Advances in Colostrum Management

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  - Saskatoon Colostrum Company (Saskatoon, SK)
- Participating dairy farms and staff
- Student and laboratory technicians

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Key Management Areas for Preweaned Calves

- Maternity pen management
- Care of newborn calf
- **Colostrum management**
- Housing and sanitation
- Preweaning nutrition
- Disease detection and treatment

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- Goals for the colostrum program:
  - > 90% of calves with serum IgG > 10 mg/mL
  - Get 150 – 200 g IgG into the calf ASAP
- The 5 Q's of a colostrum management program
  - Quality: > 50 g/L IgG
  - Quantity: 10% BWt (~4 qts)
  - Quickness: 1-2 hrs (< 6 hrs)
  - SQueeky clean (bacterial contamination)
  - Quantifying passive transfer (monitoring)

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Outline

- New tools for monitoring:
  - Colostrum quality
  - Passive transfer in calves
  - Wet lab
- Methods to reduce microbial exposure:
  - Use of Colostrum replacers:
  - Heat-treating colostrum:

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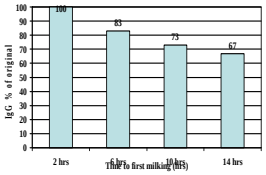
Colostrum Quality

- Goal:
  > 50 g/L IgG in colostrum
- Factors affecting quality:
  - Dry cow vaccination program
  - Feed balanced dry cow ration
  - Avoid dry cow stress (heat, crowding)
  - Avoid short dry periods (< 21 days)
  - Milk cows within 1-2 hrs (max 6 hrs)



Moore et al., J.A.V.M.A. 2005. 226:1375
13 cows – 52 quarters

Cow-side Tests of Colostrum Quality: Colostrometer or Brix Refractometer

	Instrument Cutpoint Used	Sensitivity (%)	Specificity (%)	Cost	Pros / Cons
Colostrometer IgG < 50 g/L (Chigerwe, JAVMA 233: 2008)	Green	75% (recc: cutpoint 70)	87%	$40	Rapid, Simple / Fragile, Temperature dependent
Optical Brix Refractometer IgG > 50 g/L (Bielmann JDSci. 2010)	≥ 22% Brix scale	90.5%	85%	$80 - $300	Rapid, Simple, Not temp. dependent

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MISCO Palm Abbe Digital Refractometer

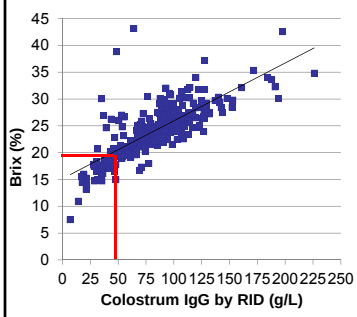
- $300 - $500
- Rapid
- Simple
- Durable
- Samples should be at room temp.

Scales:

1. Brix (%) * :
   i) Estimate colostrum IgG
   ii) Estimate milk TS
   iii) Estimate serum IgG
2. Serum Total Protein (g/dL) *
3. Predicted colostrum IgG (g/L) **
4. Predicted serum IgG (mg/mL) **

* Validation looks good.
** Very poor scales – Don't use.

Results: Colostrum
Palm Abbe Brix (%) vs IgG by RID (g/L)



Accuracy to Diagnose good colostrum (IgG ≥ 50 g/L) was best with Brix cutpoint of ≥ **19%**:

True prevalence= 83%

Sensitivity = 98%
Specificity = 76%
Overall accuracy = 94%
PPV = 95%
NPV = 90%

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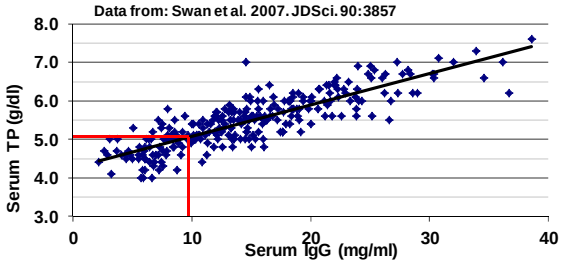
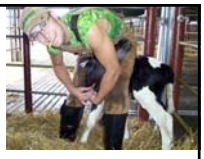
On-farm monitoring of serum total protein to evaluate the colostrum program

