
Impact of breed and colostrum intake on serum IgG, growth, health, and blood lymphocyte profiles in preweaning dairy and crossbred bulls

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BACKGROUND



HOLSTEIN DAM



HOLSTEIN SIRE



HOLSTEIN CALF

BACKGROUND



HOLSTEIN DAM



HOLSTEIN SIRE

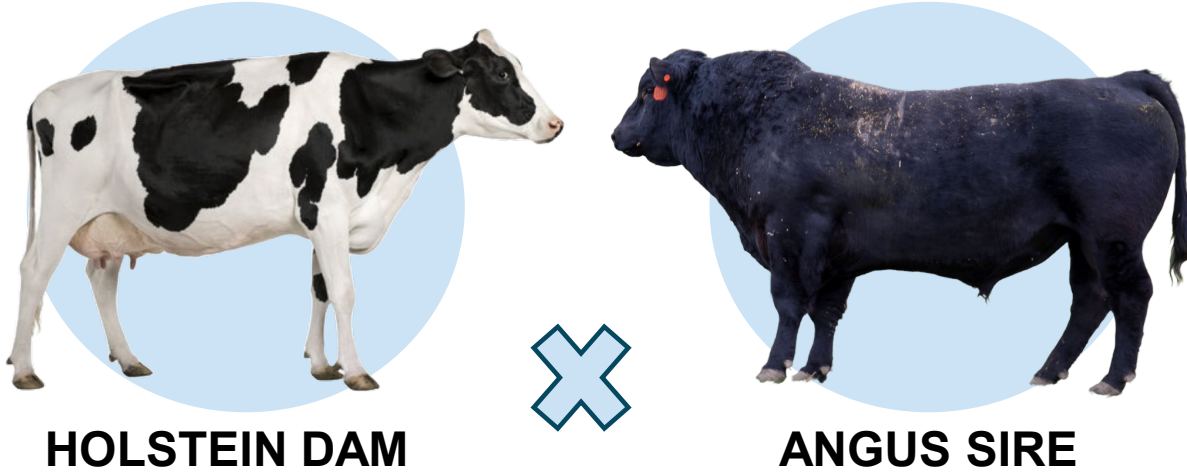


HOLSTEIN CALF

SURPLUS CALVES

- 95% are bull calves¹
- Raised as either veal or dairy – beef¹
- Provide little to no profit to dairy producers¹
 - Lower levels of care^{2,3}
 - Poor colostrum feeding protocols^{2,3,4}
 - Delayed first feeding
 - ↓ quantity
 - Failed transfer of passive immunity

BACKGROUND



BACKGROUND



HOLSTEIN DAM



ANGUS SIRE



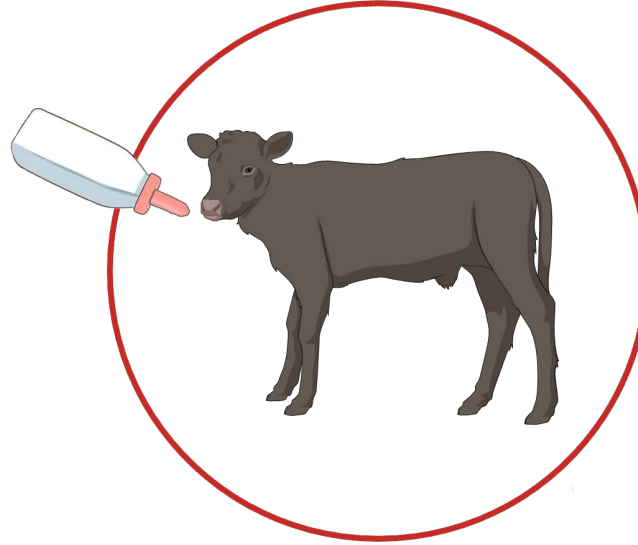
BEEF ON DAIRY CALF

BEEF ON DAIRY CALVES

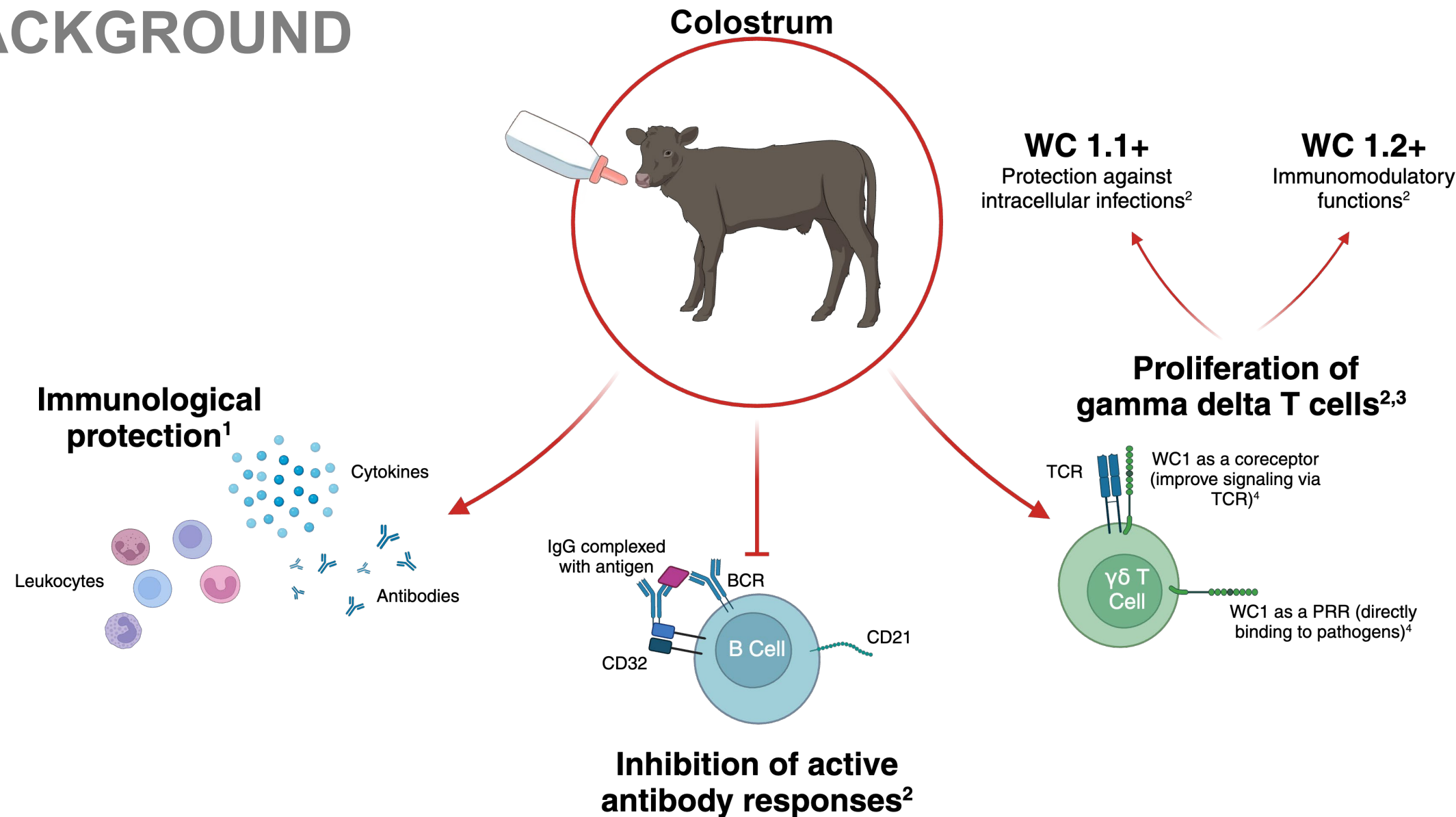
- Use of beef semen rising in popularity^{1,2}
- Raised to enter the feedlot
 - Improved meat quality^{3,4}
- ↑ profit for dairy producers²
 - Opportunity to improve colostrum management²

