

Diet Preparation



Diet Preparation:outline

- Advantages and disadvantages of TMR
- Effects of diet preparation on:
 - Particle size
 - Chewing and feeding behaviour
 - Distribution of meals the day.
 - Fluctuation of rumen pH can be beneficial for fiber digestion
 - Sorting
- How can we improve TMR preparation?

During the last 10 years

- Milk production +19%
- DM intake +6%
- It has been necessary to change diet formulation in the attempt to full fill energy requirement and prevent metabolic disease.

High producing Dairy cows

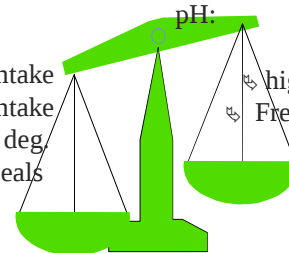
Must ↓ NDF and ↑ NSC

Factors that ↓ rumen pH:

- ✗ high DMI intake
- ✗ high NSC intake
- ✗ high rumen deg.
- ✗ abundant meals

Factors that ↑ rumen pH:

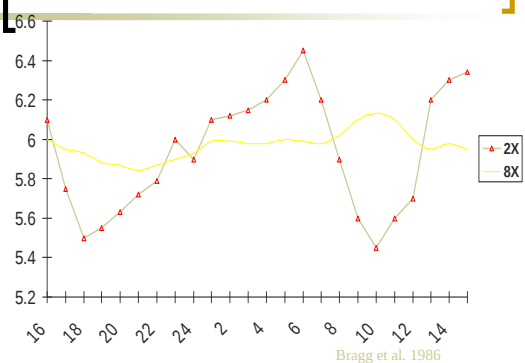
- ✗ high NDF intake
- ✗ Freq. small meals
- ✗ Chewing



Effect of Forage to Concentrate ratio on rumen pH

Forage, %	Conc., %	NDF %DM	Ruminat, min/d	PH	A:P
100	0	65	960	6.9	3.9
80	20	55	940	6.6	3.4
60	40	45	900	6.2	2.9
40	60	34	720	5.8	2.1
20	80	24	660	5.4	1.4
0	100	14	340	5.0	0.8

Effect of feeding frequency on ruminal pH



Component feeding

- Forages (hays and silages) are offered *ad libitum*, always available to the animals
- Concentrates are offered in limited amounts:
 - Group feeding (extremely rare)
 - Individual feeding:
 - Fixed amounts
 - Variable based on milk production

Concentrate distributors

- They allow individual and automatic concentrate feeding

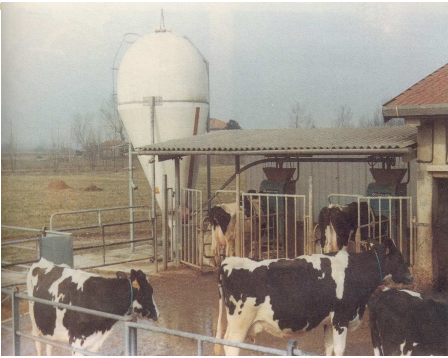
Advantages

- Individual feeding
 - Conc. Intake monitoring
 - Changes based on prod.
- Multiple distribution /d
- Fully Computerized

Disadvantages

- Cost
- Unsynchronous intake of all the feeds
- Some time they require pellets
- Animal competition at feeding station
- Malfunctioning

Concentrate distributors



TMR = Total Mixed Ration (Unifeed)

- Distribution of all the feed ingredients mixed together with the intent of obtaining the intake of all of the components at the same time.
- It requires mixing (cutting) wagons able to produce an homogeneous mixture of forages, concentrates.