refractometer



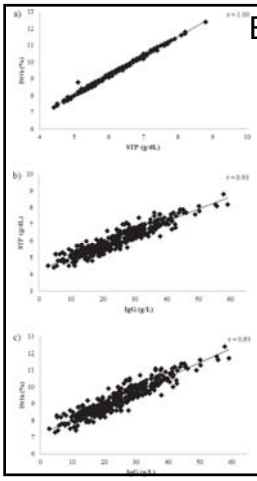
- 5.0 or 5.2 g/dL STP value to predict serum IgG of 10 mg/ml:
  (Calloway, et al., 2002)

On-farm monitoring of serum total protein to evaluate the colostrum program



- How?
  - Bleed 12 clinically normal calves 24 hrs – 7 d old
  - Let blood clot, test serum with refractometer
  - Interpret results at the group level

- Goal:
  ≥ 90% of calves should have TP ≥ 5.2 g/dl
  (Tyler. 2003. p.c.)
  or ≥ 80% of calves should have TP ≥ 5.5 g/dl
  (McGuirk, 2006)
- Is higher better? **YES**



Brix (%) or STP (g/dL) can Estimate Serum IgG

(Deelan et al., JDSci. 2014. 97:in press)

400 calves sampled 3-6 days old

STP Refractometer:
- Cutpoint 5.5 g/dL
  - SE = 76.3%
  - SP = 94.4%

MISCO Brix:
- Cutpoint 8.4%
  - SE = 88.9%
  - SP = 88.9%

Summary: Uses of refractometers?

- Optical or digital
- STP scale (g/dL):
  - Estimate serum IgG in calves: 10 g/L IgG ≥ 5.2 g/dL (group level interpretation)
- Brix scale (%):
  - Estimate TS in whole milk or milk replacer
  - Identify high vs low quality colostrum: 50 g/L IgG ≥ 19%
  - Estimate serum IgG in calves: 10 g/L IgG ≥ 8.4% (group level)
- MISCO Palme Abbe digital refractometer serum IgG and colostrum IgG scales: Don't use (grossly underpredict IgG)

Outline

- New tools for monitoring:
  - Colostrum quality
  - Passive transfer in calves
  - Wet lab
- Methods to reduce microbial exposure:
  - Use of Colostrum replacers:
  - Heat-treating colostrum:

How often do producers feed contaminated colostrum?

- Goal:
  - TPC < 100,000 cfu/ml
  - TCC < 10,000 cfu/ml

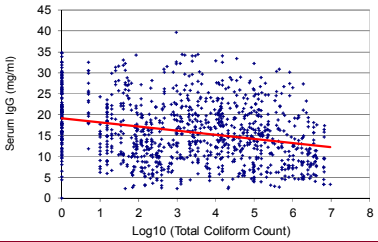
Sheila McGuirk
UWI-Madison

Sam Leadley
Attica Vet, NY

- National study: 43% of 827samples from 67 herds exceeded limit
  (Morrill et al., 2012. JDSci 95:3997)

Consequences of microbial contamination of colostrum?

- Pathogens may cause disease
  (e.g. *E. coli*, *Salmonella* spp., *Mycoplasma* spp., *M. avium* subsp. *paratuberculosis*)
- Bacteria counts are associated with ↓ serum IgG levels
  James et al., JDSci 1981; Poulson et al., ACVIM 2002; Godden et al., JDSci 2012



Critical Control Points to Reduce Contamination


- Cow
  - Identify infected cows (MAP)
  - Don't let calf suckle dam
  - Udder prep
  - Don't pool raw colostrum



- Equipment
  - Sanitation of milking, storage & feeding equipment


- Proliferation
  - Feed ASAP (< 1-2 hrs)
  - Refrigerate (< 48 hrs)
  - Freeze
  - Preservatives
- Replacers, Heat-treating

Colostrum Supplements and Replacers: Outline

- Definitions & places for use on dairies
- Manufacture & licensing
- Evaluating efficacy
- Monitoring pasive transfer

Colostrum Supplements

Calf's Choice Total Gold – 60 g
Saskatoon Colostrum Co.

