Proposal for Senior Honors Thesis

HONS 497 Senior Honors Thesis **Credits 2** (2 minimum required)

Directions: Please return signed proposal to the Honors Office **at least one week prior to your scheduled meeting with the Honors Council**. This proposal must be accepted by Honors Council the semester before presentation.

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Primary Advisor: Katherine Koudele

Secondary Advisor:

Thesis Title: Monitoring the Immune Status of Calves at the Agriculture Education Center

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Targeted Semester for Poster/Final Thesis: Spring 2022

Expected Semester of Graduation: Spring 2022

I. Provide goals and brief description of your project or research.

Unlike humans, animals do not receive immunoglobulins (Ig's) transplacentally *in utero:* they receive them in the colostrum, the first milk. The calf receives these Ig's has whole molecules during a 24-hour window after birth when the small intestine is able to absorb them. The transfer of Ig's in the colostrum to the calf is termed "passive transfer." If the calf does not receive the colostrum in the first 24 hrs after birth the Ig concentration in the blood is too low and does not provide protection from pathogens. Ideally the colostrum should be fed in the first 6 hours after birth. (Figure 1).

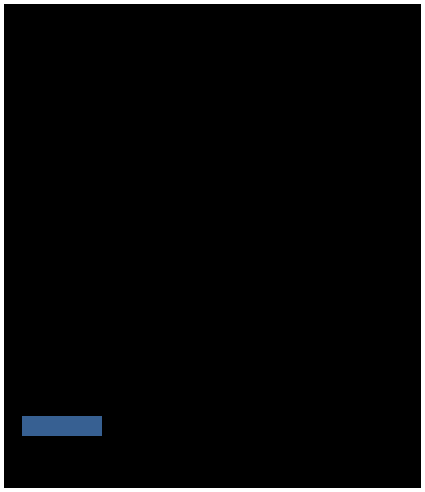

Figure 1 The efficiency of immunoglobulin absorption by the neonatal calf. *(https://www.extension.iastate.edu/dairyteam)*

At about 2 weeks of age, the calves' active immunity will start developing and the passive immunity (PI) will begin weakening. (Figure 2). Passive immunity is crucial because if they do not receive PI they will not have any immunity until their active immunity develops. Active immunity is the natural immunity developed over time due to exposure to different pathogens.

The calves in this study will be housed at the A.U. Agriculture Education Center (AEC). They will be composed of two populations: 1) the calves born to resident cows and 2) the purchased calves. Those calves which are born at AEC are expected to show higher levels of serum immunoglobulins since they will have received their colostrum in a timely manner and have not experienced the stressors that the purchased calves will have experienced. The purchased calves will come from a large dairy farm about 1.5 hours from the AEC. The stressors that these calves will experience include 1) possibly not receiving colostrum within the first 6 hours after birth, 2) traveling via trailer, 3) a new environment (people, animals, surroundings), and 4) possible exposure to different pathogens/diseases. The stress experienced by the calves will weaken their immune systems increasing morbidities (Hulbert and Moisa).

The goal of this research project is to correlate the relationship of immunoglobulin (Ig) levels in the blood of the young calves, both resident and purchased, at the Agriculture Education Center (AEC) and their health status during the 8-week period they are fed milk.

II. Outline your methodology. **Please be specific**. How does this achieve your goals and how reliable is it?

Each fall semester calves from two different sources are raised by the Animal Science students at the A.U. Agriculture Education Center: those born to the resident cows and those born at another farm and brought here. The calves born at the AEC will be weighed and monitored from the time they are born. For these calves, the blood will be drawn within the first week following parturition (birth). For the purchased calves, the blood will be drawn from the time they arrive. After the initial blood draw, the blood will be taken weekly for 8 weeks to determine immunoglobulin G (IgG) levels. IgG immunoglobulins are the most prevalent in cattle blood. IgG levels will be measured using bovine IgG ELISA kits produced by ABclonal (https://abclonal.com/) . Bovine IgG ELISA kits have a sensitivity of 1.245 ng/ml, a range of 3.125 ng/ml – 100 ng/ml, the sample type can be plasma or serum, and the detection method is colorimetric. Data collected from the calves will include weekly blood for Ig level analysis, daily rectal temperatures, daily milk and grain intake, weekly body weights, and any incidence of disease such as diarrhea or pneumonia. This data will be analyzed to determine any correlation of health status/morbidity and serum immunoglobulin levels in the calves. All other health indicators will be recorded when the calves are cared for twice daily.