BACKGROUND

Colostrum

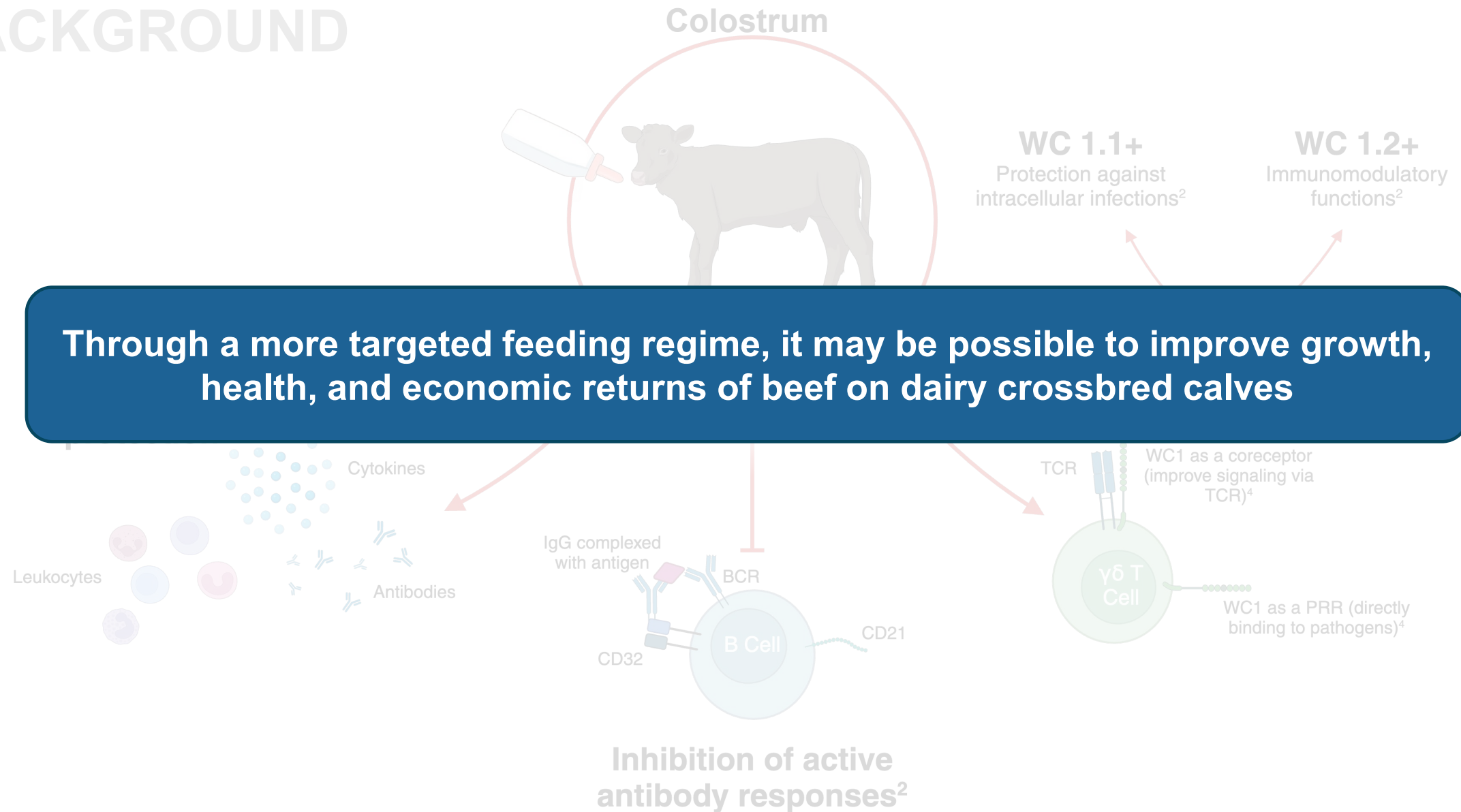


BACKGROUND



1. Chase et al., 2008; 2. Cangiano et al., 2024; 3. Krueger et al., 2016; 4. Guerra-Maupome et al., 2019

BACKGROUND



OBJECTIVE & HYPOTHESES

Objective:

- Explore the effects of **breed** and **colostrum quantity** in the first 12 hours of life on **IgG kinetics, health, growth, and blood lymphocyte profiles** in Holstein and Holstein-Angus crossbred bulls