- $9 to $18 USD per dose
- Lacteal or serum-derived IgG
- 25 to 60 g IgG per dose
  - Inadequate IgG and nutrients if fed alone
- Intended to supplement poor quality or inadequate volume of maternal colostrum:
  - No value to supplementing high quality MC
  - Useful if supplementing low quality MC
    (Thompson and Heusel, AABP, 2014)

Lifeline Protect- 50g
APC, Inc.

Colostrum Replacements

- $25-40 USD per dose
- Lacteal or serum-derived IgG
- 100 to 150+ g IgG per dose
- Includes nutrients
- To replace maternal colostrum (MC):
  - Convenient: mix & feed
  - Use if inadequate supply of MC
  - Infectious disease control (e.g. Johne's)

Land O' Lakes CR – 100 g
Saskatoon Colostrum Co.

Calf's Choice Total HiCal
100 g; Sask. Colostrum Co.

Colostrx 130 - 130g
APC, Inc.

Manufacture

- Lacteal-derived products:
  - Fresh frozen colostrum from Grade A dairies
  - Pooled, heat-treated, spray dried, packaged
  - Non-Ig components (e.g. nutrients) unchanged

Land O' Lakes CR – 100 g
Saskatoon Colostrum Co.

- Serum-derived products:
  - Collect blood at USDA inspected abattoirs
  - Centrifuge to separate serum, spray dry serum to 20% Ig powder,
  - No nutrients: must add nutrient pack

Colostrx 130 - 130g
APC, Inc.

CVB-Licensed CR or CS Products

- CFIA (all) or USDA Center for Veterinary Biologics (CVB)
- From bovine colostrum
- Can claim 'for prevention or treatment of FPT'
- Accepted protocols for manufacture & testing
- Each batch tested by CVB lab to guarantee:
  - Purity: Specified TPC; NO Coliforms, Salmonella or fungi
  - Potency: Minimum IgG content
  - Efficacy: ≥ 10 mg/ml serum IgG) in 90% of calves
  - Traceability
- Annual plant inspection by CVB
- Some do additional testing
  (e.g. Sask. Colostrum Co. tests each batch for *M. paratuberculosis*)

Selected examples of CVB-licensed colostrum replacement (CR) or supplements (CS)

CR's

Calf's Choice
Total HiCal – 100 g
Saskatoon Colostrum Co.

Land O' Lakes CR – 100 g
Saskatoon Colostrum Co.

Colostrum Plus 100
La Belle Associates

CS's

Calf's Choice Total Gold – 60 g
Saskatoon Colostrum Co.

Kid or Lamb's Choice Total
Saskatoon Colostrum Co.

Immu-Start 50 Bovine IgG
Immu-Tek

Non-Licensed CR or CS Products

- AAFCO Guidelines (Assoc. Am. Feed Control Officials):
  - Not a feed, but is being used in feeds
  - Each State (Dept. of Ag) adopts its own guidelines
  - No federal or state system to regulate or test
  - No product testing or plant inspections unless complaints brought to State Dept. of Ag.
  - Internal quality testing program at manufacturer's discretion
- Cannot claim 'for prevention of FPT'
- Ig may be from bovine colostrum or serum

Selected examples of non-licensed colostrum replacement (CR) or supplements (CS)

CR's

Lifeline Rescue, 150g; APC, Inc.

Colostrx 130 APC, Inc.

150 Benefit La Belle Associates

First Day Formula 150g; Milk Products

CS's

Lifeline Protect, 50g; APC, Inc.

Colostrx Multi Species 20g; APC, Inc.

Ranch 40 La Belle Associates

First Day Formula 60g; Milk Products

Dose of IgG (g) Fed

Land O' Lakes CR – 100 g Saskatoon Colostrum Co.