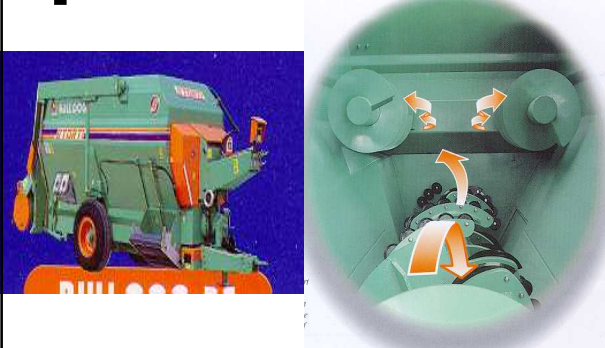
Advantages of TMR

- Improved feeding efficiency
 - Synchronous availability of energy and N optimized microbial growth.
 - Concentrates are 'diluted' with forages - Less ruminal problems
- Improved precision/accuracy of diet formulation
- Fully mechanized

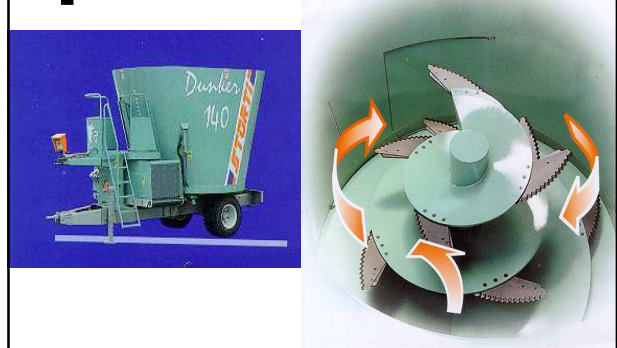
Advantages of TMR

- Allows to use all farm produced feed lowering feeding costs.
- By products can be easily introduced in the diet (lower feeding costs)
- A larger number of feed can be used – more flexibility.
- when mixed in the diet also feeds that would be less palatable can be used.

Mixing wagons: horizontals



Mixing wagons: : verticals



Mixing wagons: self propelled



Disadvantages of TMR

- Cost of mixing wagons
- Accuracy of the diets still depends on the knowledge of feed composition and on the accuracy of the wagon's scale.
- Diets must be formulated for group of cows not on individual performances
- Unsufficient mixing allow sorting
- Over mixing reduce effectiveness of fiber

Group feedings

- Virginia researchers suggested lead factors depending on the number of groups):
- 1 group or ration: Add 30 percent to the group average
- Example: $30 \text{ kg} \times 30\% = 9 \text{ kg} + 30 \text{ kg} = 39\text{kg}$
- 2 groups or rations: Add 20 percent to the group average
- 3 groups or rations: Add 10 percent to group average

Mixing time

N° cows/farm	Tempo (min)	DS	Time *		
			< 20'	21'-40'	> 40'
<= 60	38.5	13.7	18.2	36.4	45.5
61 - 100	36.9	16.8	21.4	39.3	39.3
101 - 200	37.5	14.2	3.1	68.8	28.1
> 200	33.8	13.4	25.0	50.0	25.0
All farms	36.9	14.6	15.3	50.0	34.7

* Time between the first ingredient and distribution

Disadvantages of feeding groups

- It requires large herds
- Needs labor to manage groups
- Changes of groups(diet) can results in drop in production::
 - Changes in energy about 10%
 - Social stress
- It often requires changes in the structures of the farm

Alternative to group feeding

■ Partial TMR (PTMR):

- Base of TMR
- Concentrates autofeeders to account for animal variability in performances

■ Disadvantages of PTMR:

- Same as TMR
- Plus the cost of the autofeeders

TMR preparation

- Wagons used to prepare TMR diets have evolved in the past years and now beside the simple mixing function, farmers require others features such as chopping and desiling.
- Chopping is necessary to reduce forages into small particles that facilitate the production of a homogeneous mix and reduce the chances of selection by the animal.
- The benefit of having small forage particles have been overemphasized and the wagon constructors under this concept have developed very efficient cutting systems.
- With modern wagon the misuse of the wagon like overmixing can lead to diets that lack of long particle size that affect chewing behaviour and ruminal environment.

