Supplementation of neonatal calves with fatty acids: nutritional modulation of the immune response

C.A. Kentler, B.B. Babatunde and T.L. Frankel
Department of Agricultural Sciences
La Trobe University
Bundoora, Victoria, 3086
Australia

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The Australian Dairy Industry

- Pasture based, seasonal calving
- Average herd size: 220 head (70% Friesian Holstein)
- Cows calve outside
- Calves reared in groups in outdoor sheds

Neonatal Calf Mortality

- **Most susceptible to disease from birth to weaning**
  - Neonatal mortality 2-10% in Australian herds
- **Most common cause of death and disease in Australian herds diarrhoea**
  - *Crypotosporidium parvuum*, *E. coli*, *Salmonella sp.*, Corona virus and Rotavirus

Peyer's Patches (PPs) and Serum IgG

PPs dynamic innate immune structures in small intestine

- Provide first line of defence
- Produce B cells for acquired immunity

Serum IgG indicates effectiveness of passive transfer and development of acquired immunity

Nutritional Modulation

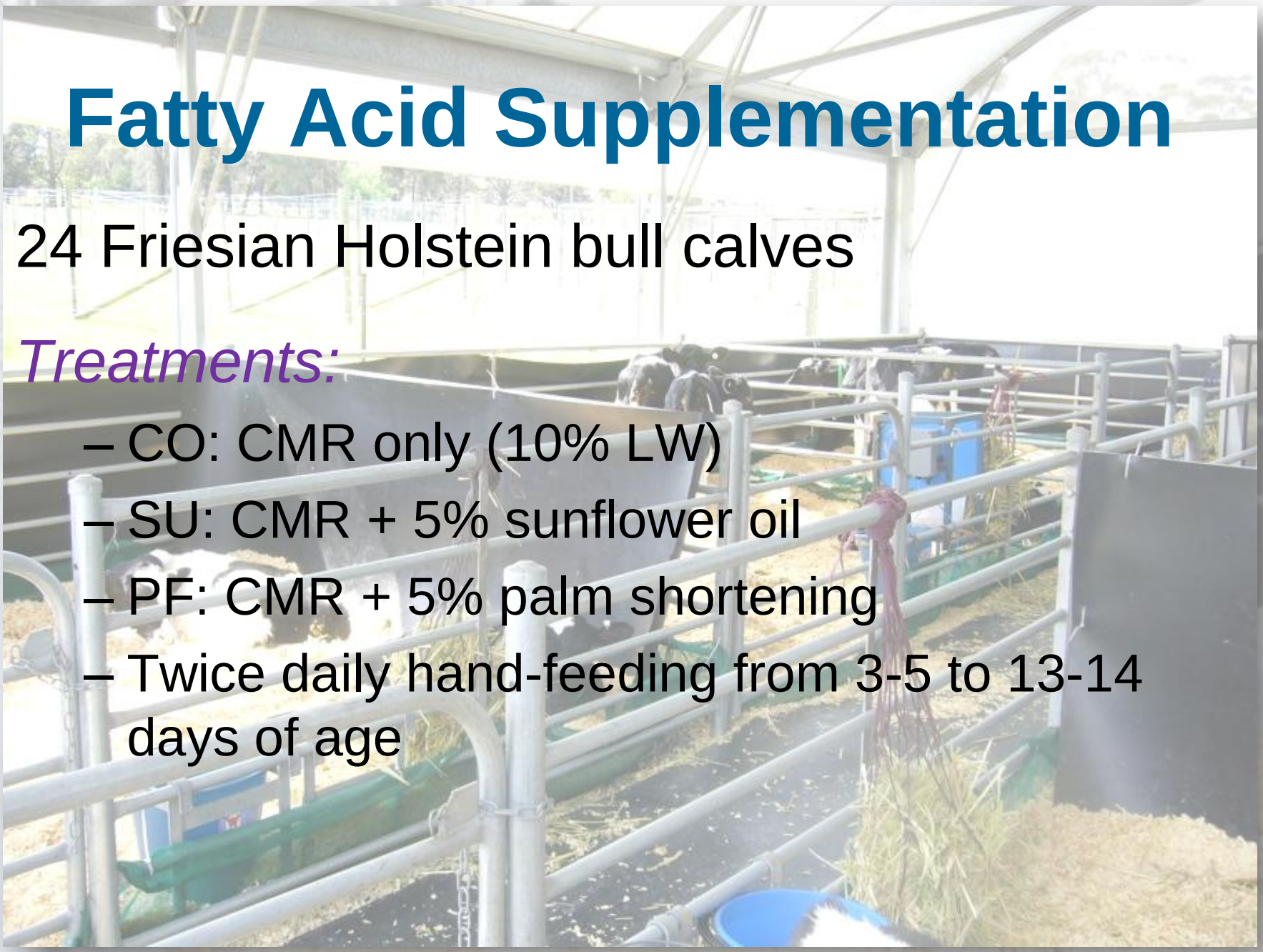
- Evidence suggests PP morphology can be altered by nutritional supplementation
- Nutritional support may assist in development of immunity
  - Stimulating mucosal growth/increasing innate response
  - Boosting/supporting immune response

