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University of Wisconsin-Madison

Managing the Environment of Dairy Calves to Maximize Health

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Presentation Layout

- Introduction
- Indoor pen considerations
 - Group size
 - Age at introduction to group pen
 - Delivery of clean, nutritional feed
- Feeding consistency
- Cross sucking
- Weaning strategy
- Screening for health and performance
- Summary and conclusions

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Trend Toward Inside Calf Housing

<p>USDA, 2011 Heifer Raisers</p> <ul style="list-style-type: none"> • <u>Inside individual</u> housing <ul style="list-style-type: none"> • 7.1% West • 43.5% East • <u>Inside group</u> housing <ul style="list-style-type: none"> • 0 in West • 21% East • <u>Outside individual</u> housing <ul style="list-style-type: none"> • 93% West • 30% East 	<p>Wisconsin</p> <ul style="list-style-type: none"> • 2014 and 2015 Survey Data of 344 farms (inside and outside pens) <ul style="list-style-type: none"> • 79% (272/344) single calf pens • 24% (84/344) group pens • Only 9% are groups of 5 or more calves 
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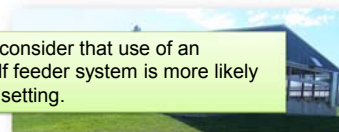
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Indoor Calf Housing Considerations

<p>Individual Pens</p> <ul style="list-style-type: none"> • Health advantages <ul style="list-style-type: none"> • Limited calf-to-calf contact • Decreased disease transmission • Individual calf observation and attention • Starter and water consumption may be monitored more easily • Managing individual calf milk or milk replacer (MMR) delivery may be easier to control • Individual calf handling fa 	<p>Group Pens</p> <ul style="list-style-type: none"> • Labor efficiencies for feeding time • Automatic calf feeding allows calf control of its feeding pattern and volume <ul style="list-style-type: none"> • Remote monitoring • Cleaning pens and bedding management is easier • Socialization advantages for calves
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For this talk, consider that use of an automatic calf feeder system is more likely in group pen setting.



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Excellent Husbandry Is Required in All Types of Calf Housing

- Perinatal calf management
- Colostrum
- Nutrition
- Environment
- Health screening and management



Group Pen Size

- Ranges from 2 to 40 calves per pen
- ACF companies often recommend 25 to 30/pen
- 20/pen is a very common size
- Groups > 12/pen have compromises



Offering more space per calf doesn't solve a big group pen issue – wet bedding, competitive interactions, or access to feeder



Group Pen Size Considerations (2)

- Too many calves in a pen:
 - Competitive interactions
 - Decreased feeding time
 - Decreased milk intake
- (von Keyserlingk, 2004)
- Difficult to detect sick calves in large groups
- Large groups have wider age range
- There can be up to 4 nipples/ACF
 - Typically 2 nipples/feeder and 1 nipple/pen
 - Usually 1 calf drinks at a time despite 2 nipples/feeder



Group Pen Size Considerations (3)

- Groups with <12-18 calves
 - Less pneumonia
 - ↑ADG
- (Svensson, 2006)
- Socially stable groups, ↑ ADG
- Continuous additions, ↓ ADG
- (Pederson, 2009)



- Bedding management is key
 - More animals, more feed = more urine and more manure

Age at Introduction to Group Pen

- Age at introduction varies from 2 – 21 days
- Young calves do not compete well and need more guidance
 - Lower intakes and ADG (6 vs 14 days at introduction)
 - If moving young – monitor closely
 - Assist 1-2 times/day for first week if previous 24h consumption < 50% allotment
 - A little help is good, more is not better
- Avoid introduction during scours' risk period



Nutrition Before Group Pen Introduction

- Avoid underfeeding
- Be consistent with group feeding
 - Same MMR
 - Same total solids
 - Same meal size
- Provide starter
- Provide water
- Plan any necessary transitions



Cleaning Considerations

- Not just a bucket and whisk anymore...
- Producer choices
 - Brand and volume of cleaning agent
 - Frequency of cleanings
 - Circuit, mixer/HE, hoses, nipples, unit
 - Hose type and frequency of hose replacement
- Assign people to roles and develop a schedule
- Routine oversight to ensure clean is clean is necessary



Cleaning Considerations

Clean-In-Place Process (CIP)

- Pre-rinse with water
- Heated alkaline wash (70-80°C)
- Alkaline rinse – 2 times
- Heated acid rinse
- Final water rinse or recycling of sanitizer



Automatic Calf Feeder Cleaning

- Fewer steps
- Lower temperatures
- Circuit and mixer cleanings are on different schedules
- Manual and/or automatic features need to be managed