Materials and Methods

■ Mixing time in the TMR wagon:

- 10 min - minimum required to have a complete an homogeneous mixing (LONG);
- 60 min - overmixing (SHORT);
- Cross-over design with periods of 3 weeks (2 wk of adaptation and 1 of sampling);
- 14 cows with an average milk production of 35.2±5.1 kg/d, DIM=90±50 d and BW=597 kg/d before the beginning of the trial.

(Trial TMR #1)

Diets composition

Feedstuff	(kg/d as fed)
Corn Silage	20
Grass silage	2
Alfalfa dehy	3
Corn ground	3.7
Barley rolled	1.8
Prot. Concentrate	4
Whole cotton seed	1.5
Chemical Composition	
DM (%)	53.3
CP (%DM.)	16.4
NDF (%DM)	36.4
ADF (%DM)	24.4
Starch (%DM)	21.6

(Trial TMR #1)

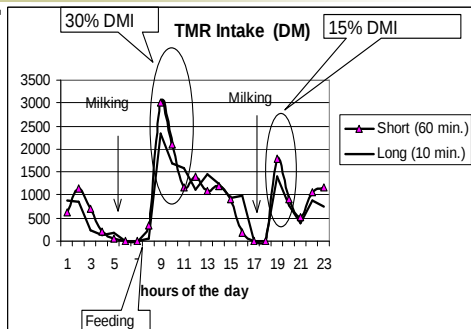
Particle sizes of diets and orts

	60 min	10 min	SEM	P<
Diets				
19mm (%)	5.1	10.3	0.7	0.01
8mm (%)	34.9	28.4	0.6	0.01
Pan (%)	60.0	61.3	1.1	NS
Orts				
19mm (%)	4.3	19.0	1.2	0.01
8mm (%)	40.8	33.1	1.0	0.01
Pan (%)	54.9	47.9	1.1	0.01

(NS:P>0.10)

(Trial: mixing time)

Milk production and quality



(Trial: mixing time)

Milk production and quality

	60min	10min	SEM	P<
Milk (kg/d)	32.2	31.9	0.4	NS
FCM (kg/d)	28.9	30.2	0.5	NS
Fat				
- (%)	3.3	3.6	0.1	0.01
- (g/d)	1072	1161	28	0.04
Protein				
- (%)	3.3	3.3	<0.1	NS
- (g/d)	1070	1061	14	NS
Lactose (%)	5.2	5.1	<0.1	NS

(NS:P>0.10)

(Trial: mixing time)

Efficiency of milk production

	60min	10min	SEM	P<
Milk energy:GE, %	21.0	22.4	0.5	0.08
FCM4%:DMI	1.30	1.39	0.03	0.08
IOF ¹ , €	5.10	5.48	0.15	0.12
Costs:100 kg of FCM ² , €	13.1	12.4	0.2	0.60

¹IOF=Income over feed costs

²Feeding cost/100 kg of Fat Corrected Milk

(NS:P>0.10)

(Trial: mixing time)

Conclusions (Mixing time)

- Overmixing decreases particle size which then affect eating and chewing behaviour.
- Smaller particles may have a faster ruminal transit time that allows greater intake, but reduce efficiency of milk production and income over feed costs.
- Diets must contain sufficient long particle to stimulate chewing even if diet selection will be greater
- The use of the Penn State particle size separator can represent a useful tool to be used at farm level to check particle size of the diets

How to prepare a TMR

Feed order:

1. Concentrates
2. Hays
3. Silages

Don't over mix!!

