5 stars… would recommend!

What would your cows say about their dining experience?

David Carlson, PhD
Paulina Letelier, PhD

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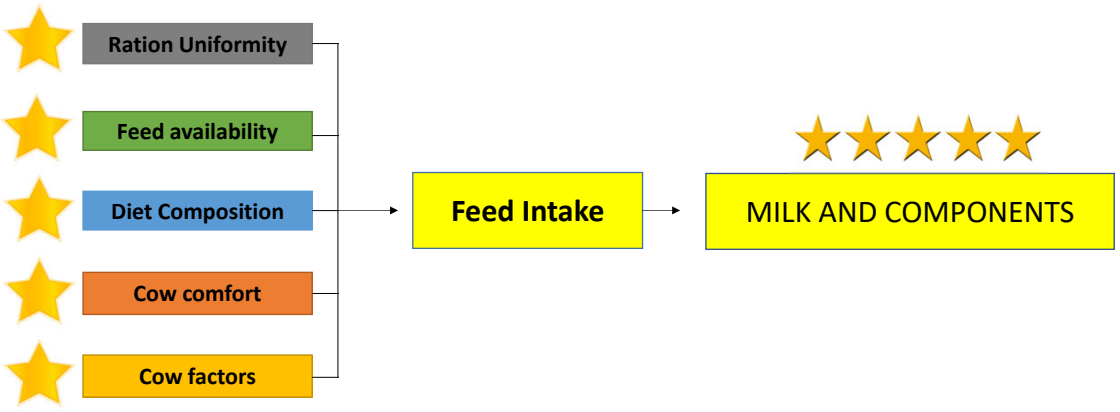
1

The 5-Star Dining Experience



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2

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• Machine
  • Mixer
• Method
  • Facing
  • Mixing time
  • Load Size
  • Levelness of the mixer
  • Loading location
  • Loading sequence
	• Delivery time
	• Push-up
	  • Frequency
	• Refusals
	  • Percent
	• Fresh feed
	• Mother Nature
	  • Rain events
	  • Wind
	  • Frozen Feed
	  • Heat
		• Nutrient composition
		• Forage
		  • Maturity
		  • Fermentation profile
		  • Nutrient composition
		  • Condition (mold, pH)
		• Physical form
		• Forage to Concentrate ratio
			• Stocking density
			• Physical Environment
			  • Temperature
			  • Humidity
			  • Ventilation
			• Bunk Space
			• Cow to stall ratio
			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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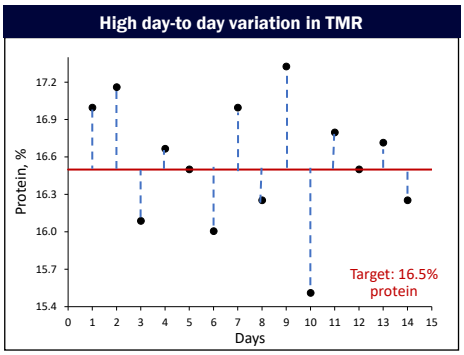
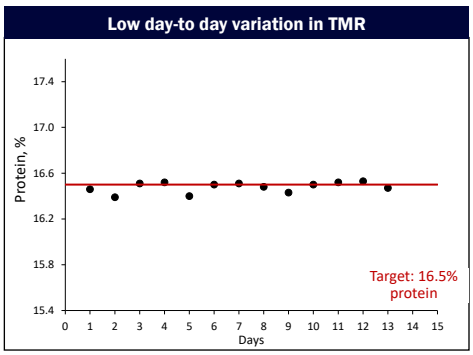
3

Ration uniformity: low vs high variation

Variation: ***"Change or difference in amount or level, typically within certain limits"***





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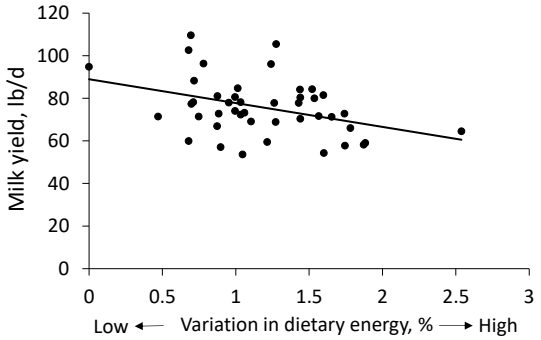
Effects of dietary energy variation on milk yield