ACF Cleaning Considerations

- Water temperature
- Alkaline or acidic cleaning agents
- Circuit clean daily
- Mixer/HE clean 2-4x/d
- Replace feeder hoses q 1-2 weeks
 - Many are replacing every other day
- Clean and disinfect nipples 2-3x/d
 - Replace q 1-2 weeks
- Clean around the mixer
- Standard plate counts n



Total bacterial counts < 20,000 cfu/mL
Fecal coliforms = 0 cfu/mL
Recommended and achievable

Automatic Calf Feeder Anatomy



Nutritional Considerations

- Group housing advantages with computer-controlled automation
 - Offer more milk and increased feeding frequency
 - Precision and phase-feeding
 - Offers a gradual weaning process
 - Offers feeding alarms to aid in disease detection
- Potential disadvantages
 - Feeding competition
 - Cross sucking
 - Bacterial contamination of MMR

Feeding larger volumes of MMR does not require ACF's but it favors their use.

Nutritional Considerations (2)

- Not all group housed calves are computer fed
- Calves in individual pens can be computer fed
- Consumption of more milk improves ADG, which is positively correlated with milk production
- Ad-lib access to good quality MMR promotes feeding frequency that mimics natural suckling of cow-calf pair
- Larger MMR volume improves digestion and feed efficiency
- Increased number of MMR meals may lower risk for abomasal ulcers



Nutrition by ACF

- Consider all of the variables:

- Volume consumed
- Meal size
- Nutrient density
- Milk type and components
- Group housing dynamics
- Group size
- Number and type of feeding stations
- Calf factors
 - Vigor
 - Immune status and health
 - Age at introduction
 - Adaptation to group housing



With feed allowance $\geq 10\text{L}$ and group size < 24 , competition is limited and unrewarded visits are low.

Things to Know about ACF's

- Milk portions range between 0.5 and 3.0 L
- Time lag between meals range between 30 and 240 minutes
- Increasing meal size and lowering the number of visits may lower competition for feeder access
- Estimated that time commitment (labor) per calf for feeding is 1 minute
- Precision feeding of milk, nutritional supplements or medications
- Phase feeding, commonly done for poultry and pigs, can be done for calves
- Combination feeders (MMR and pelleted feed) may become more common
- Calf-rail automatic feeders for individualized calves
- Water meters, measured starter feed, and body scales are coming



Automatic Calf Feeders



ADG Expectation: 1.6 to 2.3 lbs. (0.7-1.0 kg)

- Most ACF's deliver whole milk or milk replacer
- But, there are 3 diets:
 - Paper diet
 - Diet delivered through the feeder
 - Diet consumed



Make a Nutritional Plan

Ration Results	
Milk Dry Matter Intake :	1.50 (lbs/day)
Starter Dry Matter Intake :	0.45 (lbs/day)
Energy Allowable Gain :	1.81 (lbs/day)
Diet ME :	2.00 (Mcal/lbs)
Diet NE _m :	1.68 (Mcal/lbs)
Diet NE _g :	1.34 (Mcal/lbs)
Diet CP :	19.5%
Diet DCP :	17.4%
ADP Allowable Gain :	1.16 (lbs/day)

- NRC Simulation Program
- Goal: Double birth weight by 60 days
- Use actual ration inputs
- Adjust for weight of calf
- Input environmental temperature

Average Daily Gain (lb/day)
1.0
1.2
1.6
1.8
2.0
2.0
1.4

NRC Calf Calculations: 100 lb Holstein (0.5 lb starter and 65°F)

Whole Milk	5 L per Day	10 L per Day
Energy allowable ADG	1.63 lb/day	3.52 lb/day
ADP allowable gain	1.35 lb/day	2.75 lb/day
Growth limiting nutrient	Protein	Protein
Crude protein balance	-34 gm/day	-90 gm/day
20:20 Milk Replacer	5 L per Day	10 L per Day
Energy allowable ADG	1.51 lb/day	3.33 lb/day
ADP allowable gain	1.12 lb/day	2.30 lb/day
Growth limiting nutrient	Protein	Protein
Crude protein balance	-48 gm/day	-122 gm/day

Feeding Consistency is a Priority

- Total solids
- Temperature
 - Mixing
 - Feeding
- Delivery – same feed from first to last calf and from one feeding to the next
- Between feeders (non-automated)
- Additives
- Timing
- Water availability within 20 to 30 minutes of MMR feeding