- Most CR products include 100-130 g IgG

but

- Really need 150-200 g IgG if expect ≥ 90% calves to pass (serum IgG ≥ 10 mg/mL)

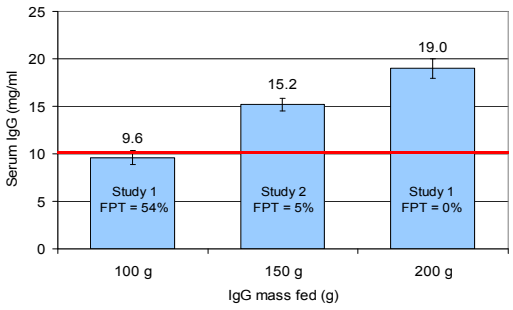
Land O' Lakes CR Tub Saskatoon Colostrum Co.

- How to get to 150-200 g IgG?
  - Some products provide larger dose (e.g. 150 g/dose)
  - Large tubs: Operator determines the dose
  - Feed multiple doses

Calf's Choice Total Gold – 60 g Saskatoon Colostrum Co.

Dose response of serum IgG to IgG mass fed

(Godden et al., 2009. JDSci. 92:1750-1757)



Conclusion: Producers wishing to reduce the risk of FPT may opt to feed higher doses IgG (150-200 g) in Colostrum Replacers

Comparing Efficacy of Supplement and Replacement Products

- Ask for the data:
  - Many products are untested
  - Head-to-head controlled trials needed to make comparisons
- Factors to evaluate:
  - Serum IgG in calves (mg/mL)
    - Dose of Ig (g) fed
    - Efficiency of absorption of IgG (%)
  - Calf health
  - Future performance
  - Disease control (e.g. Johne's)

Sample of Colostrum Replacement Product Comparative Efficacy Studies

Study	Tx Group	IgG fed (g)	AEA (%)	Serum IgG (mg/mL)
Godden et al., JDSci 2009	MC – 3.8 L (71 g/L)	271 g	32%	20.7 [a]
	LOL CR-1 dose	100 g	36%	9.6 [b]
	LOL CR-2 doses	200 g	37%	19.0 [a]
Place et al., AABP 2010	LOL CR-1.5 doses	150 g	38% [a]	14.7 [a]
	Colostrx 130 – 1 dose	130 g	28% [b]	9.6 [b]
Priestley et al., JDSci 2013	MC – 3.8 L (NR)	NR	NR	21 [a]
	Calf's Choice Tot Silver -1 dose	100 g	38.8% [a]	11.4 [b]
	Acquire 150 – 1 dose	150 g	21.6% [b]	9.3 [b]

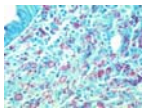
Final serum IgG is a function of dose fed (g) and absorption (%)

Role of Colostrum Replacements in Disease Control Programs?

- Though fecal-oral transmission is most common, MAP can be shed in colostrum and milk of subclinically infected cows

  (Sweeney et al. J.Clin.Micro. 1992. 56; Streeter et al., J. Clin. Micro. 1995. 30)

  - Can one feeding of colostrum cause infection with MAP?
  - Will use of a colostrum replacer prevent MAP transmission?



Risk of MAP Infection in Calves Fed Raw Colostrum or a Colostrum Replacer

(Pithua et al. 2009.J.A.V.M.A. 234:1167-1176)

Newborn heifer calves from 12 herds (N = 497)

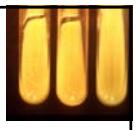
maternal colostrum (n = 261)

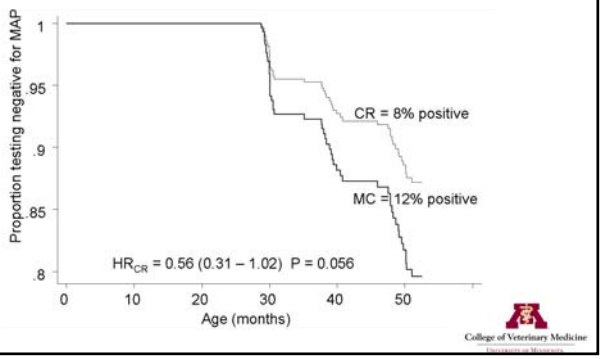
colostrum replacer (n = 236)

Acquire / Secure APC, Inc.

Adult Period: 1st calving to 54 mos:
- Fecal culture and serum ELISA for MAP at 30, 42 and 54 mos.