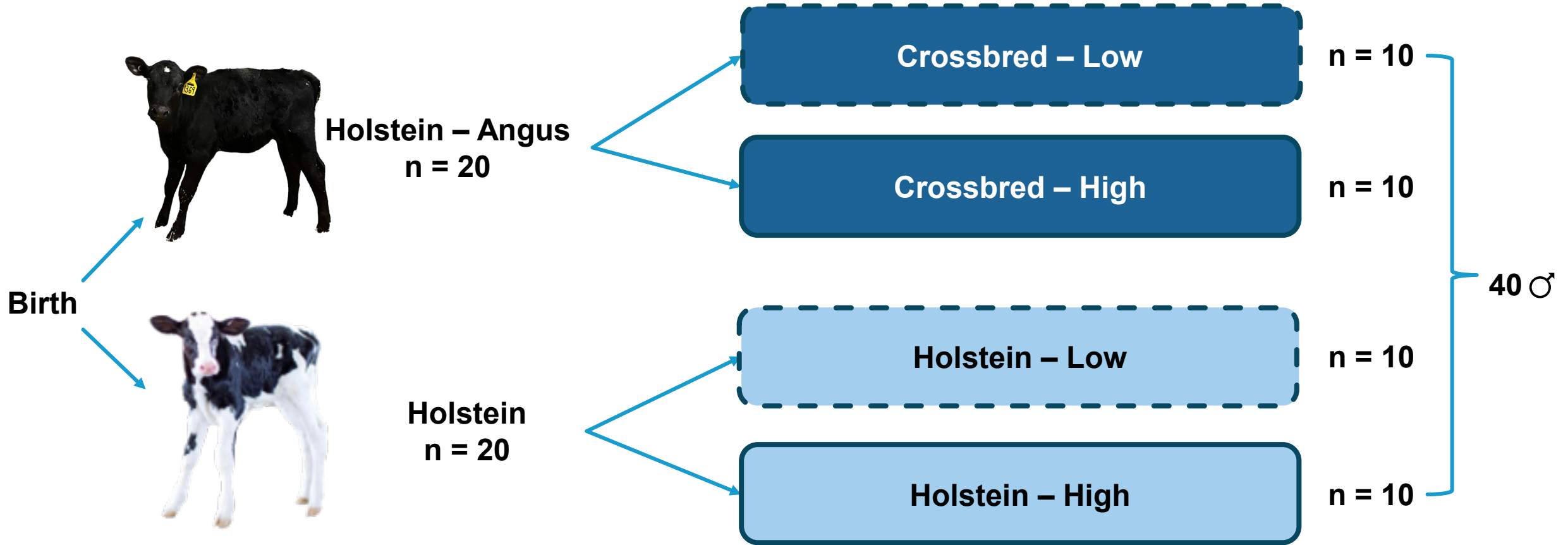
Hypotheses:

- Crossbred calves will have increased serum IgG concentrations, average efficiency of absorption (AEA), and average daily gain
- Breed and colostrum quantity will alter lymphocyte profiles of peripheral mononuclear blood cells (PBMCs) and biomarkers of health resulting in changes in immune system development and function

MATERIALS & METHODS



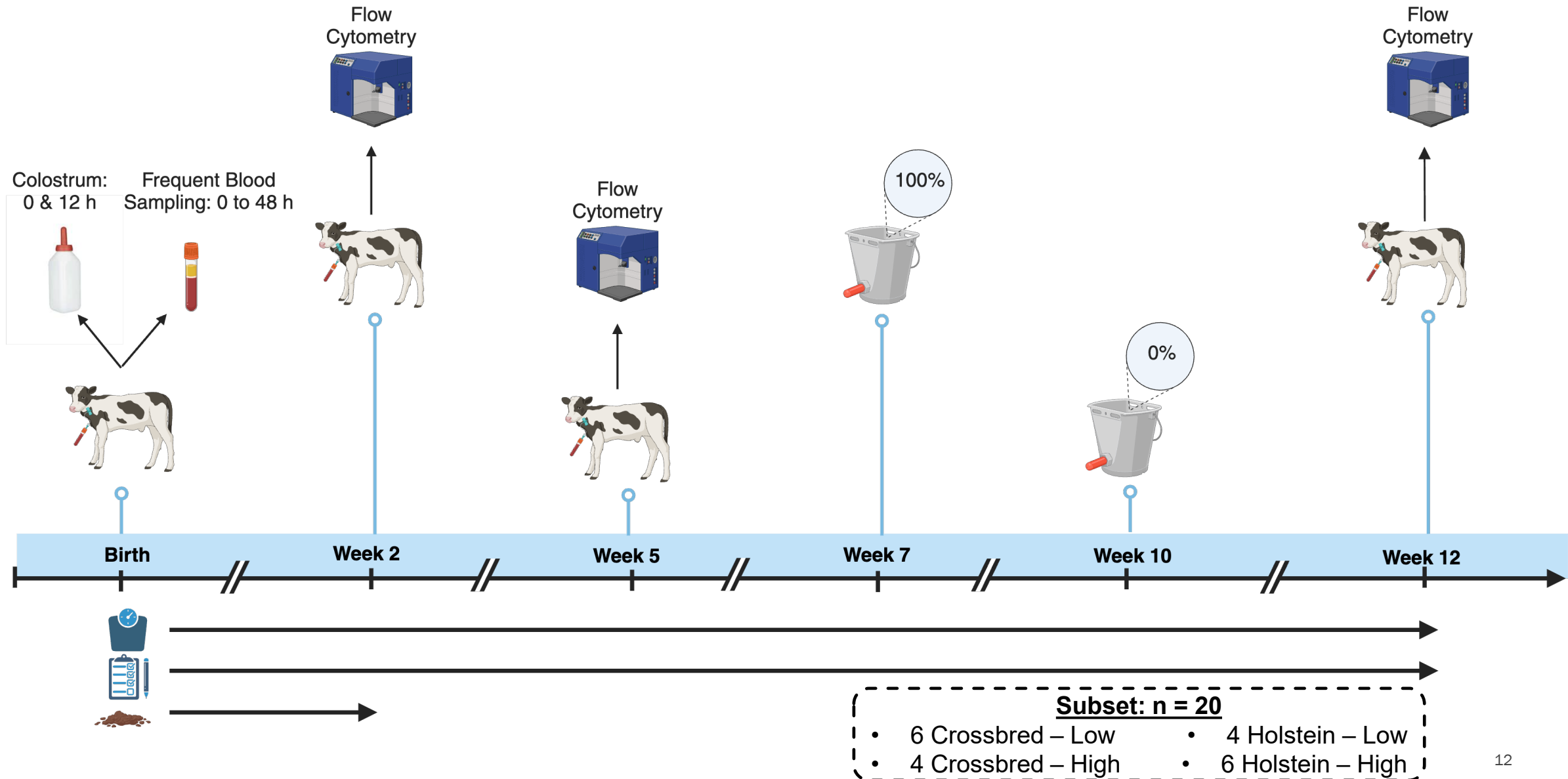
EXPERIMENTAL DESIGN



Low: Two meals of 27% IgG colostrum replacer containing 2.5 g of IgG per kg of BW at 0h and 12h of life
(3.5 ± 0.11 L; 236 ± 4.2 g of IgG)

High: Two meals of 27% IgG colostrum replacer containing 5 g of IgG per kg of BW at 0h and 12h of life
(7.0 ± 0.11 L; 470 ± 8.8 g of IgG)

