



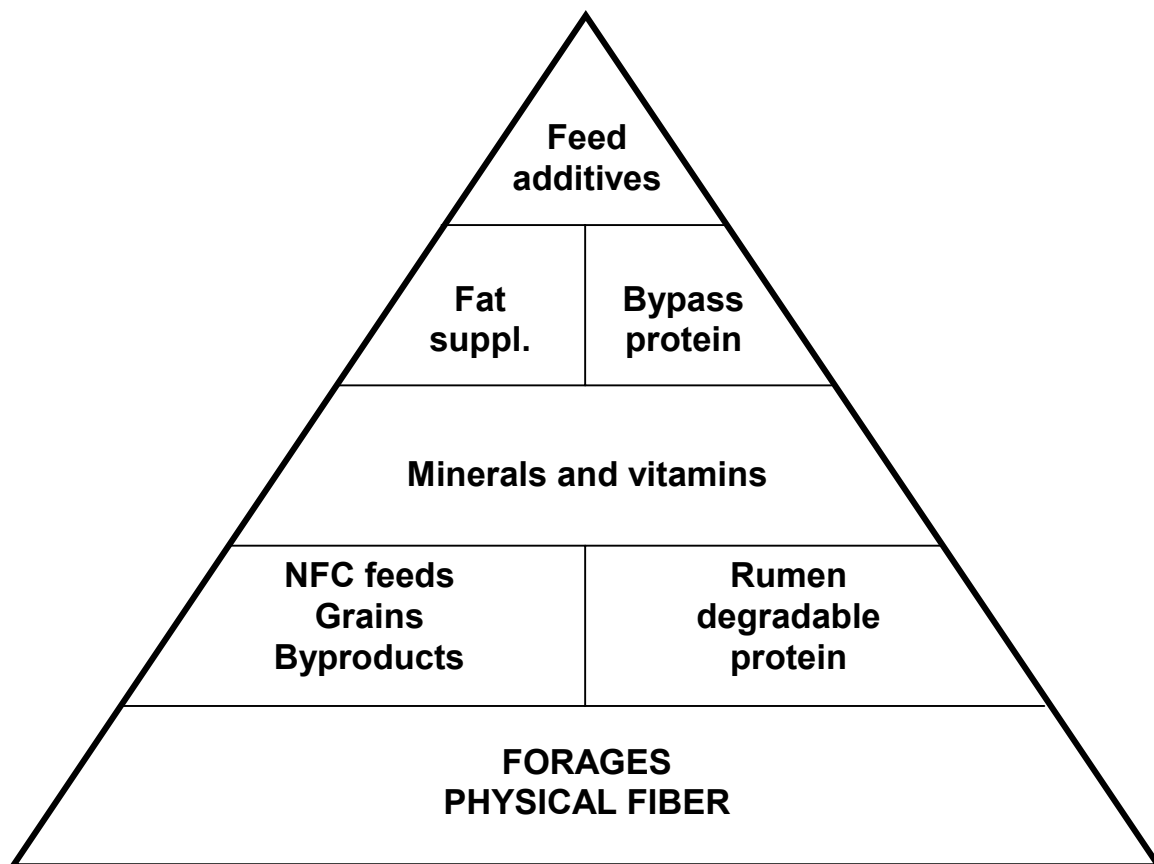
Factsheet 4: Ration Guidelines for Milking and Dry Cows

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The Feed Pyramid

(Rick Lundquist, 1995)

Use the Feed Pyramid to think about how rations should be formulated and cows fed. A basic ration with high quality forages (bottom three sections of pyramid) should support up to 75 lb of milk per day. Fats, bypass proteins and feed additives are needed by higher producing cows and should top off the base ration.