Fatty Acid Supplementation

24 Friesian Holstein bull calves

Treatments:

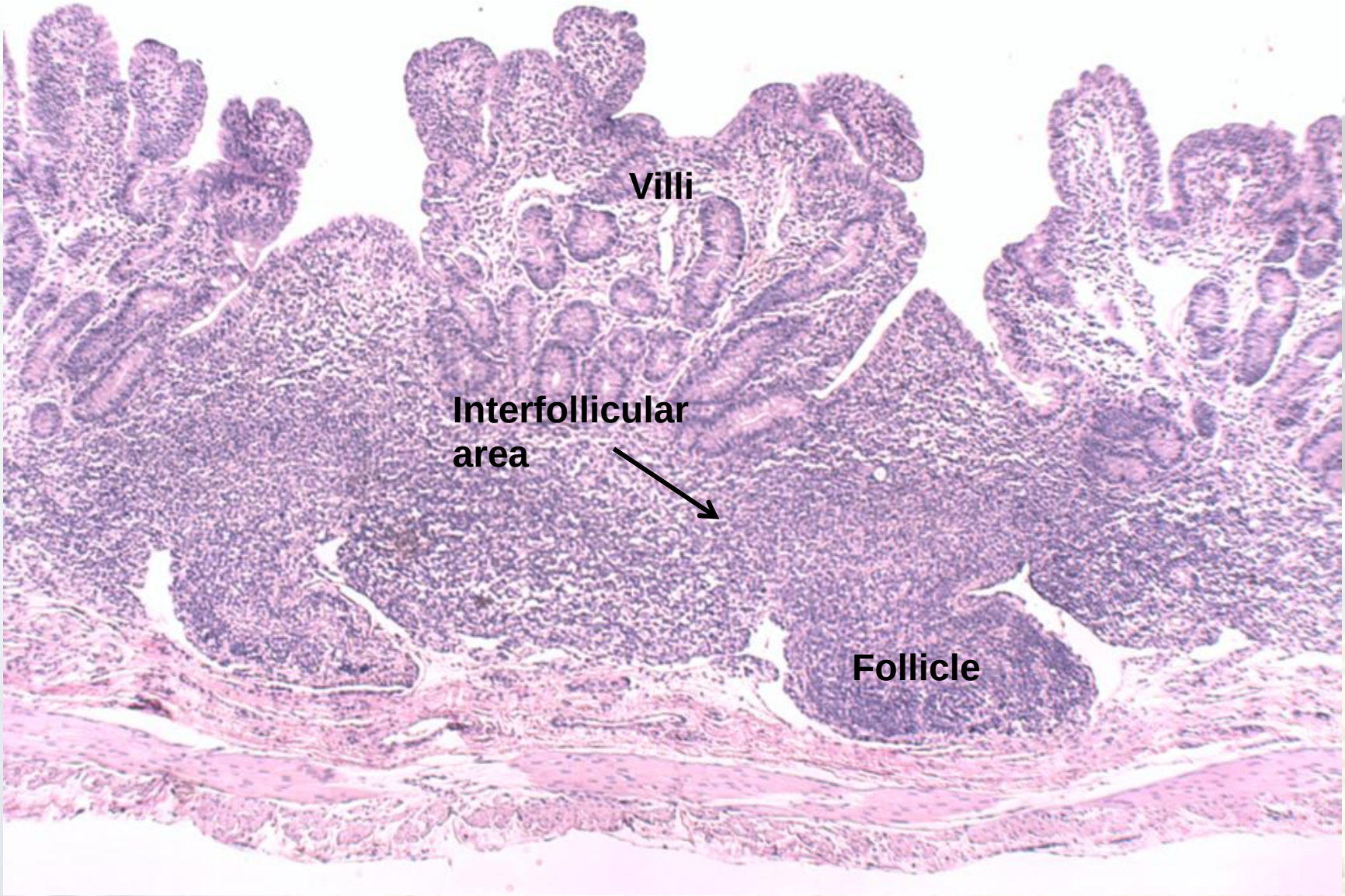
- CO: CMR only (10% LW)
- SU: CMR + 5% sunflower oil
- PF: CMR + 5% palm shortening
- Twice daily hand-feeding from 3-5 to 13-14 days of age