A decrease in 0.5-percent-point the variation of dietary energy was associated with:

- **Milk yield:**
  - +3.2 kg/d or 7 lb/d
- **DMI:**
  - +1.0 kg/d or 2.2 lb/d DMI
- **Milk/DMI:**
  - +4.3% milk/DMI

Sova et al., 2014. JDS

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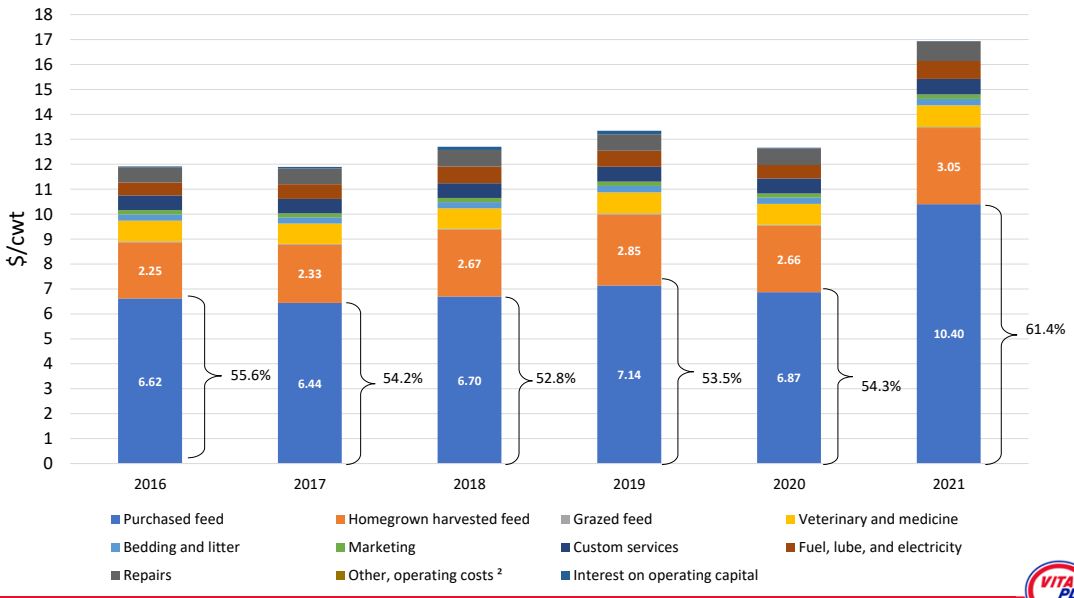
Feed costs for a 500-999 herd dairy



USDA, ERS

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6

Ration Uniformity

- **Machine**
  - **Mixer**
- Method
  - Facing
  - Mixing time
  - Load Size
  - Levelness of the mixer
  - Loading location
  - Loading sequence

Feed availability

- Delivery Time
- Push-ups
  - Frequency
- Refusals
  - Percent
  - Re-distribution
- Fresh Feed
- Mother Nature
  - Rain events
  - Wind
  - Frozen Feed
  - Heat

Diet

- Nutrient composition
- Forage
  - Maturity
  - Fermentation profile
  - Nutrient composition
  - Condition (mold, pH)
- Physical form
- Forage to Concentrate ratio

Cow comfort

- Stocking density
- Physical Environment
  - Temperature
  - Humidity
  - Ventilation
- Bunk Space
- Cow to stall ratio
- Social interaction
- Bedding/Stall comfort

Cow factors

- Milk production
- Components yield
- Body Weight
- Days in milk
- Genetics
- Health

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7

TMR Particle Size Variation Calculator

Farm Name: Demo | Vita Plus Rep:

Sample ID: Mature | Date: 3-Jun

Fresh TMR

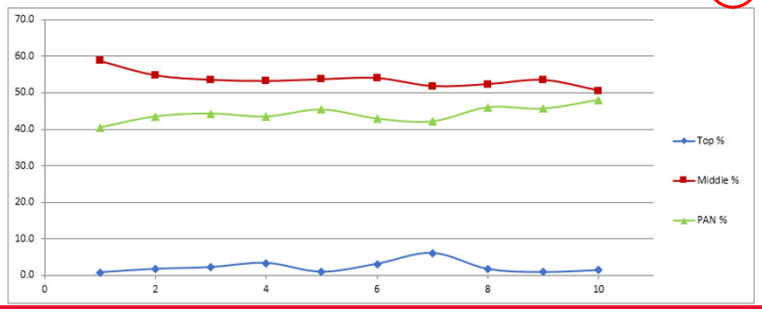
	First feed delivered 1	2	3	4	5	6	7	8	9	Last feed delivered 10
TOP	3	7	8	14	3	10	22	5	3	5
MIDDLE	230	222	196	223	174	174	187	157	190	184
PAN	158	176	162	182	147	138	152	138	162	175
Sum	*391*	*405*	*366*	*419*	*324*	*322*	*361*	*300*	*355*	*364*

TMR Refusal

A	B	C
9	4	4
188	222	212
138	166	150
335	*392*	*366*

Fresh TMR

	First feed delivered 1	2	3	4	5	6	7	8	9	Last feed delivered 10	AVERAGE %	STDEV	CV
% TOP	0.8	1.7	2.2	3.3	0.9	3.1	6.1	1.7	0.8	1.4	2.22	1.6	73.6
% MIDDLE	58.8	54.8	53.6	53.2	53.7	54.0	51.8	52.3	53.5	50.5	53.70	2.2	4.1
% PAN	40.4	43.5	44.3	43.4	45.4	42.9	42.1	46.0	45.6	48.1	44.08	2.2	5.0



	Fresh TMR %	Refused TMR %	Difference
% TOP	2.2	1.6	0.66
% MIDDLE	53.7	56.9	3.21
% PAN	44.1	41.5	2.54

Guidelines

	Min	Max	CV
% TOP	3	10	
% MIDDLE	30	50	<3%
% PAN	40	55	<3%

Goals

Fresh TMR:

Acceptable: Middle Sieve and Pan CV < 5%

Optimal: Middle Sieve and Pan CV < 3%

Fresh vs Weighback:

Top, middle, pan difference ±7%

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Mixer: Equipment Wear – Vertical Mixers

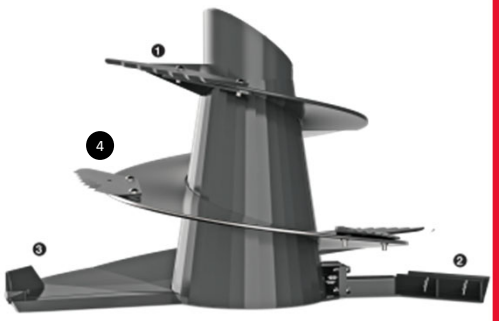
Vertical Mixer

1 – Flighting
- to move feed upward

2 – Kicker plate
- Important for efficient discharge

3 – Leading edge
- Key for lifting action

4 – Knives
- Forage processing



https://www.kuhn-usa.com/livestock/mixers-feeders/tmr-mixers/vertical-mixers/vt200

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9

Mixer: Equipment Wear – Vertical Mixers

Effect

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Mixer: Equipment Wear – Vertical Mixers

Cause(s)

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Mixer: Equipment Wear – Vertical Mixers

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Mixer: Equipment Wear – Vertical Mixers

13

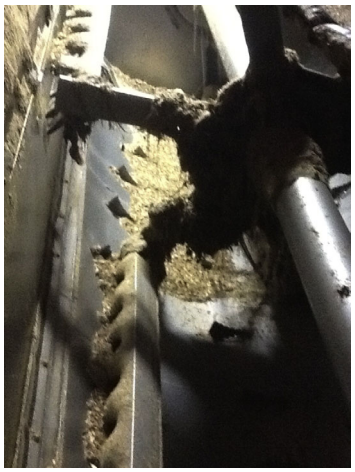
Mixer: Equipment Wear – Horizontal Mixer

Horizontal Mixer

1 – Augers

2 – Reel

3 – Paddles



Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

14

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • Mixing time
  • Load Size
  • Levelness of the mixer
  • Loading location
  • Loading sequence
	• Delivery Time
	• Push-ups
	  • Frequency
	• Refusals
	  • Percent
	  • Re-distribution
	• Fresh Feed
	• Mother Nature
	  • Rain events
	  • Wind
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			  • Humidity
			  • Ventilation
			• Bunk Space
			• Cow to stall ratio
			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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Facing: Leave a smooth silage face