DRY MATTER INTAKE (DMI)

Milk Cows

$$\text{DMI (lb/day)} = .0185 \times \text{BW}^* + .305 \times 4\% \text{ FAT MILK (lb/day)}$$

$$4\% \text{ FAT MILK (lb/day)} = .4 \times \text{MILK (lb/day)} + 15 \times \text{FAT (lb/day)}$$

Estimated daily DMI for milk cows

3.75% fat milk	Body weight, lb			
	900	1100	1300	1500
	----- DMI, lb/day* -----			

30	26	29	33	37
50	31	35	39	42
60	34	38	42	45
70	37	41	45	48
80	40	44	48	51
90	43	47	50	54
100		50	53	57
100+		52	56	60

*Decrease DMI .2%/day for cows <90 days in milk

Dry Cows

Far-off (2 to 8 weeks before freshening)

$$\text{DMI (lb/day)} = 1.8 \text{ to } 2.0\% \text{ BW}$$

Close-up (0-2 weeks before freshening)

$$\text{DMI (lb/day)} = 1.5\% \text{ BW}$$

DMI guidelines for dry cows	DMI range	
BW	Far-off	Close-up
-- lb --	-- lb/day --	-- lb/day --
900	16 - 18	14 - 16
1100	20 - 22	16 - 18
1300	23 - 26	18 - 22
1500	27 - 30	20 - 24

*BW = Body weight

Check the following when observed DMI is different than expected:

(DMI is amount the cows consume, not amount fed)

DMI 5% above guidelines

1. Feed weight accuracy - mixer scales calibrated, good feed mixing.
2. Weigh back amounts accounted for.
3. Moisture or DM content of feeds correct.
4. Cow body weights.
5. Compare milk production to amount of DMI. Cows should average 1.8 to 2.2 lb of milk per lb of DMI.

DMI less than predicted

1. Ration DM below 50%.
2. Empty bunks, cows not on full feed.
3. Inadequate bunk space, crowded facilities.
4. High fiber ration, check NDF and ADF.
5. Low salt intake.
6. Water intake restricted or quality problem.
7. Moldy feed.
8. Poor bunk management, old feed not cleaned out.
9. Unpalatable feeds and/or low quality forages being fed.
10. Heat stress and/or poor barn ventilation.
11. Excess RUP (bypass protein) being fed.

ENERGY - REQUIREMENTS AND SOURCES

Carbohydrates and fat are the major source of energy in dairy rations. Carbohydrates should be considered as the primary source with fat an additional source when ration energy recommendations cannot be met.

Ration recommendations and concentrations

Item	Lactation stage				
	Early	Mid	Late	Dry	Close-up
Net energy-lactation (NE _L), Mcal/lb	.78 - .81	.74 - .78	.70 - .74	.60 - .65	.70
Non-fiber carbohydrates (NFC), %	37 - 42	35 - 40	30 - 40	20 - 30	35
Fat, add %, maximum	3	3	2	0	1

Non-fiber carbohydrate (NFC) is a measure of starches, sugars and pectins. NFC values for feeds are calculated as follows:

$$\text{NFC (\%)} = 100 - [\text{NDF\%} + \text{CP\%} + \text{ASH\%} + \text{FAT\%}]$$

All values are on a DM basis

Excess ration NFC symptoms

1. Low or fluctuating DMI.
2. Low milk fat %, high milk protein %.
3. Acidosis problems.
4. Rapid hoof growth, sore feet.
5. Excessive corn in the manure.

Inadequate ration NFC symptoms

1. No peak milk, generally low production.
2. Considerable body weight loss, especially in early lactation.
3. Ketosis problems.
4. High milk fat %, low milk protein %.

Fat feeding guidelines

1. Maximum fat added to a lactating ration should be 4% of DM.
2. General feeding guidelines, maximum amount of fat from source:

Animal fat	-	1.0 lb/cow/day
Plant/vegetable	-	1.2 lb/cow/day
Inert fats	-	1.0 lb/cow/day

3. Symptoms of excess fat feeding:

Low DMI
 Over-conditioned (fat) cows
 Loose greasy manure
 High milk fat test (>3.6%) with low fiber (<19% ADF) ration

Grain processing/rumen degradability

Rumen degradability or digestion of starch from fastest to lowest in grains as follows:

Oats, Wheat, Barley, Corn, Sorghum

Processing also affects degradability with steam flaking, fine grinding and ensiling increasing degradability compared to coarse or whole dry grains.