SAMPLE TIMELINE



STATISTICAL ANALYSIS

Generalized linear mixed model procedure in SAS Studio (SAS 9.4M6, SAS® Studio, SAS Institute)

$$Y_{ijklm} = Y_0 + \mu + \text{Breed}_i + \text{Treatment}_j + \text{Time} + \text{Calf}_k + e_{ijkl}$$

Fixed effects: Breed and Treatment

Repeated measures: Time

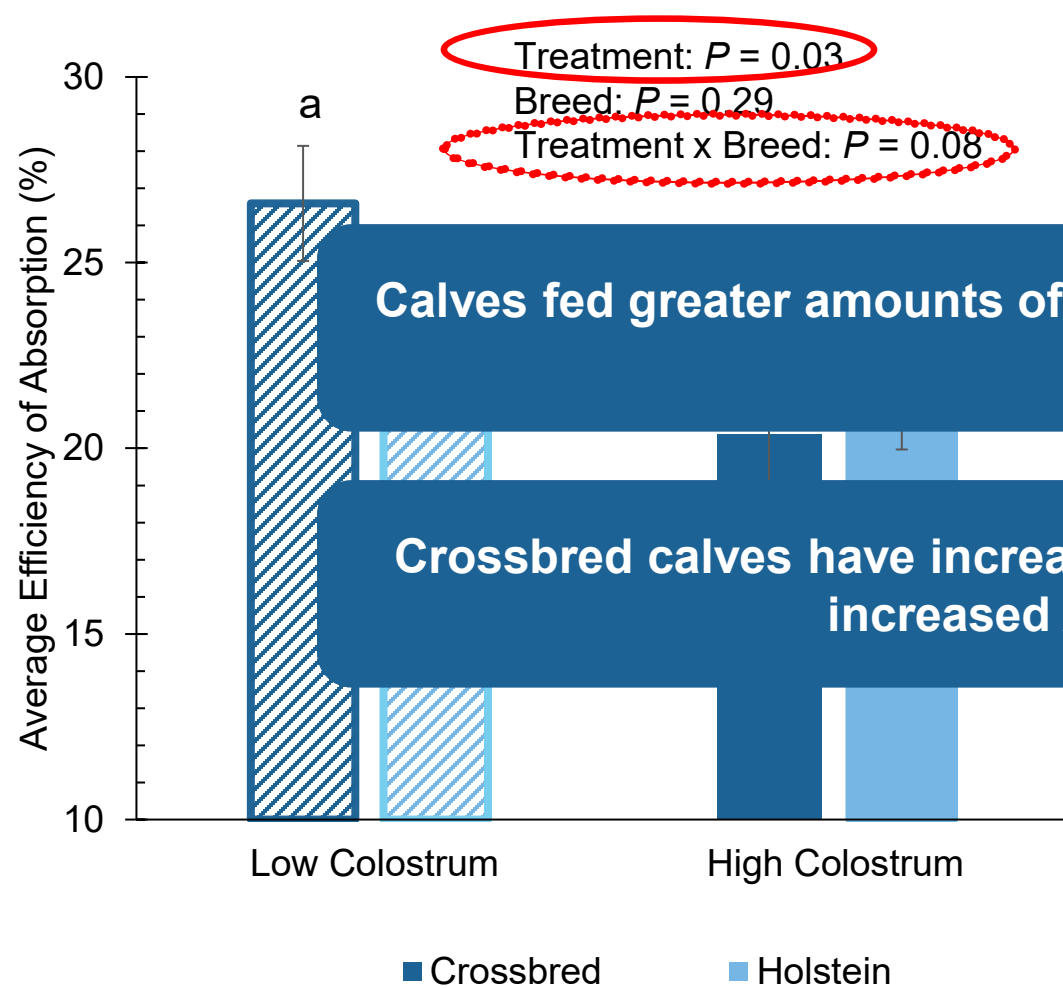