Vertical and smooth silage face

Uneven silage face

Curved silage face

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16

PL0

Facing: DM and nutrients variation

Dairyland Results (Older results)

- DM 31.7%, CP 7.5%, starch 29.2%
- DM 34.3%, CP 6.5%, starch 36.5%
- DM 29.0%, CP 7.3%, starch 33.3%

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Premix the defaced silage

- **Premixing the silage with a loader bucket or mixing wagon makes the silage more consistent in moisture and nutrients.**
- **Include any forage at the bottom of the silo that was not removed with the defacer.**

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18

Slide 17

PL0 Not translated
Paulina Letelier, 2023-04-21T13:13:39.515

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • **Mixing time**
  • Load Size
  • Levelness of the mixer
  • Loading location
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	• Delivery Time
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			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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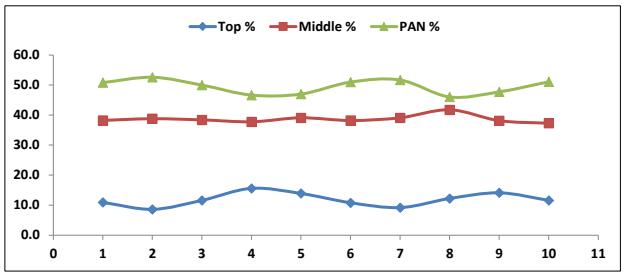
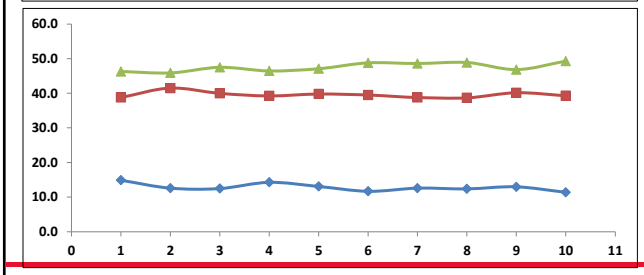
19

Mix Time: 4-auger horizontal



3.5 min final mix time

AVERAGE %	STDEV	CV
11.85	2.2	18.5
38.68	1.2	3.1
49.47	2.4	4.8



5 min final mix time

AVERAGE %	STDEV	CV
12.85	1.1	8.3
39.58	0.8	2.1
47.57	1.2	2.6

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Mix Time Guidelines

Horizontal auger mixer:	**5 minutes**
Horizontal reel-auger mixer:	**3 to 5 minutes**
Vertical mixer:	**3 to 5 minutes**

***timing starts after last ingredient added**

***RPM should be >30 for vertical mixers**

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21

22

How is Mixer Capacity Determined?

- Manufacturers publish estimates of volume and/or lbs
- Function of volume (cubic feet) and ration density (lbs/cu ft)
- Ration density estimates
  - Lactating – 20-25 lbs/cu ft
  - Dry/heifer – 15-20 lbs/cu ft
- ***Volume of ration more important than weight***

Patz	Kuhn	Supreme	Meyer
ration density, lb/cu ft			
25	30	29-32	30

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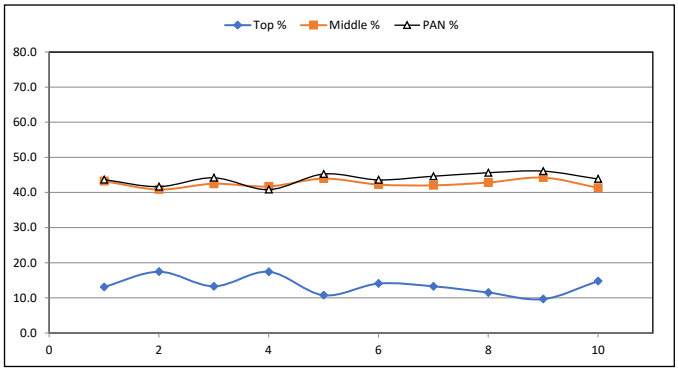
23