- after the last constituent mix it for 10-15min

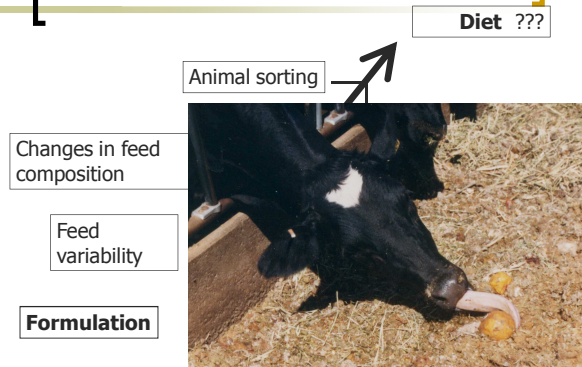
Feeding TMR: bunk management

- Always feed ad libitum
 - Need to have about 5% of residual (orts)
- Increase or decrease number of 'doses' to accomodate changes in intake
- Keep pushing up feed, it stimulate cow to come to the bunk
- Never, ever leave cows without feed for more than one hour, particularly in the morning
- Feed twice a day in the summer

Monitor diets and animals

- Feeding problems are often attributed only to diet formulation.
- However, feeding problems could derive from errors in the preparation and distribution of the diet.
- It is important to evaluate diet characteristics and monitor animal behaviour

Diet preparation



Chemical composition of the diet

- The availability of software and scale in mixing wagon is NOT a guarantee of a correct diet:
 - Variation in feed composition, particularly forages
 - Malfunctioning of scales
 - Errors of the operator
- For each group of animal there are at least 3 diets:
 - Diet calculated by the nutritionist
 - Diet prepared by the farmer
 - Diet actually taken by the cow

Forage variability: hay

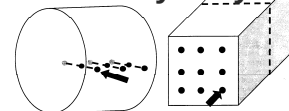


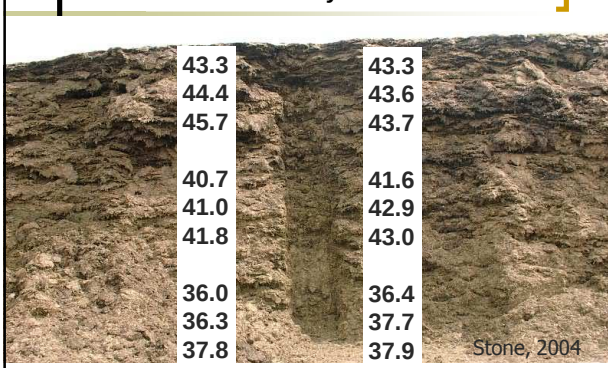
Figure 1. Sampling patterns of round and rectangular bales.

Variability of alfalfa hay bales

constituent	AVG	SD btwn bales	Min - max Btwn bales	SD Wthn bales
NDF	40.2	2.0	36.3 – 44.1	2.1
CP	17.2	0.8	15.7 – 18.7	0.8

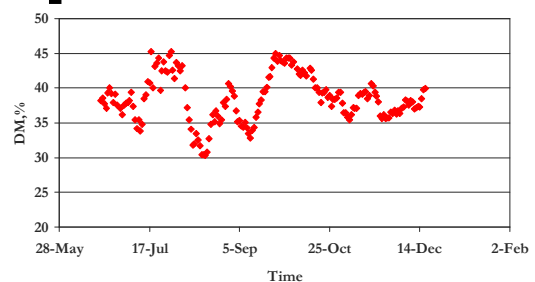
Collins, 2000

Haylage NDF – Sampling and Laboratory Consistency Evaluation



Stone, 2004

Variation over time



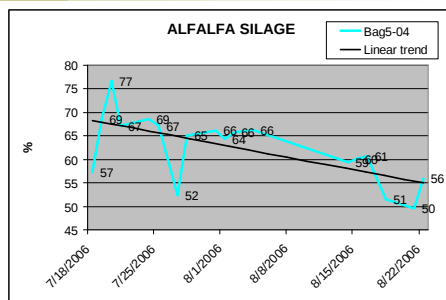
Changes in DM content of Alfalfa haylage – USDFRC Prairie du Sac (modified from Undersander et al., 2005)

Feed quality control program

- Managing feed variability requires:
 - Accurate and Frequent sampling
 - Accurate analytical method
 - Rapid return of analysis
 - Simple to implement
 - Low cost



Variation in forages over time



Changes in DM Intake relative to baseline