Towards Becoming More Consistent in Calf Feeding

- Timing, temperature, weights
- Total solids at calf level
- Additive effects – medications, supplements, vitamins or minerals
- Keeping liquid feed agitated during delivery
- Clean mixing, delivery and feeding equipment
- Nipple height
 - 15 cm above mixer outlet
 - 60-70 cm above nursing platform

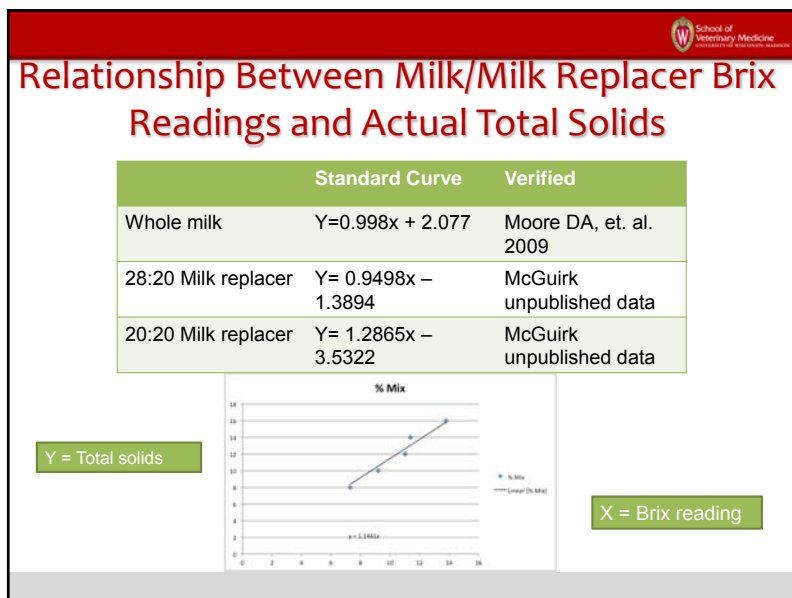


Total Solids is a Convenient Monitoring Tool for Feeding Consistency



Total Solids

- <2% change between feedings
- Never >18%
- Nutritional concerns at <10%



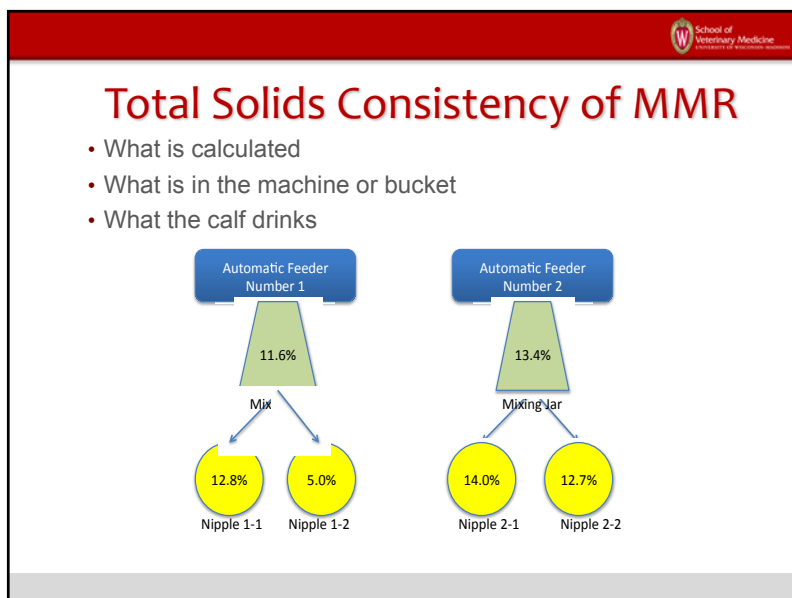
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ACF Milk Replacer Mixing

Expectation: 160 gm in 1 L Water

- Expected Total Solids: 160 gm/1 L solution = 16%
- Actual Mix: 80 gm/580 ml solution = 13.8%
- Default setting for Förster Technik ACF's: 150 gm powder plus 1,000 gm water = 13% solids

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Daily Monitoring of MR Brix Readings