Results:
Calves fed a colostrum replacer had reduced risk for MAP infection





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Monitoring Serum Total Protein Measures when Feeding Colostrum Replacers

- Maternal colostrum:
  - STP 5.0 or 5.2 g/dL ≈ 10 mg/mL IgG

- Colostrum-derived colostrum replacers:
  - STP 5.0 or 5.2 g/dL ≈ 10 mg/mL IgG
- Serum-derived colostrum replacers:
  - STP ??? = 10 mg/mL IgG
  - STP values vary between 4.2 to 5.4 g/dL between studies and products:
    - e.g. 4.75 g/dL for Colostrx 130 (Place et al., 2010)
  - If STP values are not published for a specific product, do direct testing of IgG (ELISA, RID, zinc sulfate-turbidity)

Summary on Selection and Use of Colostrum Supplements and Replacers

- Supplements are NOT replacers
- Must feed 150-200 g IgG for acceptable passive transfer.
- Considerations in selecting a product:
  - Ask for the data: independent research describing efficacy?
    - IgG Dose; AEA (%); Passive transfer levels in calves
    - Must have head-to-head studies to make direct comparisons
- Monitoring FPT using STP: Cutpoints will depend on CR product type

Outline

- New tools for monitoring:
  - Colostrum quality
  - Passive transfer in calves
  - Wet lab
- Methods to reduce microbial exposure:
  - Use of Colostrum replacers:
  - Heat-treating colostrum:

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Outline: Heat-treating Colostrum

- Review of effects of heat-treatment on:
  - Colostrum characteristics
  - Calf health
- Novel methods to treat colostrum – Do they work?
  - Perfect Udder Bag
  - UV treatment
- 'Must do's" when heat-treating colostrum

Developing a Method to Heat-treat Colostrum

- Traditional Pasteurization (PMO):
  - Continuous flow (72 °C x 15 sec) or Batch (63 °C x 30 min)
  - Unacceptable thickening
  - 25-32% [illegible] (mg/ml)
  - Lower serum IgG in calves

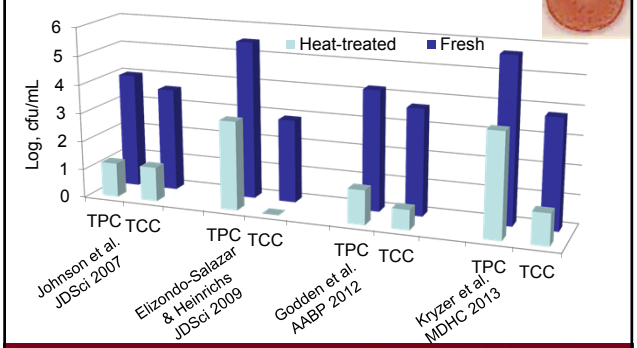
(Gre[illegible]al. [illegible]i. 2003. 86:246; Go[illegible]n et al. [illegible]ci. 2003. 86:1503)

- Heat-treat: 60 °C (140 °F) x 60 min
  - No viscosity changes
  - No change in colostrum IgG (g/L)
  - Significantly reduce or eliminate *MPTB, Salmonella, Mycoplasma, E. coli*….

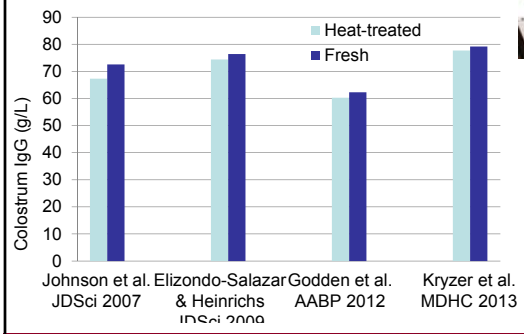
(McMartin et al. JDSci. 2006. 89:2110

Heat-treatment reduces colostral bacteria counts

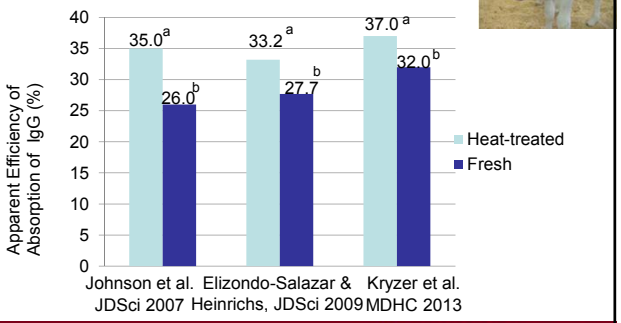
(TPC = Total Plate Count; TCC = Total Coliform Count)



