thesis would have not been possible. I would also like to thank Ann & Leonard Barrett, Sandy Stampfler, and my father James Broaddus for their support throughout my education career. They all have played vital roles in my continuation of the education process and my success. Thank you all.

I would like to thank Robert J. Harmon for his guidance, advice, and support during my education at the University of Kentucky. As an advisor, teacher, researcher, and a friend the amount of respect I have for him cannot be put into words. Thanks for everything Pickle!

I would also like to thank Roger “auntie” Scaletti, Susan Hayes, Bernice Smith, Kabby Akers, Hugo “poof daddy” Hamilton, Ben “hoo hoo” Hatler, Ronan O’Carra, Sharon Franklin, and Bill Crist for all their help collecting and analyzing my samples during my 16-month trial. You all have been great and made a hellish trial a little better.

Recognition is also due to Jack “birddog” McAllister, Paul Cornelius, Fred Thrift, and Debra Aaron for their statistical help and advice on this trial.

Special recognition is due to George “putzmo” Heersche for his great attitude on life and research and his ability to always point out the important things in life during the weekly symposium meetings. Dr. Heersche also has been vital in my development and involvement in 4-H, and ultimately the career I have chosen. I cannot thank him enough for all he has taught me and all I will be able to learn from him in the future.

Finally, I would like to give credit to Frank Button and all the employees at the University of Kentucky dairy research unit for always making sure that my trial stayed as complicated as possible. Thanks for all you all did, you made it a challenge.
# TABLE OF CONTENTS

## Acknowledgments
iii

## List of Tables
vi

## List of Figures
vii

## List of Files
ix

## Chapter I: Introduction
1

## Chapter II: Literature Review
2
- What Are Somatic Cells?
- What Is Normal Somatic Cell Count?
- Pathogens That Cause Changes In Somatic Cell Count
- Role Of Inflammation On Somatic Cell Count And The Mammary Gland
- Age’s Effect On Somatic Cell Count
- Stage Of Lactation Effects On Somatic Cell Count
- Stress Effect On Somatic Cell Count
- Effect Of Season on Somatic Cell Count
- Diurnal Variation Of Somatic Cell Count
- DHIA And Somatic Cell Count
- Relationship Of Production Loss To Somatic Cell Count
- Use Of Somatic Cell Counts And DHIA In Dairy Herd Management

## Chapter III: Impact Of Season And Heat Stress On Somatic Cell Counts
12
- Introduction
- Materials and Methods
  - Milk Sample Collection
  - Bacteriological Determination
  - Somatic Cell Count
  - Livestock Stress Index And Rainfall
  - Statistical analyses
- Results And Discussion
- Conclusions

## Chapter IV: Dynamics of Staphylococcus aureus Infections
48
- Introduction
- Results And Discussion
- Conclusions
Chapter V: General Conclusions
References
Vita
LIST OF TABLES

Table 1. Estimated differences in lactation milk production associated with an increase in SCC score...................................................................................................................10

Table 2. Estimated infection prevalence and losses in milk production associated with elevated BTSCC........................................................................................................................................11

Table 3. Proc Mixed ANOVA Table showing tests of significance for main effects and interactions on $\log_{10}$ SCC for uninfected quarters.................................................................32

Table 4. Proc Mixed ANOVA Table showing tests of significance for main effects and interactions on $\log_{10}$ SCC for infected quarters........................................................................35

Table 5. Proc Mixed ANOVA Table showing tests of significance for main effects and interactions on $\log_{10}$ SCC from *Staphylococcus aureus*-infected Quarters.................40

Table 6. Proc Mixed ANOVA Table showing tests of significance for main effect and interactions on $\log_{10}$ SCC from coagulase-negative staphylococci infections..............43

Table 7. Pearson correlation coefficients for SCC and LSI by infection status at the time periods of 16 months (06/99-09-00), first 12 months (06/99-05/00), last 12 months (10/99-09/00) of the trial.................................................................45

