Dairy calf and heifer management: *influence of nutrition, socialization, performance, and welfare*

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KENTUCKY

Outline –

- Introduction
- Benefits of early socialization
- Milk feeding strategies: accelerated programs

What about dairy calves?

- USA National data:
  - Individual housing until weaning: **85.3%**

NAHMS, 2014

Individual housing is associated with…

- Lower social ranking and competitive success
- Increased aggressiveness
- Increased fear responses

See review by Costa et al., 2016

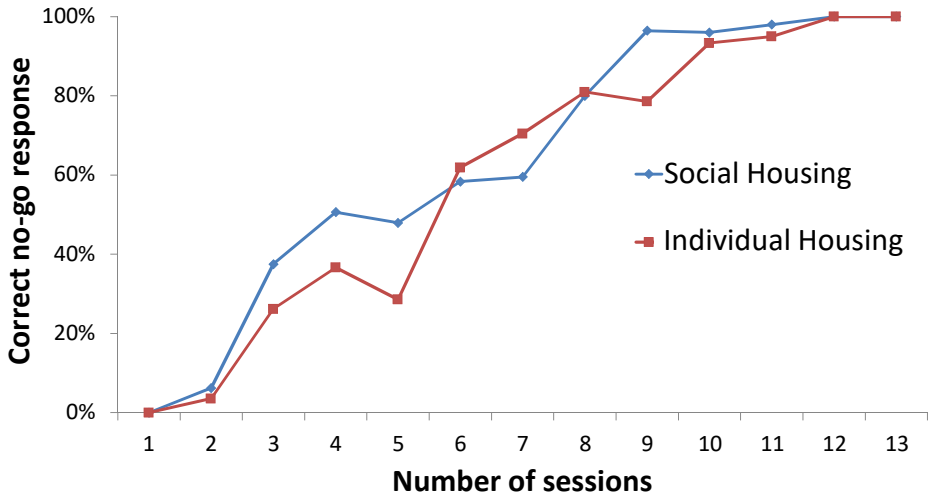
Adaptability and flexibility: Reversal Learning

Effects of social rearing on cognition

Initial Discrimination

Positive approach for milk reward	⇔	**Negative** do not approach; time-out punishment

Discrimination learning



Meagher et al., 2015

Effects of social rearing on cognition

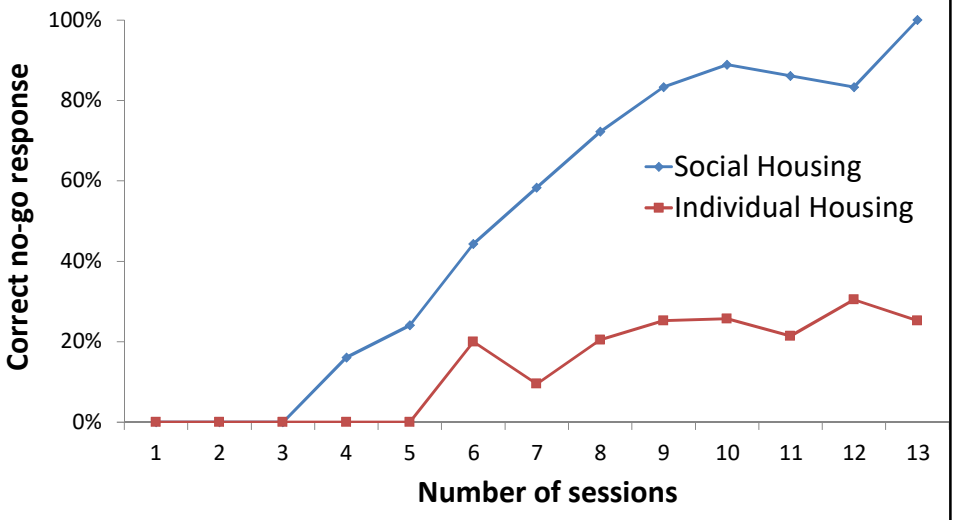
Initial Discrimination

Positive approach for milk reward	⇔	**Negative** do not approach; time-out punishment

Reversal

Positive approach for milk reward	⇔	**Negative** do not approach; time-out punishment

Reversal learning



Meagher et al., 2015

But my calves do not play with computers….

