Impact of Antibody Supplementation on Immune Function in Jersey Heifer Calves

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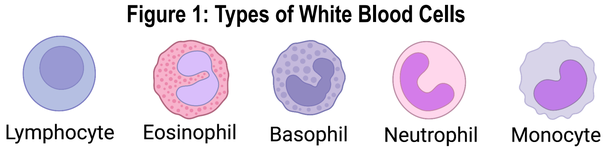
INTRODUCTION

- Jersey dairy calves have a higher mortality rate (8%) than Holstein calves (6%). (Bleul, 2010).
- White blood cells (WBCs) correlate with health and immune function
- Lymphocytes, a WBC, are the most common type in the blood. They are thought of as providing ”adaptive immunity.” This facilitates a specific response to a given antigen (Buonacera et al., 2022).
- Neutrophils, another WBC, can indicate an inflammatory response at elevated levels in the blood. They are also referred to as providing the “innate immunity,” which helps initiate the initial immune response (“Normal Leukocytes,” 2019; Buonacera et al., 2022).
- Less numerous cells present in the blood are basophils, eosinophils, and monocytes. (“Normal Leukocytes,” 2019).
- The analysis of these cells can be performed through a WBC differential, consisting of looking at the stained slide (containing the blood sample) under the microscope. This is performed until 100 cells are counted. (“Smear examination,” 2015).

Figure 1: Types of White Blood Cells



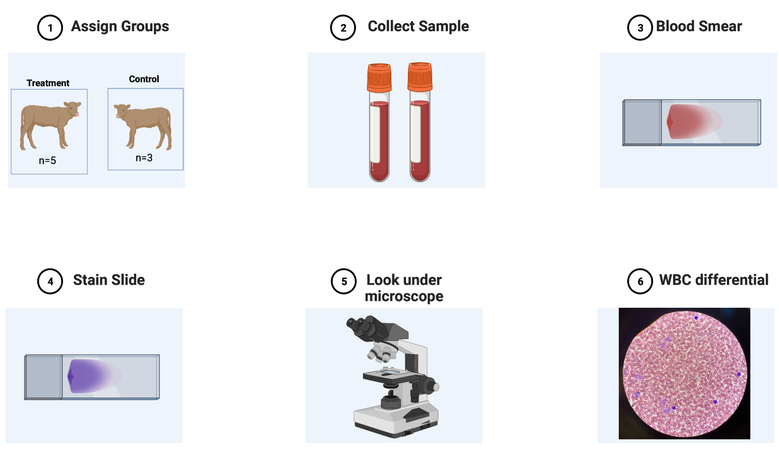
OBJECTIVE

Determine impact of feeding an antibody supplement on calf white blood cell populations.

MATERIALS & METHODS

- **Location**: Litton-Reaves Hall and two commercial farms that raise Jersey calves
- 8 calves total enrolled in either control group or treatment group. The treatment group in this study will receive an oral supplement providing them with antibodies against rotavirus, coronavirus, and *E. coli* at birth. These are expected to improve the calves’ immune function. The control group will not receive an antibody supplement.
- Blood sampling and measurements (weight, hip height, wither height) taken at < 3 days (S1), 14 days (S2), and 60 days of age (S3).
- Following each blood sample, slides were stained with Wright’s stain
- Once slides were dry, a WBC differential was completed
  - e.g. S1 Lymphocytes (%) = # cells present / 100
- R used to analyze data, calculate standard error, create box plots, and create models (plotrix package used)
- Descriptive statistics compiled for each value/measurement (mean, minimum, maximum, standard deviation, standard error)
- Total number of each WBC calculated at each sampling
  - e.g. S1 Lymphocytes (num) = WBC count (total) * S1 Lymph. (%)
- ANOVA modeling for each desired factor was performed (measuring significance, AIC, BIC, adjusted R-squared value)

Figure 2: Sample collection and slide analysis steps

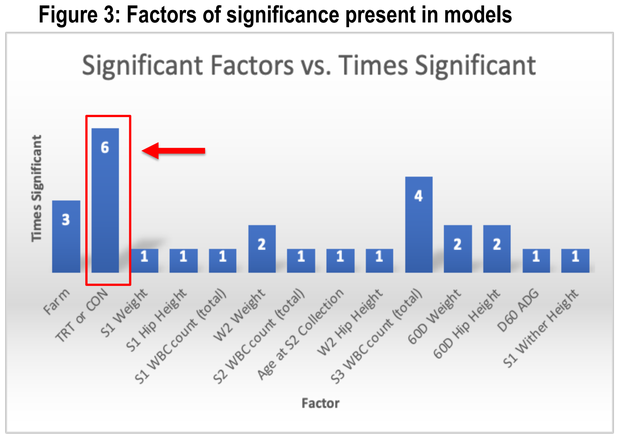


RESULTS

Table 1: Descriptive Statistics of Groups (mean ± standard error)

	Treatment	Control
# of Calves	5 ± 0	3 ± 0
Age at S1 (hrs)	56.6 ± 2.7	62.2 ± 4.3
Age at S2 (days)	15.8 ± 0.7	14.3 ± 0.3
Age at S3 (days)	60 ± 0	60 ± 0
S1 Weight (lbs)	57.2 ± 1.4	57.6 ± 0.6
S2 Weight (lbs)	62.0 ± 0.7	65.2 ± 5.9
S3 Weight (lbs)	108.1 ± 7.2	116.5 ± 11.5

Figure 3: Factors of significance present in models



Significant Models:

S1 Eosinophils (%), S1 Monocytes (%), S1 Eosinophils (num.), S1 Neutrophils (num.), S2 Eosinophils (num,), S2 to S3 Basophils, S3 Lymphocytes (%), S3 Lymphocytes (num.), S3 Neutrophils (num.), S1 to S3 Lymphocytes, S1 Total WBC Count

Figure 4: Change in WBCs (Control Group)

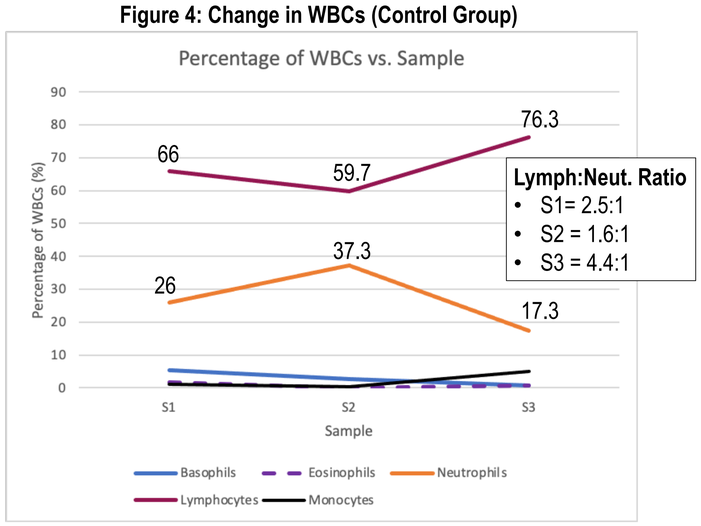
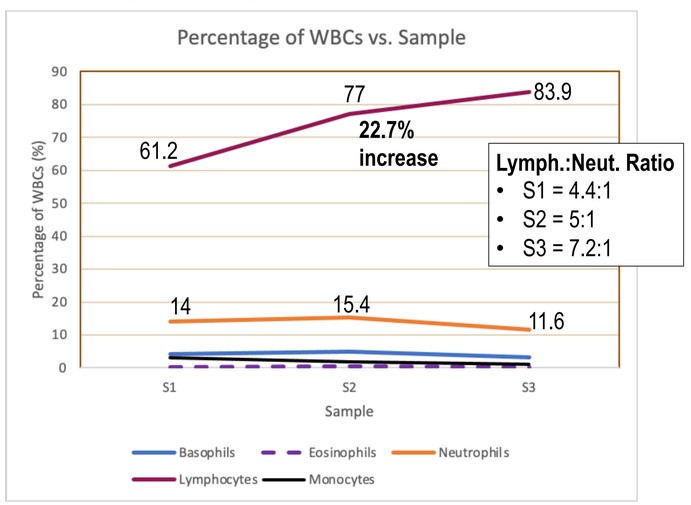


Figure 5: Change in WBCs (Treatment Group)

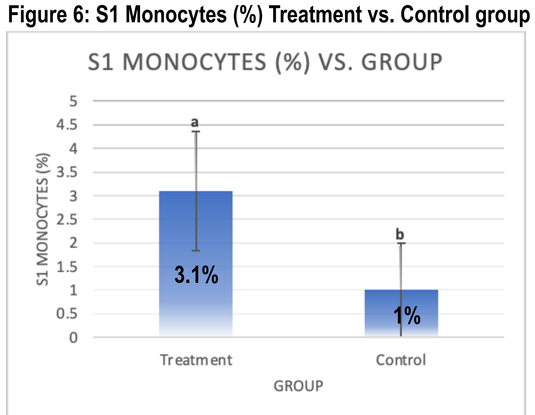


RESULTS

Table 2: Correlation Table (corr. coefficient, P-value)

Variable	S2 WBC Count (per mL)	S2 Lymph. (%)	S2 Neut. (%)	S2 Neut. (num)	S3 Lymph. (%)
S2 Lymph. (%)	-0.94288 0.0004	--			
S2 Neut. (%)	0.86643 0.0054	-0.96157 0.0001	--		
S2 Neut. (num)	0.89557 0.0026	-0.9517 0.0003	0.98726 <.0001	--	
S3 Lymph. (%)	-0.97278 0.0002	0.95969 0.0006	-0.92681 0.0027	-0.9286 0.0025	--
S2 to S3 Eos.	0.8297 0.0209	-0.91603 0.0037	0.9644 0.0005	0.9644 0.0005	-0.85148 0.015

Figure 6: S1 Monocytes (%) Treatment vs. Control group



TRT/CON p-value = <0.01

CONCLUSIONS

- S1 Monocytes (%), S1 Neutrophils (num.), S2 Eosinophils (num.), S2 to S3 Basophils change, S3 Lymphocytes (num), and S1 Total WBC Count differed significantly between treatment and control groups
- Larger increase in lymphocytes over other cell types in the treatment group throughout the duration of the study (< 3 days– 60 days)
- A larger number of neutrophils in the control group (mainly at S2), than the treatment group can be indicative of an increased inflammatory response. This ratio can also portray a decreased immune function compared to that of the treatment group (less adaptive immunity).

IMPLICATIONS

- Giving Jersey calves an oral supplement containing specific amounts of antibodies (like the treatment group in this study) can improve the health in the breed, through the distribution of the different types of WBCs. This treatment can cause a wider distribution, mainly between lymphocytes and neutrophils
- Improved health can also lead to increased numbers of dairy cows at farms able to be used for milk production, therefore increasing production in the dairy industry for commercial production
- Ultimately, an increased health leads to lower mortality and losses, therefore resulting in more money for a given farm

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