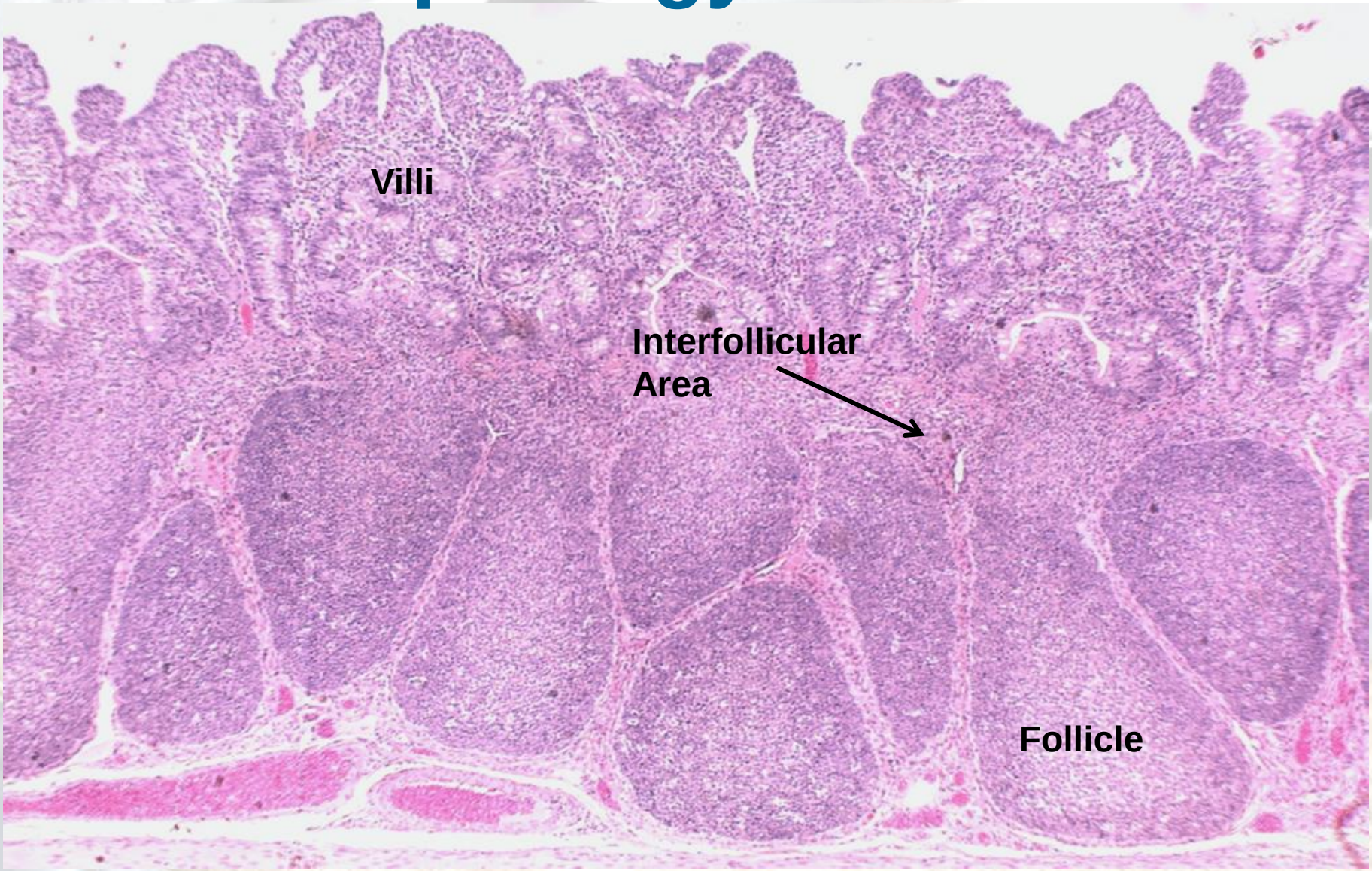
Sample Collection

- Blood samples taken at 3-5, 10 and 12 – 13 days of age
  - Serum removed; analysed by conjugate ELISA
- Calves euthanised at 13-14 days of age

Morphology: Jejunal PP



Morphology: Ileal PP



Morphology of JPPs

Treatment Group	IFA ($\times 10^3\ \mu m^2$)	VA ($\times 10^3\ \mu m^2$)	VH (μm)	VC (μm)
CO (N = 8)	57.3	153.2	737.1	2096.1
SU (N = 7)	45.0	158.5	772.0	2145.0
PF (N = 7)	47.5	155.6	770.0	2097.1

Morphology of JPPs

Treatment Group	FA ($\times 10^3\ \mu m^2$)	FH (μm)
CO (N = 8)	99.0^{ac}	278.5^{ac}
SU (N = 7)	116.2^{ab}	320.9^{ab}
PF (N = 7)	76.8^{c}	240.9^{c}