Food neophobia test

- 70 d of age
- Presented 2 kg of:
  chopped carrots (n = 8)

- The test lasted 30 min and was repeated 3 times per calf

Costa et al., (2014) J Dairy Science: 97:7804–7810

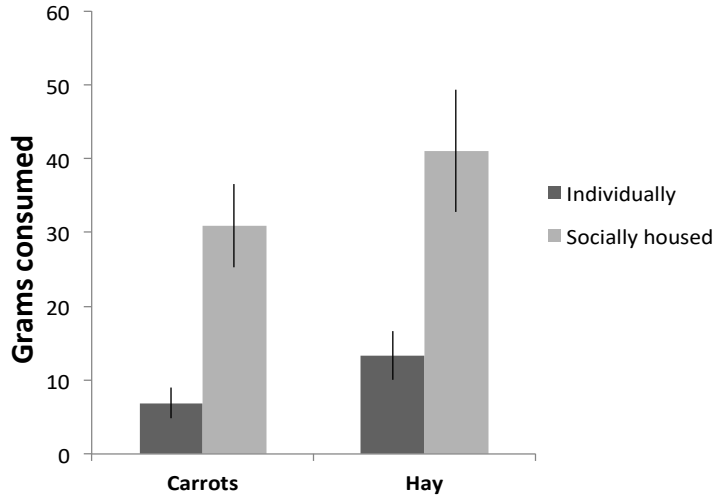
Food neophobia test

- 70 d of age
- Presented 2 kg of:
  chopped hay (n = 8)

- The test lasted 30 min and was repeated 3 times per calf

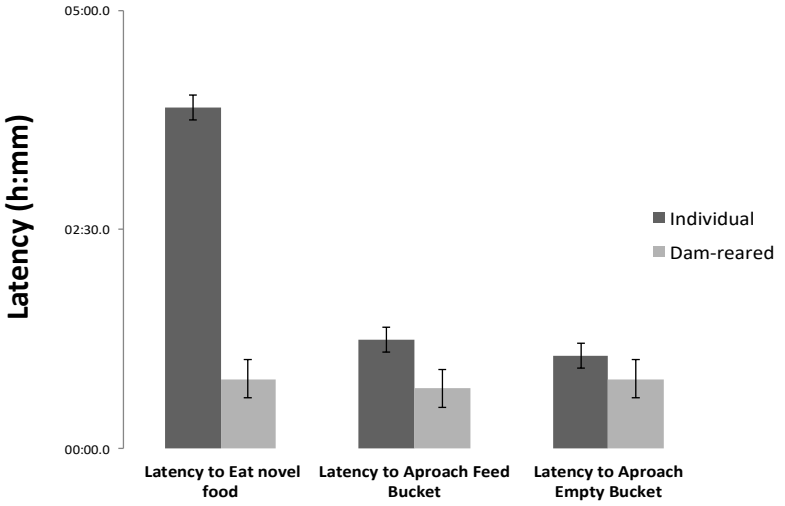
Costa et al., (2014) J Dairy Science: 97:7804–7810

How much novel food did they eat?