Random effect: Calf

Significance declared at $P \leq 0.05$ and tendencies at $0.05 < P \leq 0.10$

RESULTS

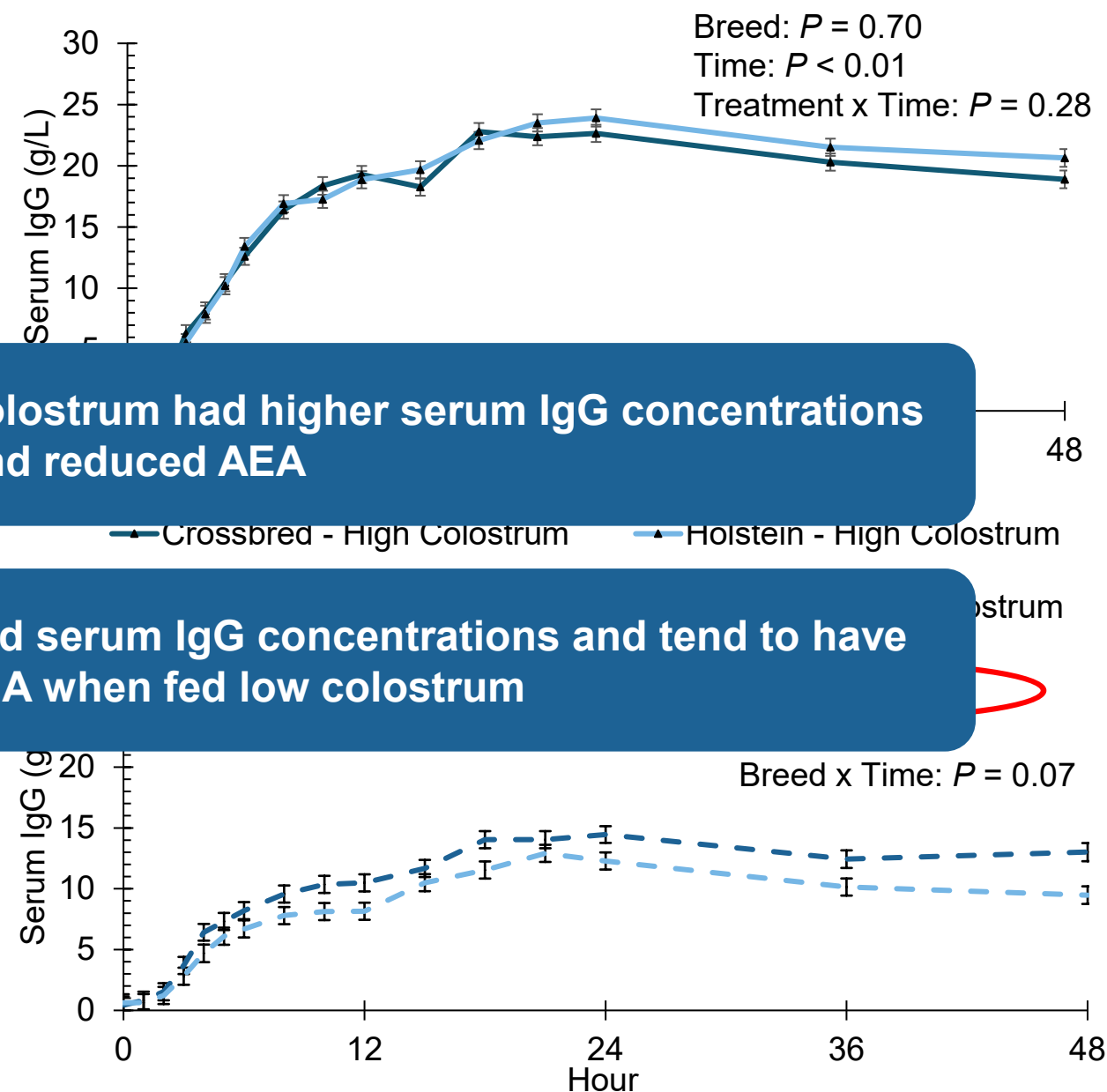


RESULTS: Serum IgG and AEA



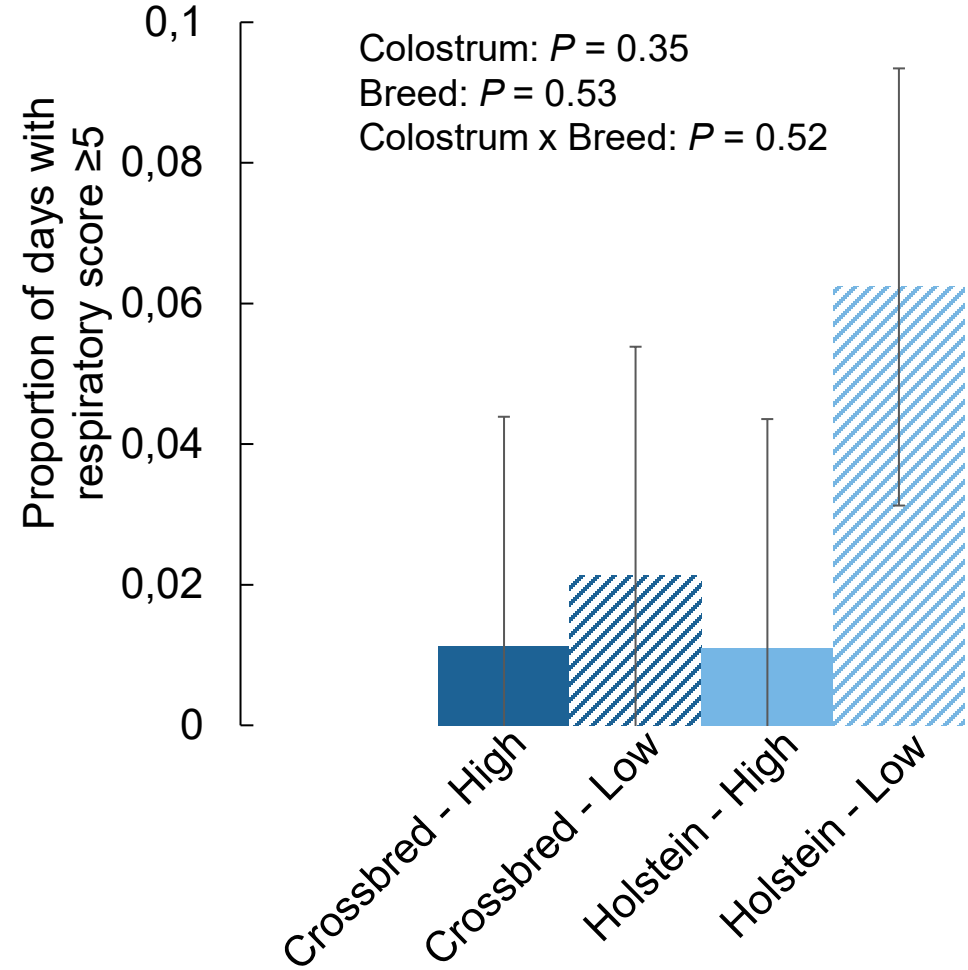
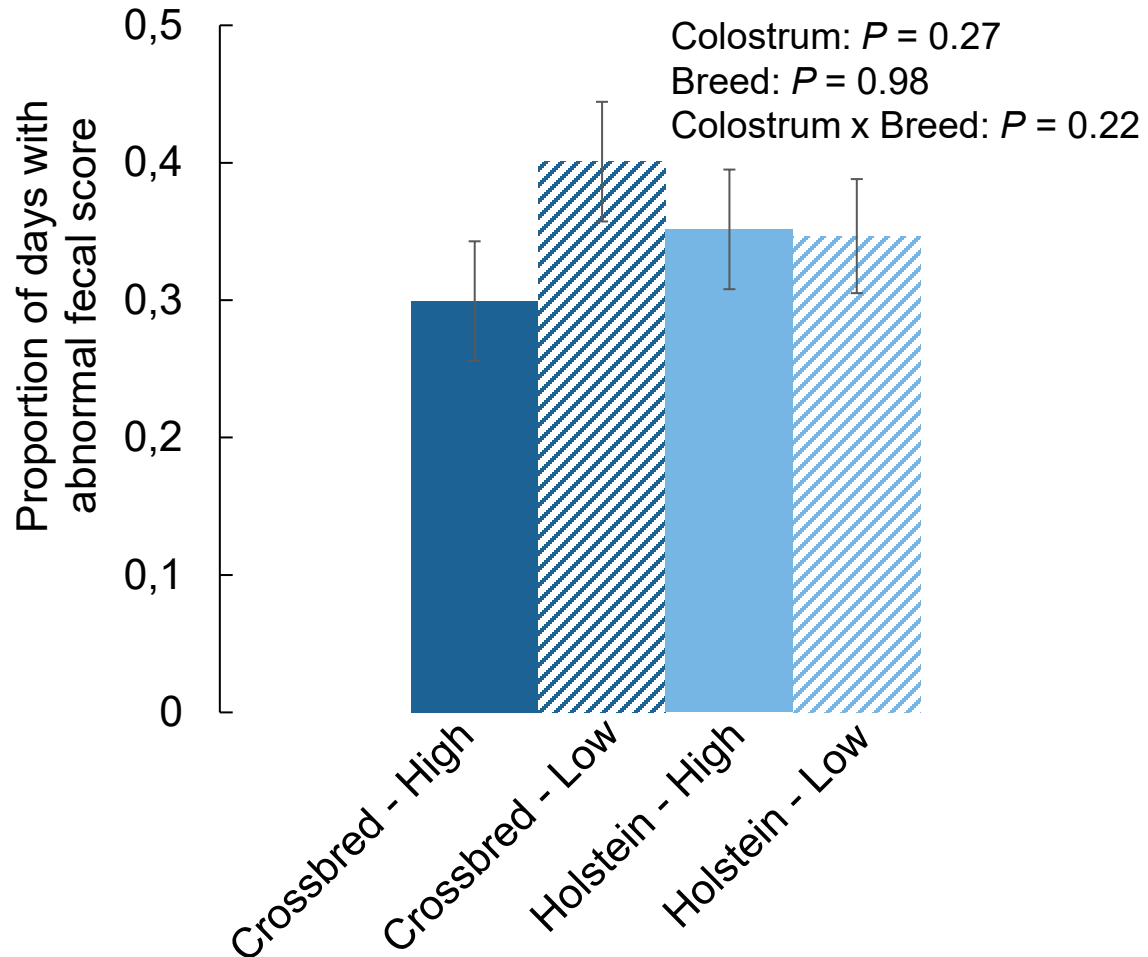
Calves fed greater amounts of colostrum had higher serum IgG concentrations and reduced AEA