Energy feeds				
Feed	NE _L Mcal/lb	Fat %	NFC %	Feeding limit lb/cow/day
	----- DM basis -----			-- As fed --
Grains				
Corn, shelled	0.92	4	75	25
Ear corn	0.90	3	62	30
Barley	0.87	2	61	15
Oats	0.75	2	46	15
Byproducts				
Beet pulp	0.81	3	30	10
Brewers grains - wet	0.81	6	21	25
Corn gluten feed	0.82	3	19	15
Distillers grains	0.99	10	16	5
Soybean hulls	0.85	2	14	10
Wheat midds	0.87	5	34	10
Fats				
Tallow	2.65	99	0	1.0
Vegetable fats				
Free oil	2.65	99	0	0.5
Cottonseed, fuzzy	1.01	20	13	7
Soybeans, cracked	0.92	19	16	5
Sunflowers, whole	1.10	40	10	3
Rumen inert fats	2.5+	80+	0	1

PROTEIN RECOMMENDATIONS AND SOURCES

Four forms of protein are often considered in evaluating or formulating rations. Crude protein (**CP**), or total protein, is first and foremost. Rumen degradable protein (**RDP**) and rumen undegradable protein (**RUP**) are used to fine-tune protein feeding. Soluble protein (**SP**) is considered in some cases for rumen fermentation, and should be about 50% of RDP in rations.

Ration protein recommendations

Protein	Lactation stage				
	Early	Mid	Late	Far-off dry	Close-up dry
CP, % of DM	18 - 19	16 - 17	13 - 15	12 - 13	15 - 16
RDP, % of CP	60 - 65	64 - 68	64 - 68	65 - 68	60 - 64
RUP, % of CP	35 - 40	32 - 36	32 - 36	32 - 35	36 - 40
SP, % of CP	30 - 35	30 - 40	30 - 40	30 - 35	30 - 35

Protein Checks and Considerations

1. All rations should be balanced for CP requirements first and then for RDP, RUP and SP.
2. Guideline is: 1 lb of CP is required to produce 10 lb of milk (example: 7 lb CP intake = 70 lb milk).
3. Forages should be checked for loss of CP from heat damage. Heat damage indicators:
 - ADF-CP/CP ratio >13%
 - Forage color is dark brown to black
 - Manure dark color and dry
 - DMI high with low milk production
4. Excess RUP in ration results in:
 - Lowered milk production
 - Manure may be stiff, dry
 - DMI low because of inadequate rumen RDP decreasing digestibility of feeds
5. Excess RDP in ration indicators:
 - Low milk production; high, early peaks with low persistency
 - High milk urea nitrogen (MUN) levels: (>18 mg/dl)
 - Loose manure

6. General RUP and RDP feeding guidelines based on forages in the ration:

High corn silage, >50% of forage DMI

- Limit use of corn based protein supplements like corn gluten meal, brewers grains and corn distillers grains because of low lysine contents
- Feed soybean meal based protein supplements
- Consider feeding some urea

High alfalfa based rations, >50% of forage DMI

- More need for higher RUP supplements
- Corn based or animal RUP sources complement alfalfa protein

Protein sources				
Feed	CP	RDP	RUP	SP
	% of DM	-----	% of CP	-----
Grains				
Corn, dry	10	50	50	12
Corn, high-moisture	10	60	40	30
Barley	13	75	25	22
Oats	13	80	20	30
Forages				
Alfalfa hay	20	70	30	35
Alfalfa haylage - <40% DM	20	80	20	60
- 40-50% DM	20	75	25	50
- >55% DM	20	70	30	40
Grass hay	12	63	37	35
Grass haylage	12	70	30	50
Corn silage	8	70	30	45
Corn silage - NPN	12	65	35	55
Protein sources				
Blood meal	88	20	80	10
Brewers grains, dry	28	47	53	10
Canola meal	40	77	28	25
Corn gluten meal	68	45	55	5
Cottonseed, fuzzy	24	65	35	27
Distillers dry grains	32	45	55	15
Fish meal	67	30	70	10
Linseed meal	38	65	35	40
Meat and bone meal	54	45	55	15
Soybean meal - 44%	49	65	35	18
Soybeans, raw	41	80	20	30
Soybeans, heated	41	50	50	18
Sunflower, meal	32	76	24	30
Urea	287	100	0	100