Costa et al., (2014) J Dairy Science: 97:7804–7810

Latency to eat and approach buckets

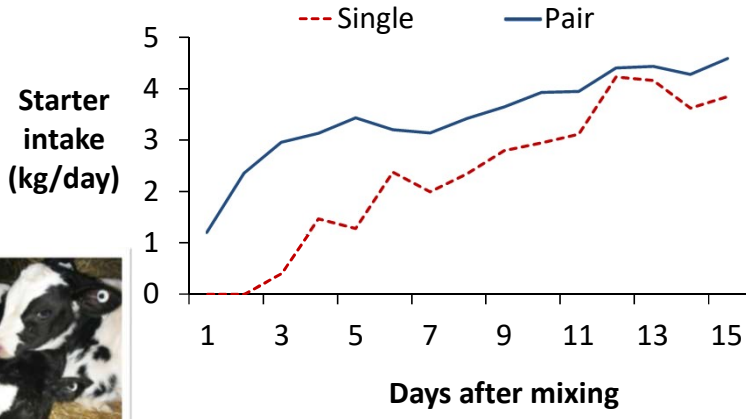


Costa et al., (2014) J Dairy Science: 97:7804–7810

Responses to mixing after weaning? Paired versus individual housing

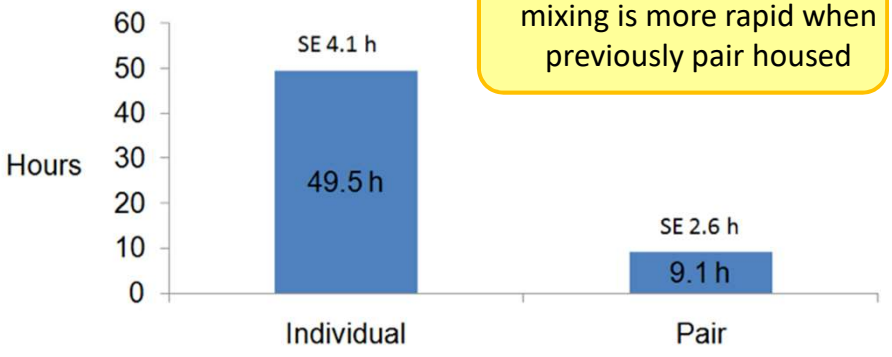
De Paula Vieira et al. 2010. J. Dairy Sci. 93: 3079-3085

Starter intake was higher after mixing in previously paired versus individually-housed calves



De Paula Vieira et al. 2010. J. Dairy Sci. 93: 3079-3085

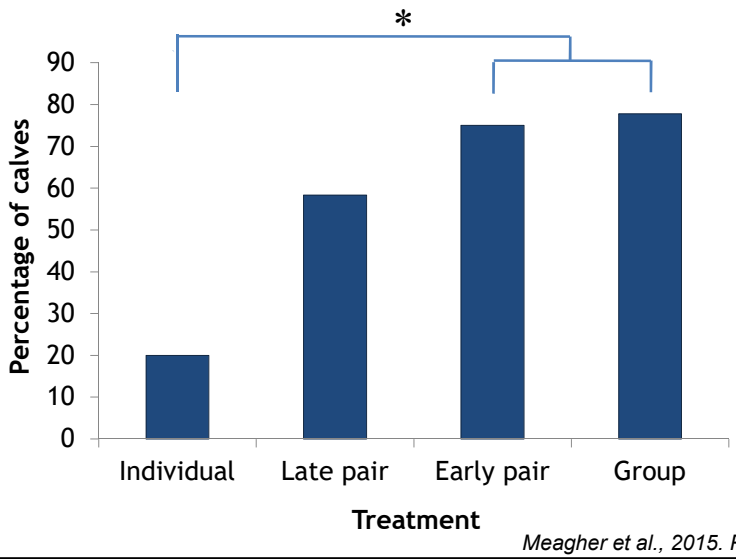
Pair housing improves access to resources at mixing



Time to start feeding after mixing is more rapid when previously pair housed

De Paula Vieira et al. 2010. J. Dairy Sci. 93: 3079-3085

Success in reversal task – Calves that got the change



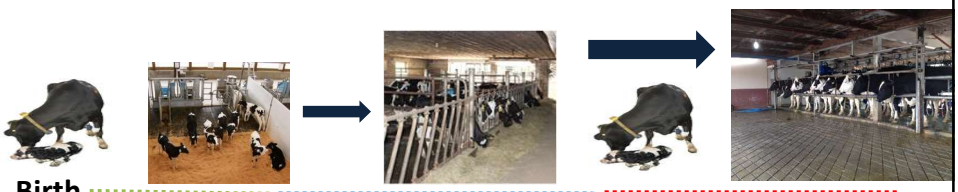
Meagher et al., 2015. PLoS One

Limitations => Future directions

Are the cows on our farms “normal”?

Limitations => Future directions

- Does the early life environment influence how cows cope with stress?



Regrouping | **Diet changes** | **Transition period** | **Milking procedure**

Take Home Message… Round 1 of 3

- Early life socialization is likely to **promote behavioural flexibility** and **adaptability** to novelty
- The housing system in which young dairy calves are raised **impacts neophobic behaviours** towards new food items.