Crossbred calves have increased serum IgG concentrations and tend to have increased AEA when fed low colostrum



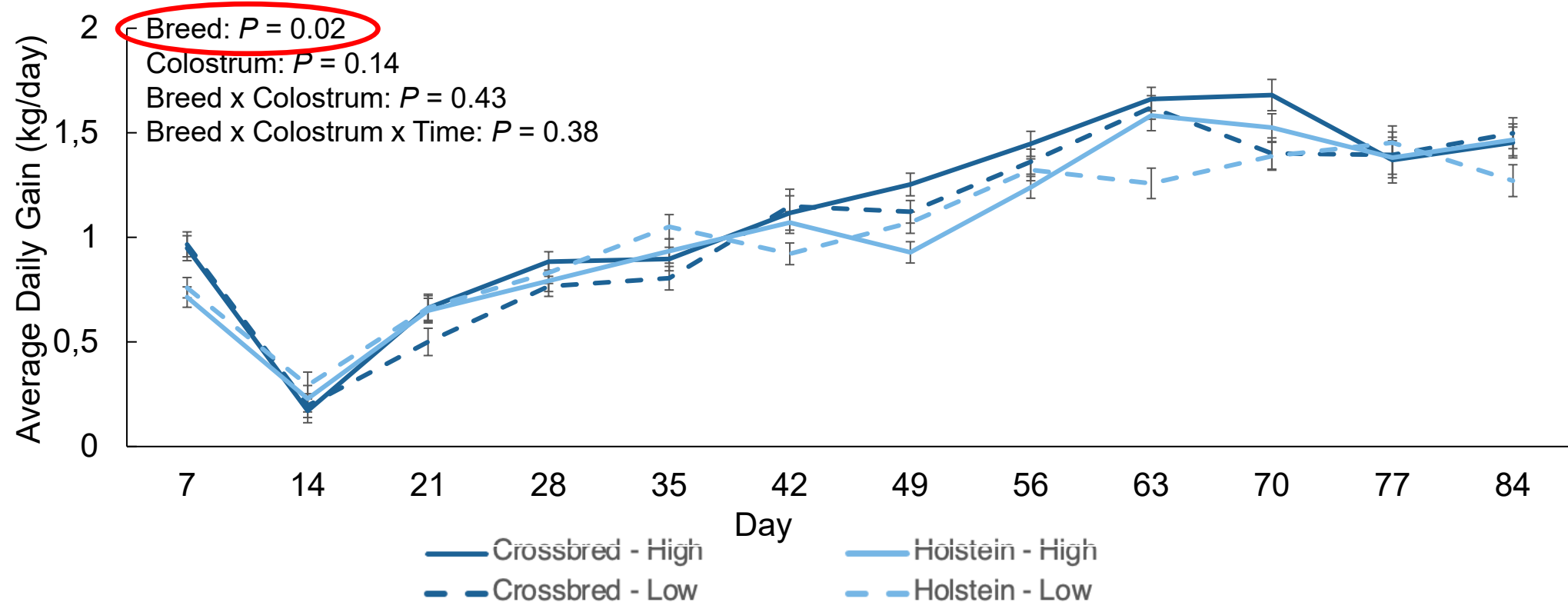
Values with different letters tend to be different.

RESULTS: Health



Breed and colostrum quantity had no impact on the incidence of diarrhea or bovine respiratory disease.