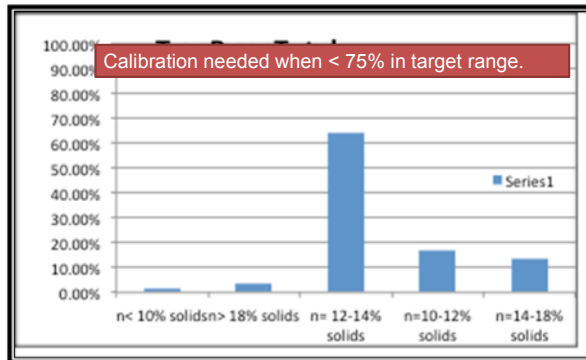
# fills	brix 1	brix 2	brix 3	initials		total percent
2	9.5	9.5		bw		
2	10.5	10.5		bw	n< 10% solids	2 1.31%
3	10.6	10.5	10.4	bw	n> 18% solids	6 3.92%
3	9.1	12.8	12.9	shu	n= 12-14% solids	98 64.05%
2	12.5	12.6		shc	n=10-12% solids	26 16.99%
2	13.5	16.1		bw	n=14-18% solids	21 13.73%
3	13.6	15.2	16.8	bw		
2	17.9	19.2		bw	total readings= 153	153
2	16.9	16.8		shu		
2	9	11.1		shc		

Inconsistencies and missed targets provide alerts:

- Calibration
- Cleaning frequency and effectiveness
- Needed changes in nipples, feeding or mixer hoses
- Nipple height

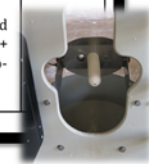
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Daily Monitoring of MR Brix Readings



Regularly Assess Standard Plate Counts

Select Microorganisms Counts (CFU/ml)	Pen 1-1	Pen 1-2	Pen 2-1	Pen 2-2	Goal Levels
Total Plate Count (CFU/ml)	5,400,000	6,250,000	5,150,000	1,300,000	< 10,000
Coliforms (lactose-positive)	1,750,000	150,000	2,550,000	200,000	< 100
Gram negative rods (lactose-negative)	0	3,400,000	350,000	300,000	< 5,000
Streptococci (non-agalactiae)	3,350,000	2,600,000	2,000,000	750,000	< 5,000
Staphylococci (coagulase-negative)	300,000	100,000	200,000	50,000	< 5,000
Comments	Several lactose + morphologies	Probable <i>Pseudomonas</i> spp	<i>Pseudomonas</i> and many lac + morphologies	<i>Pseudomonas</i> and many lac + morphologies	



ACF Labor Efficiency

ACF: 1 minute per calf for feeding

- Whole milk pasteurization, storage and delivery or loading milk replacer into ACF
- Review computer alerts and check calves in pen

- Monitor TS
- Activate cleaning cycles
- Monitor SPC's
- Replace nipples, feeding and mixer hoses
- Walk pens for health screening

Individual Calf Feeding: 10 min per calf

- Preparation
 - Mixing
 - Feeding equipment
- Delivery
 - Pick up
 - Water delivery
 - Cleaning and washing

Monitor feed TS and SPC
Health screening

Cross Sucking

- More common in group pens
- Directed towards pen or calves
 - Udder
 - Navel
 - Ears



Unwanted Consequences of Cross Sucking

- Hair loss
- Inflammation
- Teat or udder injury
- Mastitis
- Decreased milk production or persistence as a cow



Limiting Cross Sucking in Pens

- Increase milk allowance
- Prolong meal duration to a minimum of 10 to 15 minutes by reducing milk flow (nipples with smaller orifice)
- Protected feeding stalls
- Reduce group size
- Feed water through a teat or nipple
- Access to high energy, high quality solid feed
- Implement programmed, gradual weaning



Weaning Strategy

- Gradual milk step-down process avoids weaning stress, post weaning growth depression, and cross sucking
- ACF's offers flexibility in creation of gradual step-down while providing multiple rewarded feeding visits during the day
- Weaning duration is longer but provides gradual reduction in energy intake that encourages starter intake, limits number of unrewarded visits to feeder, reduces vocalization and cross sucking

Disease Risk in Group Pens

- Group pen housing generally associated with increased morbidity for enteric and respiratory disease

- Calf contact
- Shared nipples
- Cross sucking
- Communal bedding
- Shared aerosol

Of particular concern when:

- Group size exceeds 12 per pen
- In overcrowded pens: space per calf < 30 sq feet/calf
- High rate of failure of passive transfer of immunity (FPT)
- Age span within a group > 5 days
- No all in-all out pen management

Appetite Based Health Screening

- In ACF group pens, preset alarms are frequently the primary method of disease detection

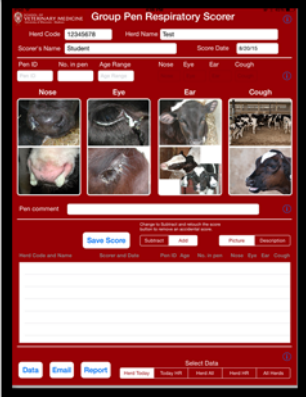
- Reduced intake
- Reduced visits
- Slow drinking

- Unrewarded visit frequency may be a more sensitive indicator
- In-pen screening is needed
- In-pen examinations are necessary