Housing environment affects PERFORMANCE…

Early social housing effects in dairy calves: Performance effects

Parameters	Socialization effects	Number of studies
Final Body	+	6
Weight	=	2
	-	0
Average Daily	+	4
Gain (ADG)	=	6
	-	0
Solid feed	+	7
DMI	=	7
	-	0

See review by Costa et al., 2016

Early social housing effects in dairy calves: Performance effects

Parameters	Socialization effects	Number of studies
Final Bod		6
Wei		2
		0
Ave		4
Ga		6
		0
Sol		7
DM		7
		0

Pattern shows that milk feeding strategy influences this effect.

More milk greater chances of find positive influence.

Not enough studies for a meta-analysis

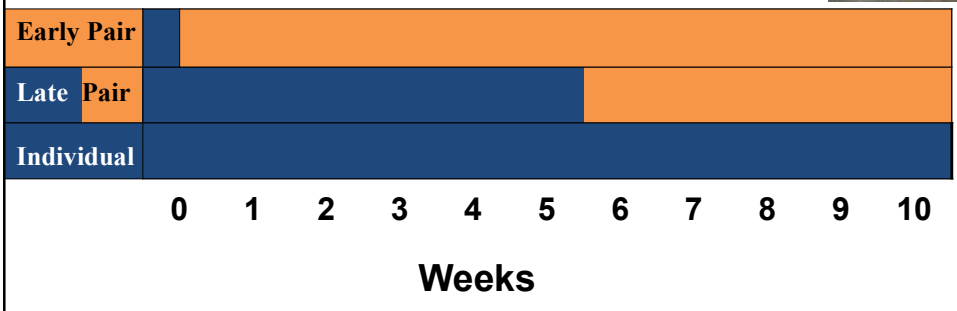
See review by Costa et al., 2016

Social contact affects early feeding behavior

- Social Facilitation
  - greater stimulation and attention towards the feed
- Social Learning
  - two heads think better than one

When to pair dairy calves?