RESULTS: Growth Performance

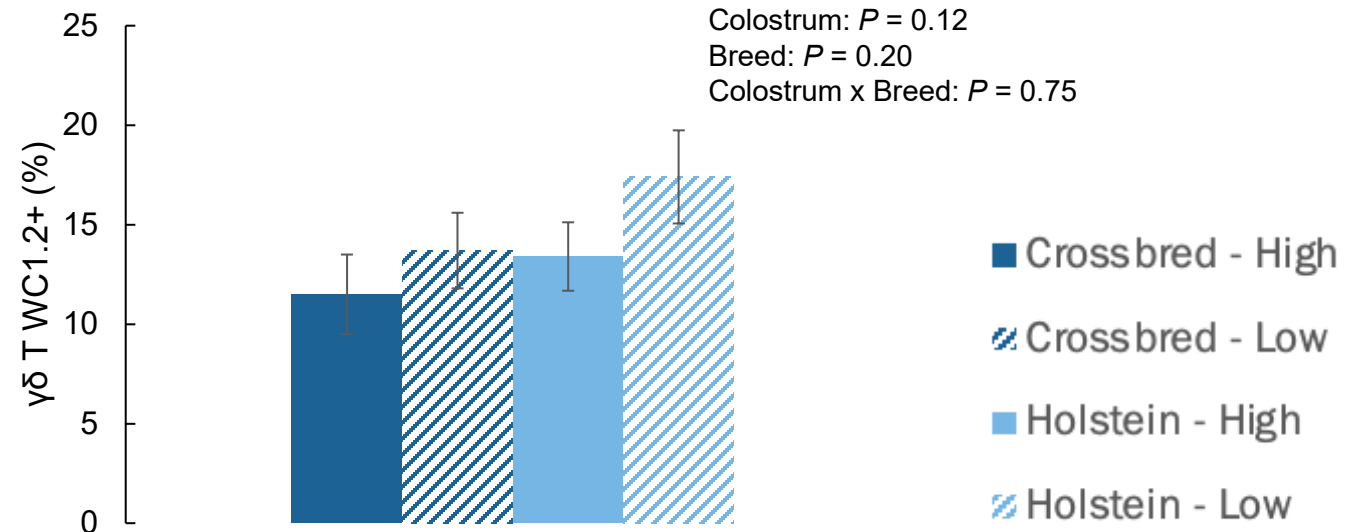
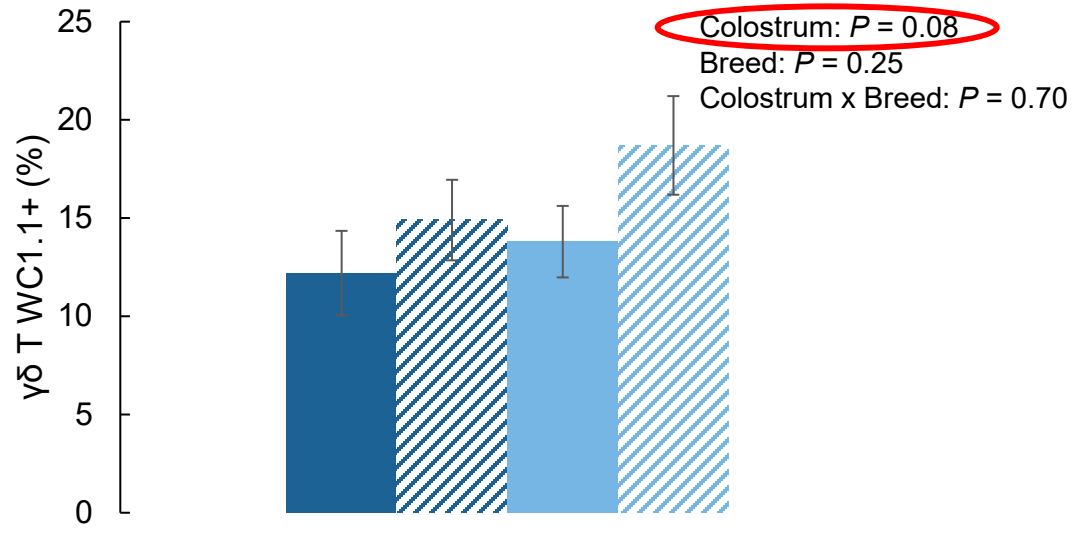


Crossbred: 1.1 ± 0.02 kg/day

Holstein: 1.0 ± 0.02 kg/day

Crossbred calves had increased average daily gain throughout the rearing phase.

RESULTS: Flow Cytometry

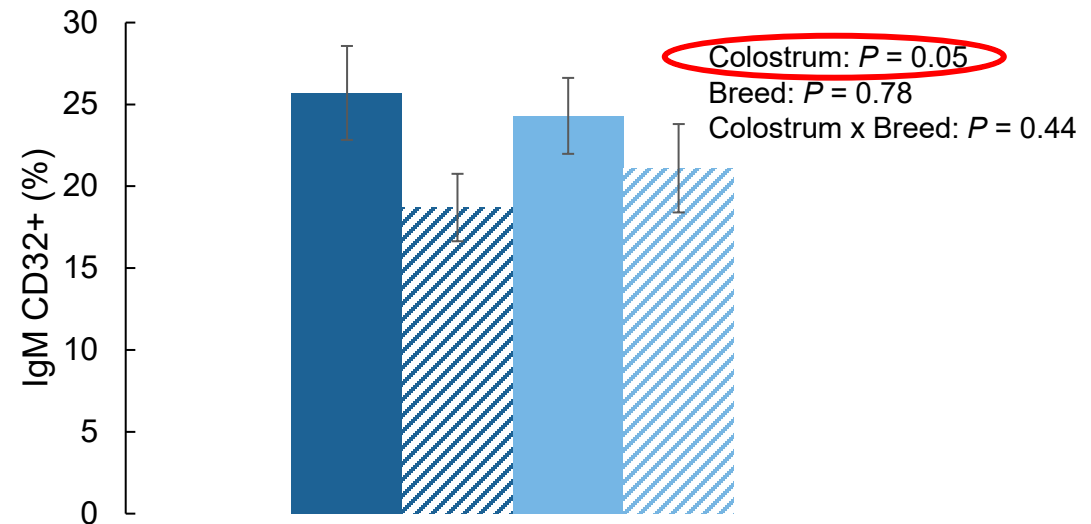
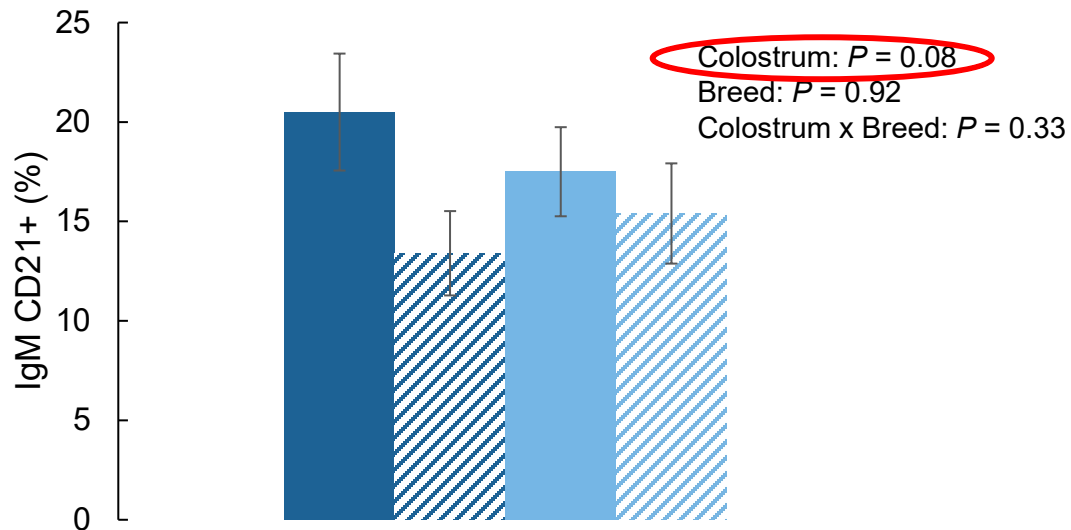


Breed did not have an impact on any of the cell subset
Treatment tended to alter the expression of certain cell markers.
GDT cells expressing WC1.1 tended to be the most abundant in calves fed LOW colostrum,
This suggests these calves have more cells involved in anti-viral responses.