Load Size: Heifer ration



AVERAGE %	STDEV	CV
13.59	2.6	**18.9**
42.48	1.1	**2.6**
43.92	1.7	**3.8**

Goals
Fresh TMR: CV for Middle Screen and Pan ≤ 5%
Batch size 15,000 lb for a 35-40,000lb mixer

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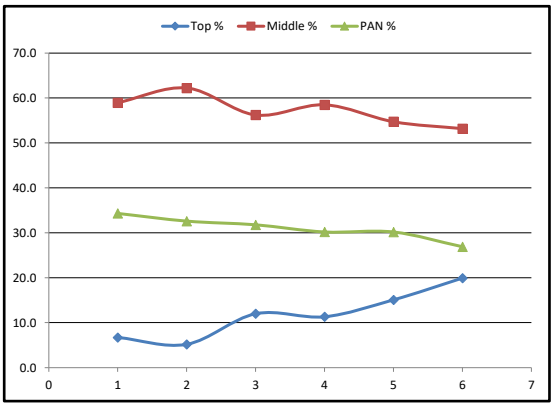
24

Load size: Overloaded



Screen	AVG %	STDEV	CV
Top	12.78	5.4	**42.3**
Middle	56.64	3.3	**5.8**
Bottom	30.58	2.5	**8.3**

Assuming 135 lbs/cow/day as-fed
Sample 1 – 34.3% in Pan: 46.3 lbs of pan particles
Sample 6 – 26.9% in Pan: 36.3 lbs of pan particles

10 lb

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25

Underloaded

Overloaded

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26

Load Size: Underfilling

- Vertical mixers
  - When ingredients remain on the augers
  - Dry or fresh cow batches
  - RPM and loading location important

27

Guidelines for Mixer Capacity

Mixer type	Optimal maximum volume recommendations
Horizontal reel-auger	Allow 4-6 inches between TMR and rails on the reel
Horizontal auger	Below the top of metal side walls
Vertical auger	2 feet above the top of the augers

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

28

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • **Mixing time**
  • **Load Size**
  • **Levelness of the mixer**
  • Loading location
  • Loading sequence
	• Delivery Time
	• Push-ups
	  • Frequency
	• Refusals
	  • Percent
	  • Re-distribution
	• Fresh Feed
	• Mother Nature
	  • Rain events
	  • Wind
	  • Frozen Feed
	  • Heat
		• Nutrient composition
		• Forage
		  • Maturity
		  • Fermentation profile
		  • Nutrient composition
		  • Condition (mold, pH)
		• Physical form
		• Forage to Concentrate ratio
			• Stocking density
			• Physical Environment
			  • Temperature
			  • Humidity
			  • Ventilation
			• Bunk Space
			• Cow to stall ratio
			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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29

Levelness

- **Sloped downward back to front**

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30

Levelness

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31

Levelness

- Hitch mount
- Parking on unlevel ground
  - Erosion of gravel pads
  - Sloped concrete

Hitch mount too low Cottonseed build-up in front Discharged first	Hitch mount level No cottonseed build-up Discharged first
	

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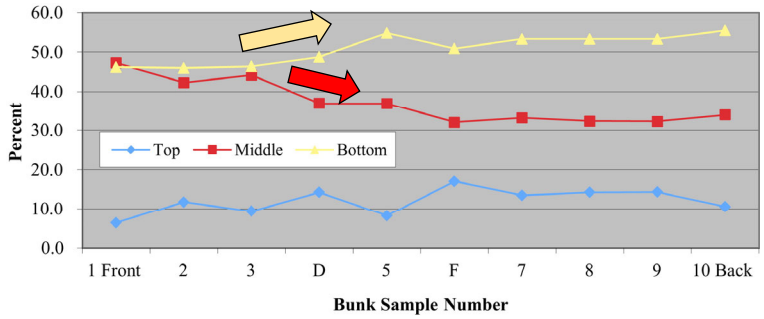
Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

32

Levelness

- Triple-auger vertical mixer
  - Parked uphill
  - Dense material went toward back of mixer
  - Last to be discharged



Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Levelness

- Gravel pad near grain bins and whey tank
- Parked here for whey addition and final mix
- Loaded from left of the photo
- Sloped downward left to right

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34

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • **Mixing time**
  • **Load Size**
  • **Levelness of the mixer**
  • **Loading location**
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				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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35