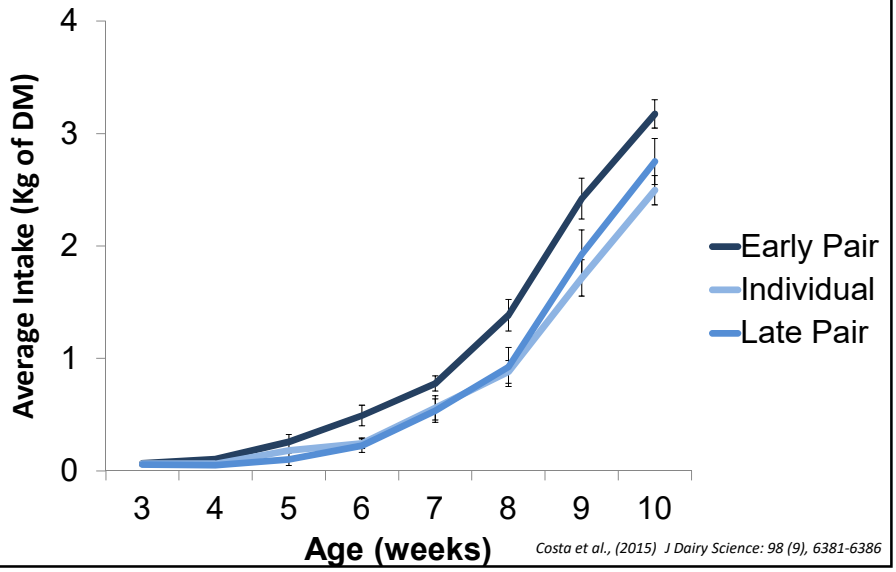
What we did…



Ad libitum access to grain and TMR: intake measured daily

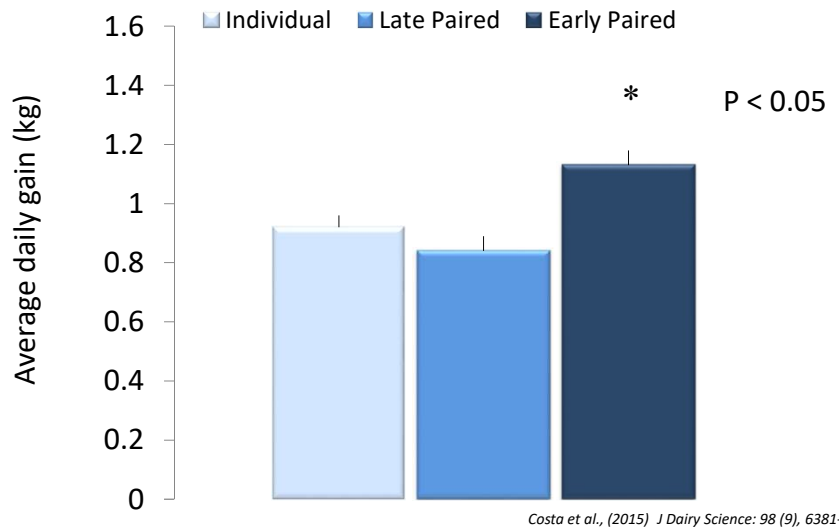
Weekly body weight and calculated Average Daily Gain (ADG) per calf

Early paired calves had higher solid feed DMI…



Costa et al., (2015) J Dairy Science: 98 (9), 6381-6386

…and higher weight gains



Costa et al., (2015) J Dairy Science: 98 (9), 6381-6386

Take Home Messages – Round 2 of 3

Early social housing (including pair housing) increases
feed intake and **weight gains**

What about how we feed them?

Summary of latest results

- Higher AGD during preweaning is associated with:
  - Early breeding and calving age
  - Lower culling rate
  - Indication of increased milk production above 1 lb per day of ADG

So how can we achieve these advantages ?

Recommendation for calf growth…

Who has heard this saying before?

“Calves need to double their birth weight by weaning”

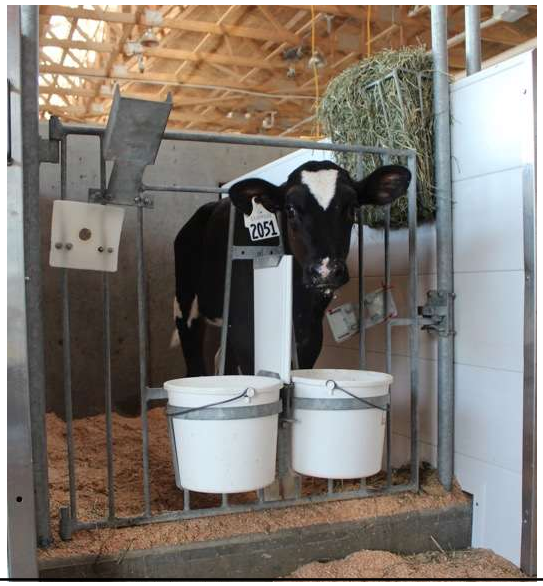
Recommendation for calf growth…

"Calves need to double their birth weight by weaning"

Hypothetical situation (average Holstein farm):

Birth weight:
~ 85 lb or 38 kg
Weaning age:
8 weeks = 56 days
Target ADG:
85 lb/56 days = 1.5 lb/day or 0.66 kg/d

What happens when we allow calves to drink more milk?

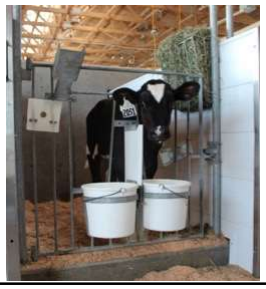


How much milk should we feed them?

In nature..

- Nurses calf 5 - 10 times/d
- Nursing bouts last 5 - 10 min
- Provides about 10 L of milk/d

What do we do?