By correlating the IgG levels with health indicators, it will be possible to determine if there is a pattern to when the calves are getting sick. The expectation is that there will a higher rate of sickness at about two weeks of age. If there is a pattern to calf morbidity, further research can be conducted to ascertain the cause or causes. Thus, when combined with the other indicators of calf health, I will be able to diagnose morbidity with a high level of certainty.

III. Explain in what sense your project is original, unique, or beyond normasible expa4 nBT/F1 9 Tf1 0 0 1 161.9 261.89 Tm0 g0 G(th)-8(e)4( )-

immunity. The article discusses the effects of maternal immunity on how calves develop specific immunity and vaccine strategies for developing protection against pathogens in calves. The research performed in this article follows a similar path I plan to perform in my research. This article states the importance of colostrum in passive immunity, "The ingestion of colostrum is essential for providing neonates with immunologic protection during at least the first 2 to 4 weeks of life." I plan to test the level of immunoglobulins in calves throughout development and the pathogens in their blood. This will allow me to compare the calves' passive immunity and active immunity and the time in between.

Filteau, V., Bouchard, E., Fecteau, G., Dutil, L., & DuTremblay, D. (2003). Health status and risk factors associated with failure of passive transfer of immunity in newborn beef calves in Québec. *The Canadian veterinary journal = La revue veterinaire canadienne*, *44*(11), 907–913.
This study was done to determine risk factors associated with failure of passive transfer immunity (FPT). Physical exams were performed on normal calves and blood samples collected for measurements of serum concentration of immunoglobulin (Ig) G_1. They found that calves born in a stanchion-stall were more likely to shows FPT. They also found the cold-stressed may have a slower rate of intestinal absorption and may also be reluctant to stand and suckle voluntarily but birth month was not associated with FPT. The final consideration mentioned was that of quality calf environment and management practices, and monitoring dams' BCS. This provides further information as to possible causes for calf sickness in Andrews University calves. These are factors that must be considered if some of the calves have FPT.

Hulbert, L. E., & Moisá, S. J. (2016). Stress, immunity, and the management of calves. *Journal of Dairy Science*, *99*(4), 3199–3216. https://doi.org/10.3168/jds.2015

showed serum TP ranging from 3.5 to 9.8 g/dL. This implied management techniques could affect the passive transfer of maternal immunity. This is important for my research because it shows how external factors can be applied to improve calf and reduce the chance of risk of failure of passive transfer (FPT).

Poulsen, K. P., Foley, A. L., Collins, M. T., & McGuirk, S. M. (2010). Comparison of passive transfer of immunity in neonatal dairy calves fed colostrum or bovine serum-based colostrum replacement and colostrum supplement products. *Journal of the American Veterinary Medical Association*, *237*(8), 949–954. https://doi.org/10.2460/javma.237.8.949

This study was done to test to the effects on the transfer of passive immunity when using bovine serum-based colostrum replacement and colostrum supplement products as compared with natural colostrum. The study included 287 neonatal heifer calves from 8 different farms. The study found that the calves that received natural colostrum had significantly higher levels of IgG and total protein levels as compared with the calves that received the colostrum replacement and colostrum supplement. No difference was detected between calves that received adequate levels of passive transfer of immunity. This article informs my research by describing and articulating the adequate levels of passive transfer of immunity. It also describes the effects of supplemental or replacement colostrum should the AEC ever need to use it.

Todd, C. G., McGee, M., Tiernan, K., Crosson, P., O'Riordan, E., McClure, J., Lorenz, I., & Earley, B. (2018). An

Secondary Advisor (signature required)

If human subjects or if live vertebrate animals are involved, evidence of approval from the Institutional Review Board or an Animal Use Committee is needed through the campus scholarly research offices (Ext. 6361).