No effect of heat-treatment on colostral IgG levels



Calves fed heat-treated colostrum have improved absorption of IgG (%)



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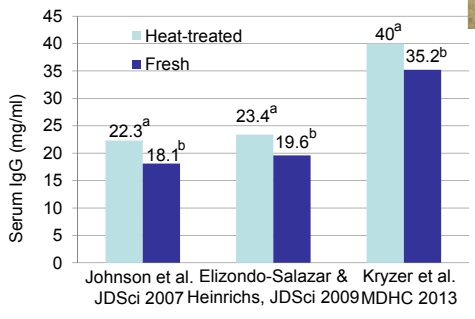
Calves fed heat-treated colostrum have increased serum IgG levels (mg/ml)



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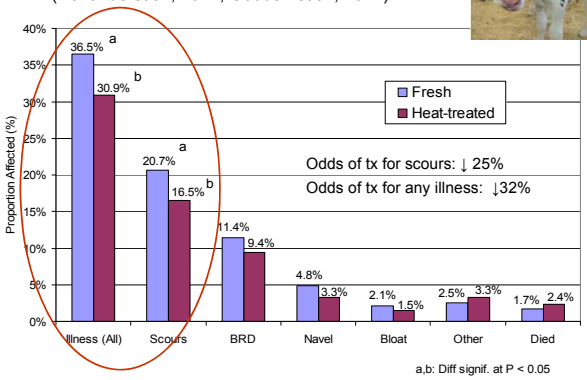
Reduced Morbidity in Calves fed Heat-treated Colostrum

(Donahue et al., 2012; Godden et al., 2012)



Novel Techniques to Treat Colostrum – Do they work?

- Perfect Udder System

- UV treatment of colostrum

Dairy Tech Perfect Udder® System

(DairyTech, Inc., Greeley, CO)

Works equally well as compared to batch pasteurization

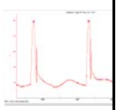
(Kryzer et al., AABP. 2013)

Summary of UV Research

- UV light passed through column of milk (200 to 280 nm = germicidal range)
- UV treatment of milk:
  - Intermediate ability to inactivate 'regular' bugs (e.g. *E. coli*, *S. aureus*, Environmental Strep. spp.)
  - Poorer efficacy vs heat-based pasteurization methods: UV: 3.3 log reduction; HTST: 5.2 log reduction (Bicalho et al., 2013)
  - Poor ability to inactive MAP (Johne's)
- UV treatment of colostrum:
  - 43-50% denaturation of IgG

(Reinemann et al., 2006; Altic et al., App Env Micro.2007.73:3728; Donaghy et al.,2009. Bicalho et al., 2013; Pereira et al., 2014; Gelsinger et al., 2014)

"Must do's" to heat-treat colostrum



- Methods:
  - Batch design or Perfect Udder System (DairyTech, Inc.)
  - NOT Ultraviolet treatment: 43-50% loss of IgG
- Constant agitation
- Active (not passive) heating and cooling
- Monitoring:
  - Times & temps:
    - 60 ºC x 60 minutes: No fluctuations above 61 ºC
  - Periodic culture of heat-treated colostrum:
    - TPC < 20,000 cfu/ml; TCC < 1,000 cfu/ml
  - Calves: STP, morbidity, mortality

Summary

- New tools (e.g. Brix) for monitoring:
  - Colostrum quality
  - Passive transfer in calves
- New methods to reduce microbial exposure:
  - Use of Colostrum replacers:
    - Ask for the data
  - Heat-treating colostrum:
    - Batch or Perfect Udder System

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Thank you!

Questions?

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