- Feed 2 times a day
- Feed using a bucket
- Provide about 4 L of milk

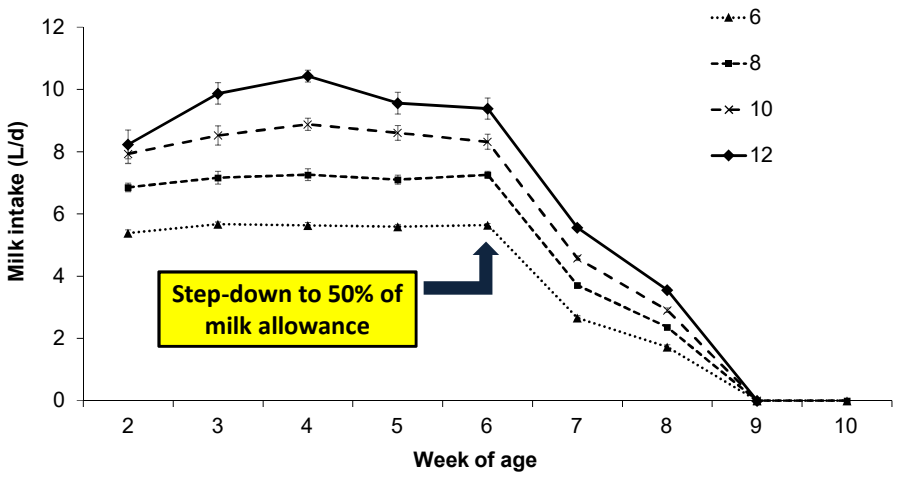
What is the optimal amount of milk?

Optimal milk allowance for **group-housed** calves using a gradual weaning protocol?

Objective: To determine the body weight gain and starter intakes of calves fed different levels of milk using the step down milk feeding regime

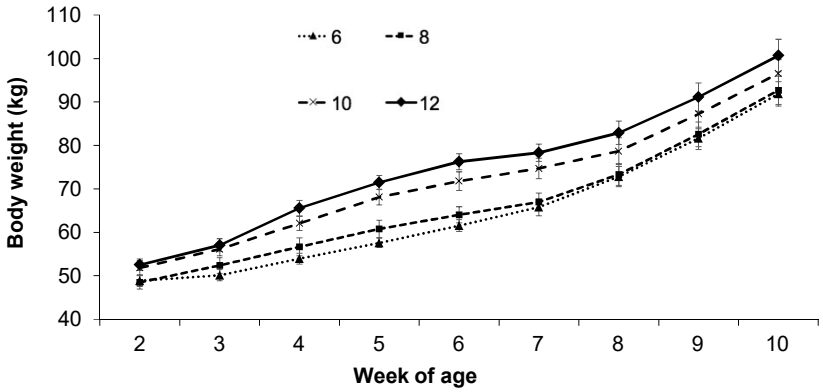
Rosenberger et al., *2017.* J. Dairy Sci.

Calves were assigned to
1 of 4 treatments within groups of 8 (n=14/treatment):
6, 8, 10 or 12 L of milk / day



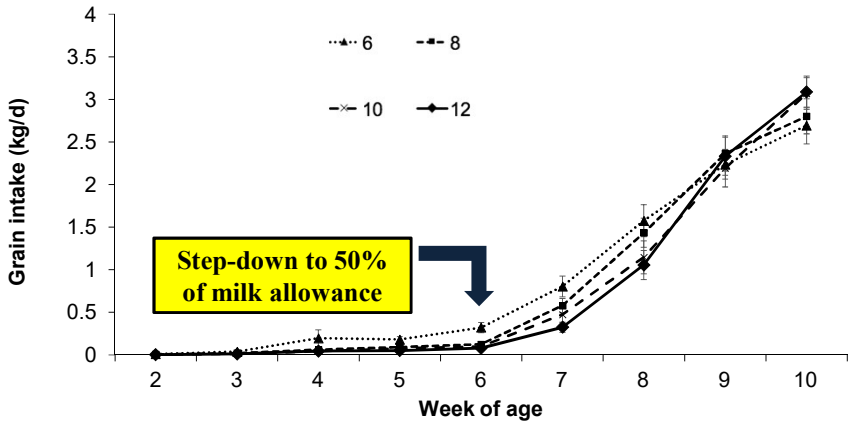
Rosenberger et al., *2017.* J. Dairy Sci.

Higher milk allowance = Increased BW



Rosenberger et al., *2017.* J. Dairy Sci.

Grain intake was not different after weaning



Rosenberger et al., *2017*. J. Dairy Sci.