Loading Location

- **Refers to the location where ingredients are added to the mixer**
- **Proper loading location**
  - **Improved ration uniformity**
  - **Shorter mix times**
  - **Less risk for particle size reduction**

Feed being loaded toward the back of mixer
Note the red triangle marking the center of the mixer

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Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

36

Guidelines for Loading Location

Mixer type	Which side?	Position?
Horizontal reel-auger	Auger side	Center
Horizontal auger	Either side	Center
Single-auger vertical	Either side	Center
Dual-auger vertical	Either side	Center (between augers)
Triple-auger vertical	Either side	Center (over middle auger)

VERTICAL: bales should be added directly over auger to avoid bending the flighting

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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37

Ration Uniformity
- **Machine**
  - **Mixer**
- **Method**
  - **Facing**
  - **Mixing time**
  - **Load Size**
  - **Levelness of the mixer**
  - **Loading location**
  - **Loading sequence**

Feed availability
- Delivery Time
- Push-ups
  - Frequency
- Refusals
  - Percent
  - Re-distribution
- Fresh Feed
- Mother Nature
  - Rain events
  - Wind
  - Frozen Feed
  - Heat

Diet
- Nutrient composition
- Forage
  - Maturity
  - Fermentation profile
  - Nutrient composition
  - Condition (mold, pH)
- Physical form
- Forage to Concentrate ratio

Cow comfort
- Stocking density
- Physical Environment
  - Temperature
  - Humidity
  - Ventilation
- Bunk Space
- Cow to stall ratio
- Social interaction
- Bedding/Stall comfort

Cow factors
- Milk production
- Components yield
- Body Weight
- Days in milk
- Genetics
- Health

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38

Loading Sequence: Ingredient order

- Factors determining ingredient order
  - Mixer type (reel vs. auger vs. vertical)
  - Ingredient type
    - Density
    - Particle size
    - Moisture level
    - Flowability
  - Inclusion level
  - Location of ingredients

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39

Loading Sequence: Ingredient order

Horizontal Auger Mixer
Vertical Mixer

- **Liquids** (molasses, whey, water)
- **Wet feeds** (Silage, wet byproducts)
- **Dry, dense feeds** (Concentrates, dry byproducts, low inclusion feeds)
- **Large particle, dry, low density** (dry hay, straw)

Haylage may need to be added first to break up clumps

Horizontal Reel/Auger Mixer

4. **Liquids** (molasses, whey, water)
3. **Wet feeds** (Silage, wet byproducts)
2. **Large particle, dry, low density*** (dry hay, straw)
1. **Dry, dense feeds** (Concentrates, dry byproducts, low inclusion feeds)

**Dry hay order switched to avoid bending the reel*

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40

Loading sequence: Order of Concentrates

- Load lowest inclusion 1st
- Rule of 50 for low inclusion feeds (50:1 ratio, wt/wt)
  - feed in the mixer:low inclusion feed
  - Example
    - 50 lbs of bypass fat
    - 50 × 50 = 2500 lbs
    - Mixer should have less than 2500 lbs in mixer when adding fat
    - Mixer should be running

Oelberg TJ, Stone W. Monitoring total mixed rations and feed delivery systems. Veterinary Clinics: Food Animal Practice. 2014 Nov 1;30(3):721-44.

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Loading Sequence: Example of adding concentrates last to a worn out mixer

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42

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • **Mixing time**
  • **Load Size**
  • **Levelness of the mixer**
  • **Loading location**
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				• Health

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Consistent TMR delivery time

- **Consistent feeding times minimize the time that the bunk is empty**
  Should be no more than 30 min per day.
- **Feed too early:**
  - Increased amount of refusals
- **Fed too late**
  - Increased time with an empty bunk,
  - Decrease feed intake,
  - Greater bunk competition,
  - Increased risk of digestive upset due to slug feeding.