Different letters indicate significant differences; $p < 0.05$

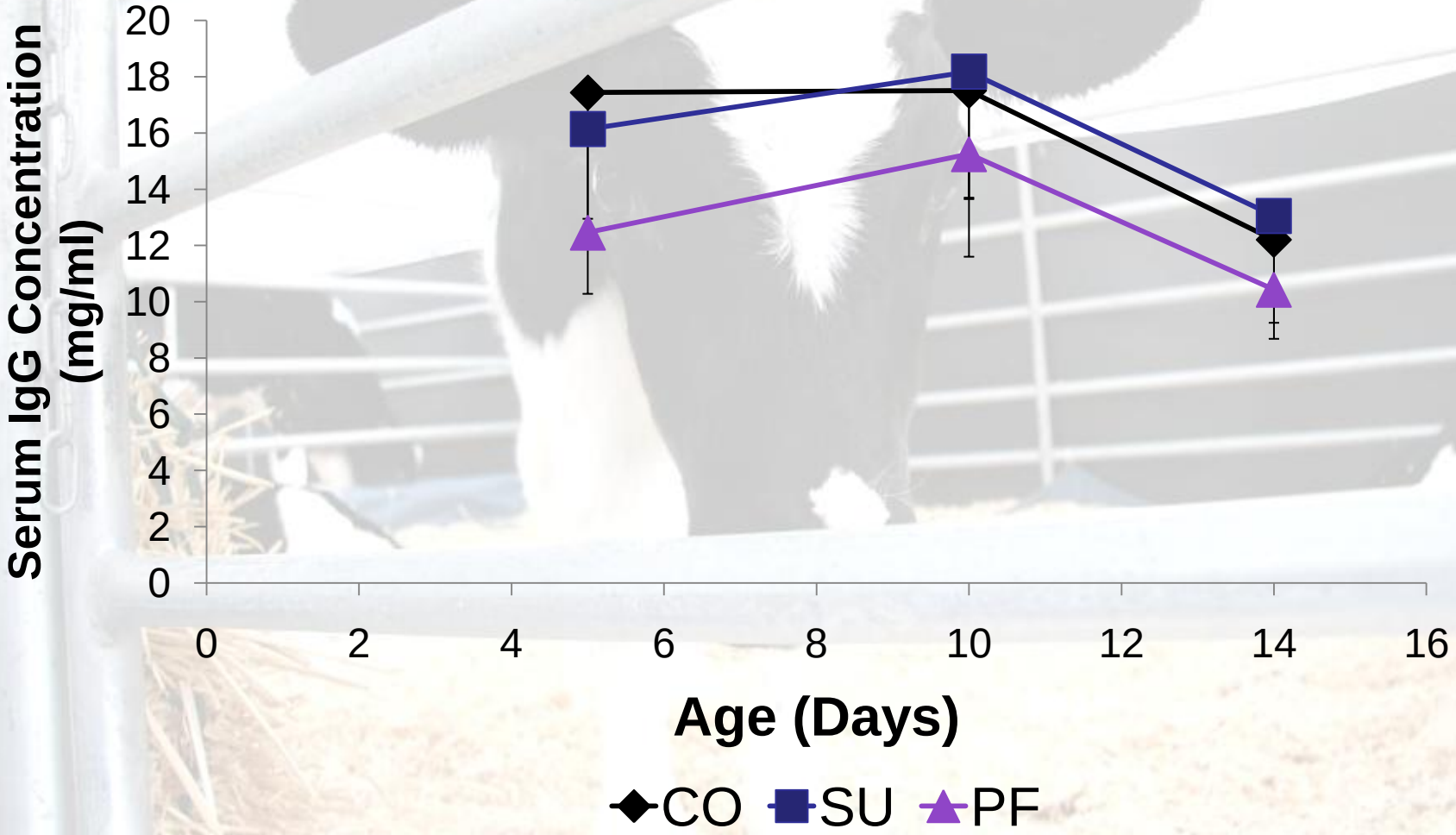
Morphology of IPPs

Treatment Group	VA (x 10^3 μm^2)	VH (μm)	VC (μm)
CO (N = 8)	128.7	601.1	1925.5
SU (N = 8)	132.0	600.6	1917.3
PF (N = 8)	137.9	606.0	1914.9

Morphology of IPPs

Treatment Group	FA ($\times 10^3\ \mu m^2$)	FH (μm)	IFA ($\times 10^3\ \mu m^2$)
CO (N = 8)	256.8	626.2	28.7
SU (N = 8)	249.7	671.9	37.4
PF (N = 8)	219.2	574.9	38.5

Serum IgG Concentration



CONCLUSIONS

Supplementation with 5% SU or 5% PF:

- Influences follicular morphology of JPPs (unsaturated vs saturated)
- Does not influence IPP morphology
- Does not influence serum IgG concentration
- Does not influence morbidity outcomes

FINALLY…

- What is the relationship between follicle size, immune cell proliferation, PP gross morphology and long term health outcomes?
- Understanding vital to:
  - Improving feed formulation
  - Decreasing calf mortality and morbidity
  - Increasing economic return

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