What we found…

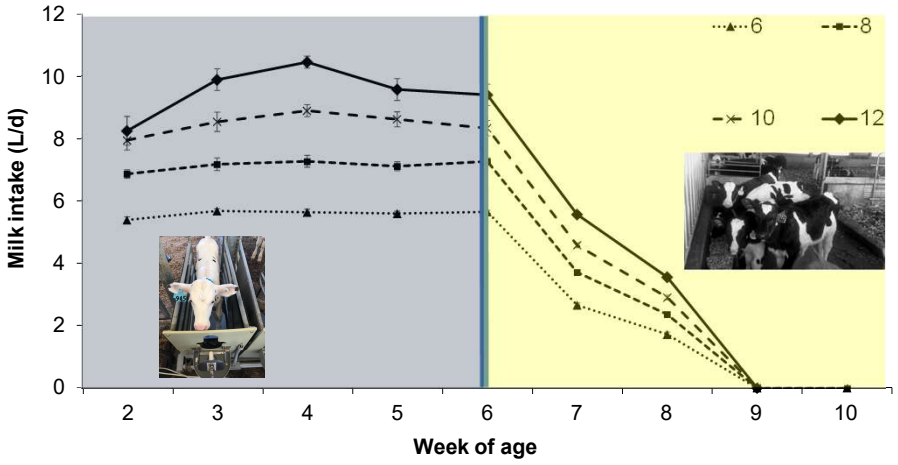
Item	6 L/d	8 L/d	10 L/d	12 L/d	SE	*P-values*[2]
ADG (kg/d)	0.77	0.78	0.81	0.90	0.04	0.01
Total[1] ME (Mcal)	260.9	279.1	295.1	305.1	20.6	0.001
Milk DMI (kg)	11.9	15.2	18.1	21.4	0.6	0.001
Starter DMI (kg)	64.0	63.7	63.4	60.3	6.7	0.50

1. Total ME is calculated from intakes of milk and starter only. Calves also consumed forage but intakes could not be recorded reliably.
2. d.f. = 1,39

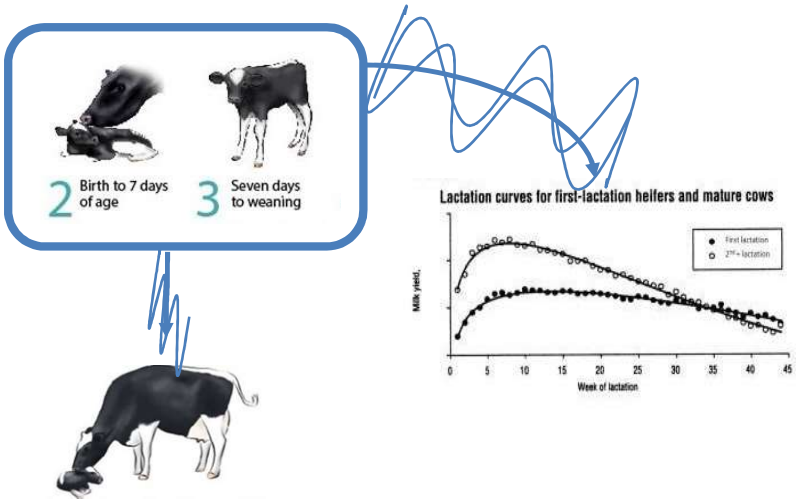
The conundrum

Ad libitum milk =
Low solid feed intake
(de Passille et al., 2011)

Solid feed intake =
Rumen development
(Hill et al., 2008)



Very long time….but it's a long term investment!



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AN ECONOMIC ANALYSIS OF THE COSTS ASSOCIATED WITH PRE-WEANING MANAGEMENT STRATEGIES FOR DAIRY HEIFERS

Hawkins et al., *2019.* *Animals*

Objective

Calculate the cost from birth to weaning

Evaluate different management styles and systems

Develop an on-farm tool to calculate costs and predict cost changes with management change