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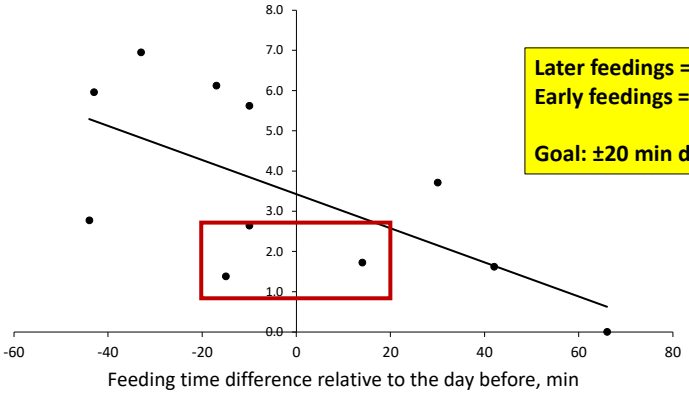
44

Refusal percent relative to feeding time



Later feedings = less weighback
Early feedings = more weighback

Goal: ±20 min deviation day-to-day

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45

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• **Machine**
  • **Mixer**
• **Method**
  • **Facing**
  • **Mixing time**
  • **Load Size**
  • **Levelness of the mixer**
  • **Loading location**
  • **Loading sequence**
	• **Delivery Time**
	• **Push-ups**
	  • **Frequency**
	• Refusals
	  • Percent
	  • Re-distribution
	• Fresh Feed
	• Mother Nature
	  • Rain events
	  • Wind
	  • Frozen Feed
	  • Heat
		• Nutrient composition
		• Forage
		  • Maturity
		  • Fermentation profile
		  • Nutrient composition
		  • Condition (mold, pH)
		• Physical form
		• Forage to Concentrate ratio
			• Stocking density
			• Physical Environment
			  • Temperature
			  • Humidity
			  • Ventilation
			• Bunk Space
			• Cow to stall ratio
			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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46

Push-up the feed

- Cows must have access to feed throughout the day to maximize their production potential.
- Frequent push-up stimulates eating behavior.
- Push-up frequency should increase after feeding and milking due to high intake.

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47

Case Study

Cows reaching 30 min after coming back from the parlor

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48

Ration Uniformity	Feed availability	Diet	Cow comfort	Cow factors

• Machine
  • Mixer
• Method
  • Facing
  • Mixing time
  • Load Size
  • Levelness of the mixer
  • Loading location
  • Loading sequence
	• Delivery Time
	• Push-ups
	  • Frequency
	• Refusals
	  • Percent
	  • Re-distribution
	• Fresh Feed
	• Mother Nature
	  • Rain events
	  • Wind
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		  • Maturity
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			• Bunk Space
			• Cow to stall ratio
			• Social interaction
			• Bedding/Stall comfort
				• Milk production
				• Components yield
				• Body Weight
				• Days in milk
				• Genetics
				• Health

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1-3% target refusal

- **The goal is to ensure that cows always have feed in front of them**
  - However, is important to minimize feed waste.
- **Cattle that are extremely aggressive and waiting at the bunk are obviously hungry.**
- **Targeted refusals should be changed gradually to determine the optimal amount that works for your farm.**

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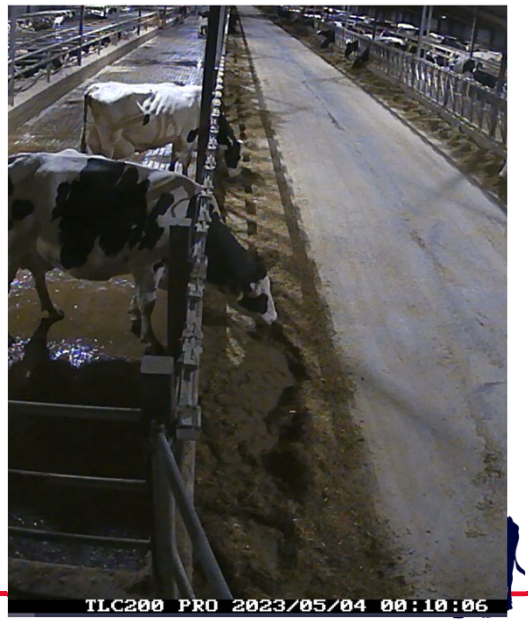
50

Re-distribution of refusals



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51

Take-home messages

- Poor ration uniformity negatively affects milk production and components
- Maximize intakes by having consistent feed availability
- Use a TMR evaluation to help you identify problems and solutions with the current feeding program
- Often, small changes have great impact!

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52