FIBER AND FORAGE RECOMMENDATIONS

Three measures of fiber should be evaluated in dairy rations: Acid Detergent Fiber (**ADF**), Neutral Detergent Fiber (**NDF**), and NDF from Forage (**NDF-Forage**). The NDF-Forage considers the NDF from hays, haylages, corn silage and 50% of the NDF in whole cottonseed. Any NDF from non-forage sources, like grains or byproducts other than cottonseed, are not considered in calculating NDF-Forage. Ration guidelines are below:

Measure	Lactation stage			
	Early	Mid	Late	Dry
ADF, minimum	18*	20	21	28
NDF, minimum	28	28	32	35
NDF-Forage, minimum	20	21	21	25
NDF-Forage, maximum	24	26	28	--

*Increase to 20% minimum when fat added to rations

Effective, Physical or Cud Chewing Fiber

Cows need a minimum of 15 and preferably 20% of the forage particles over 1.5 inches long to stimulate rumination. Cows should chew 11 to 12 hours/day or about 15 minutes/lb of DMI.

Particle size guidelines - Forages and TMR

Feed	Separator box level		
	Top	Middle	Bottom
	----- % by weight -----		
Chopped hay	15 - 25	40 - 60	<30
Haylage	15 - 25	30 - 50	<40
Corn silage	<5	50 - 65	<40
TMR	>7	30 - 50	<50

Assessing fiber adequacies in rations:

Excess fiber

1. Low milk production, cows not peaking.
2. DMI lower than expected.
3. High milk fat %.
4. Energy content of feed or ration is generally inverse of fiber content. High fiber levels mean low energy. Early lactation cows fed high forage rations may become ketotic and have rapid and excessive body weight loss.

Fiber deficiencies

1. Acidosis, off-feed problems, fluctuating DMI.
2. Low milk fat %.
3. Cows not chewing their cud.

Byproduct fiber values:

Feeds like whole (fuzzy) cottonseed can substitute for some forage in rations. Their "effectiveness" to substitute for forage fiber depends on particle size. Grinding and processing tends to reduce particle size and, thus, reduce the effectiveness of even high fiber byproducts substituting for large quantities of forages in rations. All rations should contain a minimum of 20% NDF-Forage (DM basis). Effective fiber from forages and high fiber byproduct feeds should be a minimum of 75% of total NDF in the ration.

Effective NDF (% of NDF) of some feeds

Feed	NDF, %	Effective NDF, % NDF	NDF-Forage, %
Legumes and grasses			
Hay	45	100	100
Haylage - coarse	45	80	100
Haylage - fine	45	60	100
Corn silage			
1/4" chop	24	70	100
Processed	32	80	100
Concentrates			
Barley	19	40	7.6
Beet pulp	41	40	16.4
Brewers grains	47	35	16.5
Corn, ear	26	35	9.1
Corn, shelled	10	0	0
Corn gluten feed	35	35	12.2
Cottonseed, whole	44	50	22.0
Malt sprouts	44	45	19.8
Soybean hulls	64	20	12.8
Wheat midds	36	33	12.0

MINERAL AND VITAMIN GUIDELINES

Ration guidelines

Mineral/vitamin	Lactation stage			
	Early	Mid	Late	Dry: far-off
----- % of DM -----				
Calcium	>0.80	0.70	0.60	0.50
Phosphorus	0.50	0.45	0.40	0.30
Magnesium	>0.30	0.25	0.20	0.20
Potassium	1.50	1.20	1.20	0.65
Salt	0.50	0.50	0.50	0.50
Sulfur	0.25	0.20	0.20	0.20
----- PPM -----				
Iodine	0.60	0.60	0.60	0.60
Iron	50	50	50	50
Cobalt	0.10	0.10	0.10	0.10
Copper	10	10	10	10
Manganese	40	40	40	40
Selenium	0.30	0.30	0.30	0.30
Zinc	40	40	40	40
----- 1000 IU/day -----				
Vitamin A	150	100	100	80
Vitamin D	30	30	30	25
Vitamin E	0.5	0.5	0.5	1.0