Appetite based detection compromised when allotment/day <10L

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Have a screening plan for health and performance


- Walk pen first
- Check computer alerts second

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Treatment Protocols

- Need VCPR
- Must be dynamic, flexible, responsive and monitored
 - Consistency
 - Compliance
 - Record-keeping
- Frequent side-by-side work with the veterinarian
- Most ACF's provide targeted provision of oral medication but not parenteral treatment




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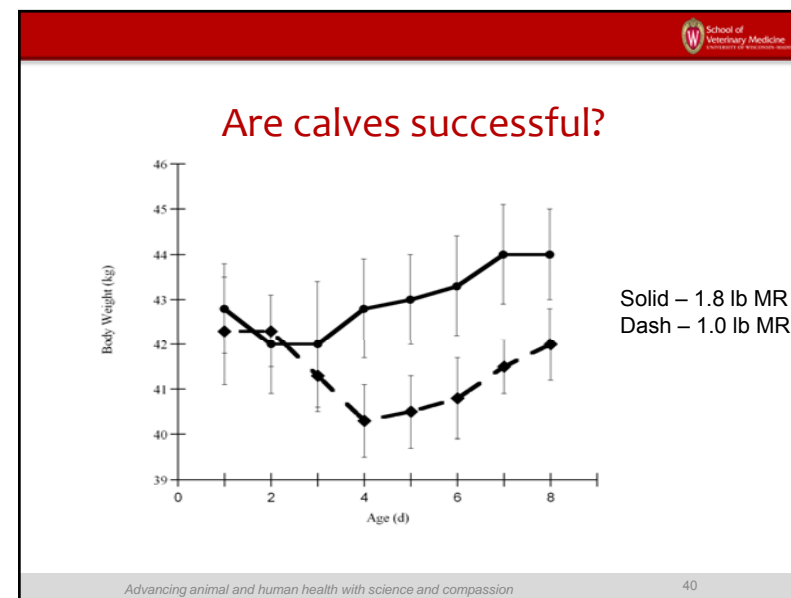
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What Should be Monitored?

- Critical control points
 - Colostrum program
 - Group size
 - Stocking density
 - Health screening
- Control points specific to feeding program
 - MMR standard plate counts
 - Consistency in total solids
 - Calf performance (ADG)



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Inside Individual vs. Group Pens

Individual Pen Advantages Summarized

- More forgiving of FPT
- Less calf-to-calf contact and disease transmission
- Less respiratory and enteric disease
- MR total solids control
- Adaptable to paired calf raising
- Disease screening and detection may be easier
- Easier handling for exam and treatment
- Less bacterial contamination of calf MMR
- Less cross sucking
- Earlier weaning



Inside Individual vs. Group Pens

Group Pen Advantages Summarized

- More frequent feeding = more MMR consumed
- Individualized feeding plans
- Individualized feeding behavior is supported
- Feeding alarms detect sick calves
- Consistent milk delivery
- Gradual weaning
- Socialization
- Easier pen cleaning and bedding
- Increased abomasal pH (theoretically) may prevent ulcers



Inside Individual vs. Group Pens: No Clear Advantage

- Both can deliver calves that reach ADG of 1.6 lb (0.73 kg)
- Both can achieve starter intakes at weaning of 3-5 lb (1.4-2.3 kg)
- Both can achieve weaning at 7 weeks
- Both can deliver consistently good quality MMR
- While labor efficiency for calf feeding may be reduced in automatic feeding systems, other details related to ACF system management require labor reallocation that might negate any advantage
- Total solids variability can occur in both settings
- Increased feed allowance facilitates appetite-based disease detection

Considering a Change from Individual to Group Pens Inside?

- Still have individual pens for 7 to 14 days
- Don't consider it until colostrum program consistently meets goals
- Don't do it strictly for reduced labor input
- Plan weaning strategy
- Plan for health screening
 - Inside pen
 - Computer alarms
- Plan for ideal environment
 - Manageable feeding system
 - Bunk space for grain; water location and access
 - Bedding type and nesting
 - Space
 - Calf number
 - Air quality
 - Age span within a group
 - Time between successive occupants
 - Cleaning strategy

Summary and Conclusions

- Indoor calf raising has many advantages where there are climatic extremes, land-base limits and labor limitations
- There are advantages and disadvantages in both inside individual and group pen settings
- Labor efficiencies of group pen housing may be over-estimated
- Greater MMR consumption improves health, performance, production and welfare
- Calf monitoring, health screening, individual calf contact, trained treatment crews, established protocols and good records are needed in all calf operations