Hawkins et al., *2019*. *Animals*

Model Description

10,000 iterations

1000 heifers in replacement female program

88 heifers in the preweaning phase

Hawkins et al., *2019*. *Animals*

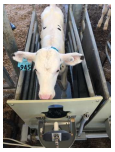
Management Pathways

1. Individual Hutches Outside-Milk Replacer-Conventional
2. Individual Hutches Outside-Pasteurized Whole Milk-Conventional
3. Individual Hutches Outside-Whole Milk-Conventional
4. Individual Hutches Inside-Milk Replacer-Conventional
5. Individual Hutches Inside-Pasteurized Whole Milk-Conventional
6. Individual Hutches Inside-Whole Milk-Conventional
7. Group Housing-Milk Replacer-Conventional
8. Group Housing-Pasteurized Whole Milk- Conventional
9. Group Housing-Whole Milk-Conventional
10. Group Housing-Milk Replacer-Automatic
11. Group Housing- Pasteurized Whole Milk-Automatic
12. Group Housing-Whole Milk-Automatic

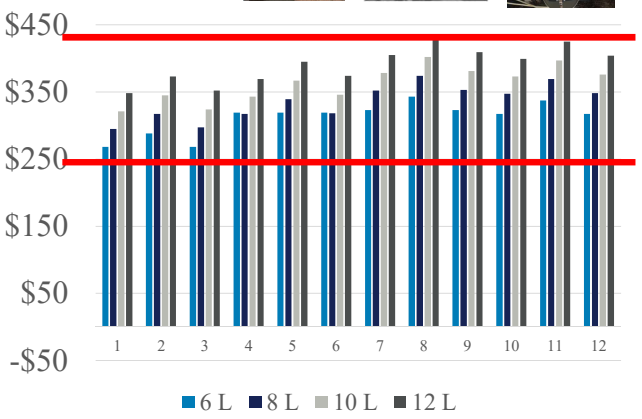



Hawkins et al., *2019*. *Animals*



Total Cost average ranged from $268.67-$430.42 from birth to weaning.



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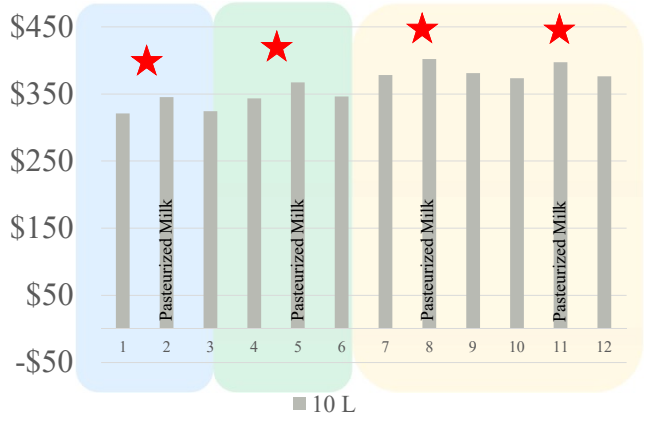
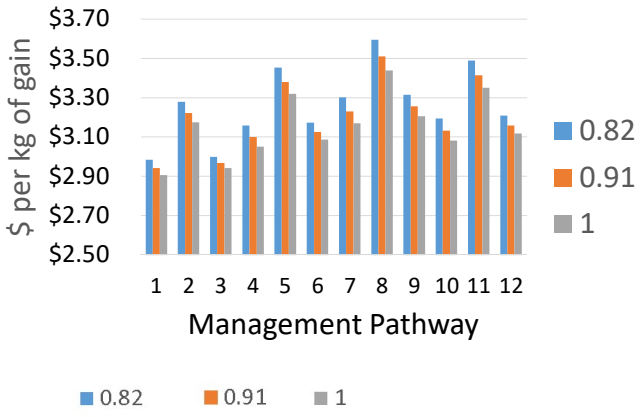


Hawkins et al., ***2019***. *Animals*

As ADG increases due to increased milk consumption, the cost per kg of gain always decreases.



Hawkins et al., ***2019***. *Animals*

Conclusions

The higher ADG achieved, the lower cost per kg of gain

Changes in management style can result in differences in total cost

Cannot use total cost as the sole factor to determine efficient farms

Hawkins et al., *2019*. *Animals*

Take Home Messages

- Accelerated feeding programs are associated with improved performance.
  - **Calves** during the first month of life are not able to eat solids enough
  - **Higher** milk allowance works better with a gradual weaning program

Thank you! Questions?

Disclosures

Joao HC Costa, PhD

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Dr. Costa is employed at University of Kentucky

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