Some key mineral and vitamin evaluation points:

Lactating cows

Calcium:	>150 grams/day or .75% of ration DM
Phosphorus:	about 100 grams but maximum of .50% of ration DM
Calcium at:	.9 to 1% and magnesium at .3% when fat is included in ration
Salt:	3 to 4 ounces/cow/day (1 oz for maintenance plus 1 oz/25 lb of milk)
DCAD of:	+20 milliequivalents or greater/100 grams of DM
Selenium:	6 to 7 milligrams/cow/day
Vitamin E:	400 to 600 IU/day

Dry cows

Calcium:	<100 grams/day
Phosphorus:	30 to 40 grams/day
Vitamin E:	800 to 1000 IU/day

Close-up dry cows - without anionic salts

Calcium:	<100 grams/day without anionic salts
Potassium:	<1% of DM
Other minerals:	same as for far-off dry cows

Close-up dry cows - with anionic salts

Calcium:	150 grams/day
Phosphorus:	40 grams/day
Magnesium:	.4% of DMI
Sodium (Na):	.05% of DMI
Potassium (K):	.65% of DMI
Chloride (Cl):	up to .8% of DMI
Sulfur (S):	up to .4% of DMI

Example ration: Na - .1%, K - 1.2%, Cl - 1% and S - .45% (DM basis)
[(.1% × 43.5) + (1.2% × 25.6)] - [(1% × 28.2) + (.45% × 62.6)] = -21.3 meq/100 grams DM

DCAD calculation: [(Na% × 43.5) + (K% × 25.6)] - [(Cl% × 28.2) + (S% × 62.6)]

***Goal:** -10 to -30 meq/100 g of DMI

BODY CONDITION SCORES

Recommended scoring time	Body condition score 1 = thin; 5 = fat
Freshening	3.2 - 3.5
Breeding, 60-90 days	2.5 - 3.0
Late lactation	3.0 - 3.5
Dry off	3.2 - 3.5

Body condition should not drop more than .5 score from freshening to pregnancy.

Weight gain during lactation requires about 2.5 lb of corn (2.3 Mcal NE_L) /lb of gain in addition to grain for milk.

NUTRITION MANAGEMENT

Feed Bunk

- 1 to 3% weigh back or feed remaining after 24-hour feeding period.
- Cows need 24 to 30 inches of linear bunk space, but may get by at 12 inches if TMR fed and available at all times.
- Cows eat best in grazing position off smooth surfaces.

Ration Formulation

- When balancing rations, the reference cow should be at the 75th percentile of the herd. To calculate reference cow, take the average peak milk of older cows and add the daily average of all cows and divide by 2.

Example: Bulk tank average - 60 lb, peak milk older cows - 86 lb
 $(60 + 86) \div 2 = 73$ lb of milk to balance for

Two groups: Balance rations at 20% above average milk production of each group.

Three or more groups: Balance rations at 10 to 15% above average milk production of each group.

Water Intake

- Cows should consume 3 to 5 lb of water per pound of DM consumed.

Example: 50 lb DM intake at 4 lb of water/lb of milk DM intake
= 200 lb of water/day or $200 \div 8 \text{ lb/gallon} = 25 \text{ gallons}$

Ration Check

All rations should contain at least 1 feed from each category:

Forage
Grains
Protein supplements
Ca-P mineral
Salt

FEED COST GUIDELINES

Target - Milking Cows

<\$5.00/cwt milk produced

Daily cow cost: \$3.00 to \$4.00

Ingredient costs	
Feed	% of total daily cost
Forages	35 - 50
Grains/byproducts	30 - 40
Purchased protein, minerals, vitamins, additives	10 - 20

Dry cows: \$1.25 to \$1.75/cow/day

Heifers: \$1.00 to \$1.50/heifer/day