RESULTS: Flow Cytometry

Naïve B cells expressing either CD 21 or 32 tended to be the most abundant in calves on the HIGH colostrum treatment
Suggesting that these calves have more cells involved in B cell activation and differentiation.

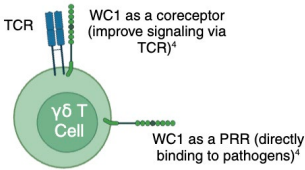
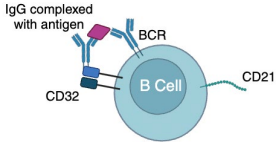
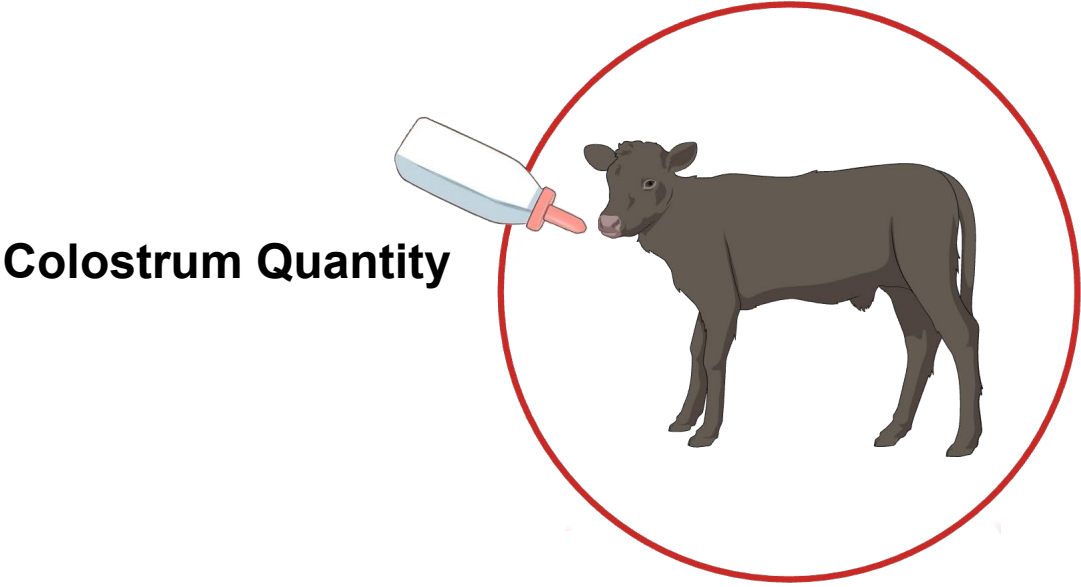
- Crossbred - High
- ▨ Crossbred - Low
- Holstein - High
- ▨ Holstein - Low





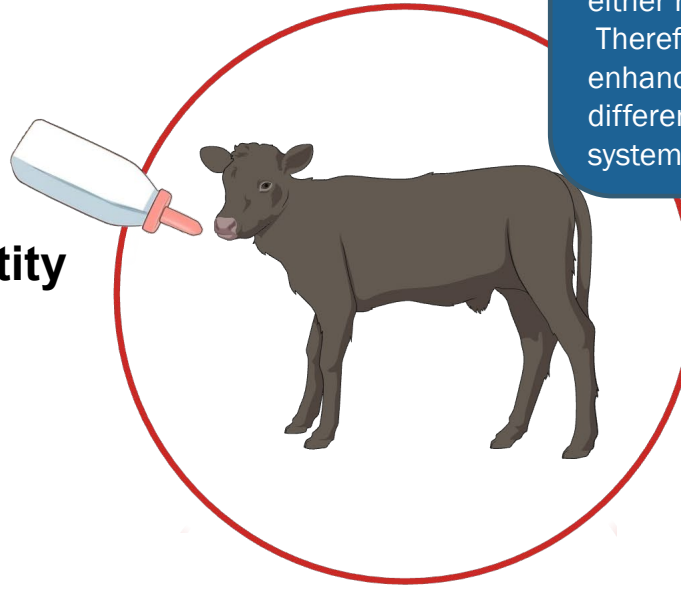
CONCLUSIONS

Take Home Messages



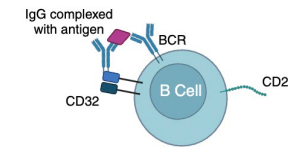
Take Home Messages

Colostrum Quantity



↑ **colostrum**: expected that would be a reduction in B cell activation due to a greater number of IgG complexes binding to CD32. However, when CD32 is bound, it only blocks the signal, and therefore does not reduce the expression of either receptor.

Therefore, the calves with higher expression of CD32 and CD21 may have enhances antigen presentation and improved B cell activation and differentiation, which all contributes to a more robust and efficient immune system of the calves.

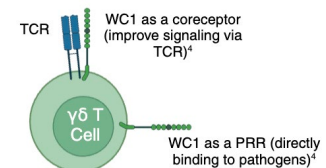


↑ **colostrum quantity** = ↑ IgM⁺ B cells expressing either CD21 or CD32

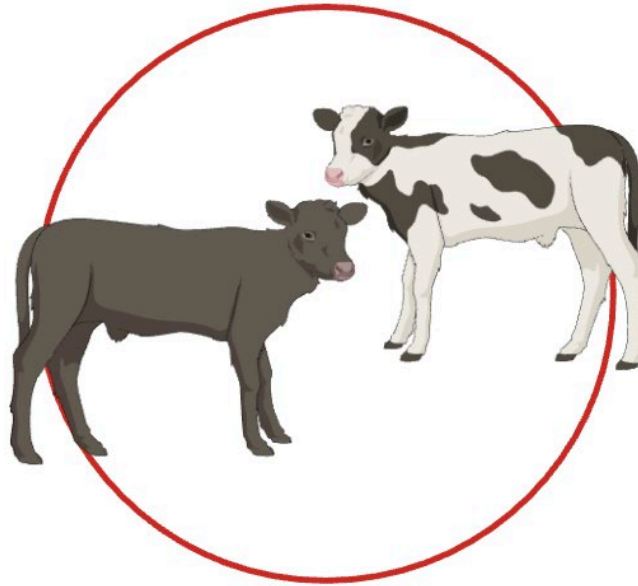
↓ **colostrum**: It suggests that these calves have a greater number of cells involved in clearance of viral infections

Compensate by upregulating the expression of WC1.1 to provide protection

↓ **colostrum quantity** = ↑ γδ T expressing WC1.1+



Take Home Messages



Breed Differences

Breed did not impact any of the health parameters, however crossbred calves had significantly higher ADG compared to Holstein calves

ACKNOWLEDGMENTS