Table 8. Number and percentage of *S. aureus* (SA) infected quarters (INF) coming from first calf heifers over the 16-month sample period.........................................................52
LIST OF FIGURES

Figure 1. Mastitis results after bacteria pass through the teat duct.................................4

Figure 2. Polymorphonuclear neutrophils passing through the blood vessel......................6

Figure 3A. Bacterial toxin damage to milk-producing tissue during Mastitis.......................7

Figure 3B. LSI and rainfall over the 16-month sample period........................................16

Figure 4. Geometric mean SCC by infection categories.................................................17

Figure 5. Geometric mean SCC of infected and uninfected quarters compared with LSI for
16-month sample period.................................................................18

Figure 6. Geometric mean SCC of infected, uninfected, and CNS-infected quarters compared
with LSI over the 16-month sample period........................................19

Figure 7. Geometric mean SCC of major and minor pathogen infections across a 16-month
sample period.................................................................21

Figure 8. Geometric mean SCC of infected, uninfected, and infected quarters without
CNS infections compared with LSI for a 16-month sample period..............................22

Figure 9. Geometric mean SCC of *Staphylococcus aureus* and CNS-infected quarters over the
16-month sample period.................................................................23

Figure 10. Geometric mean SCC of streptococcus spp. and gram-negative infected quarters over
a 16-month sample period.................................................................24

Figure 11. Geometric mean SCC of clinical quarter samples and LSI throughout a 16-month
sample period.................................................................26

Figure 12. Percentage quarters infected with *Staphylococcus aureus*, CNS, and *Streptococcus* spp.
over a 16-month sample period.................................................................27

Figure 13. Percentage quarters infected with gram-negative bacteria, coryneforms, and other
infected quarters over a 16-month sample period.................................................................28

Figure 14. Percentage quarters infected, uninfected, or infected with *Staphylococcus aureus* or
CNS across stages of lactation.................................................................29
Figure 15. Geometric mean SCC of infected, uninfected, *Staphylococcus aureus* infected, and CNS-infected quarters across stages of lactation……………………………..31

Figure 16. Effect of LSI on $\log_{10}$ SCC across stage of lactation for uninfected quarters……..33

Figure 17. Effect of LSI on $\log_{10}$ SCC across lactation number for uninfected quarters……..34

Figure 18. Effect of lactation on $\log_{10}$ SCC across LSI categories for infected quarters……..37

Figure 19. Effect of breed on $\log_{10}$ SCC across stage of lactation for infected quarters……..38

Figure 20. Effect of quarter on $\log_{10}$ SCC across stage of lactation for infected quarters……..39

Figure 21. Effect of LSI on $\log_{10}$ SCC across stage of lactation for *Staphylococcus aureus*-infected quarters…………………………………………………………….…….41

Figure 22. Effect of lactation on $\log_{10}$ SCC across stage of lactation *Staphylococcus aureus* Quarters…………………………………………………………………….……..42

Figure 23. Effect of breed on $\log_{10}$ SCC across stage of lactation for coagulase-negative *staphylococci* infected quarters………………………………………….44

Figure 24. Percent of quarters infected with *S. aureus* and CNS pathogens over a 16-month period…………………………………………………………………….…….50

Figure 25. Percentage of new *S. aureus* infected quarters coming from heifers over 15 months of a 16-month sample period………………………………………………….51

Figure 26. Percentage of new CNS infected quarters coming from heifers over 15 months of a 16-month sample period………………………………………………….53

Figure 27. Number of heifers that entered the herd during the last 15 months of a 16-month period……………………………………………………………………….54
LIST OF FILES

00CHAPTER.PDF........................................................................ 25.4 KB
01CHAPTER.PDF........................................................................ 6.18 KB
02CHAPTER.PDF........................................................................150.0 KB
03CHAPTER.PDF........................................................................167.0 KB
04CHAPTER.PDF........................................................................ 30.5 KB
05CHAPTER.PDF........................................................................ 23.9 KB