AGRICULTURAL EXTENSION SERVICE, UNIVERSITY OF MINNESOTA

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Thumb Rules for Dairy Cow Feeding

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Your dairy profits depend on a feeding program to obtain high production. You must provide adequate amounts of essential nutrients. To keep feed costs at a minimum, you must use the cow's ability to convert feed to milk at or near her maximum capacity. Secondly, you must use the most economical sources of nutrients.

Energy and Protein—Main Nutrients

Give primary consideration to providing adequate protein and TDN (energy) in your ration. The ration should contain about 14 percent total protein and .65 Mcal of net energy per pound (60 percent TDN on air dry basis.) One Mcal equals one therm of energy.

Feed Consumption

An average lactating cow will eat about 3 to 3½ pounds of dry feed per 100 pounds of body weight.

A. To maintain normal rumen function and fat test of milk, at least 1/3 of the total dry matter in the ration should be roughages.
B. To provide adequate energy from the amount of feed usually consumed, 1/3 or more of the total dry matter should be grain when feeding lactating cows.
C. Composition of the remaining 1/3 (roughage or concentrate) is determined by such factors as:
   (1) Quality of roughage fed.
   (2) Level of milk production of the cow.
   (3) Comparative cost of nutrients in grain vs. roughages.
   (4) Kind and cost of feeds available.
   (5) Comparative cost of feed in relation to other production costs and income (labor, price of milk, etc.).

Roughage Consumption

When good quality roughages (harvested at optimum maturity, no weather damage, and properly stored) are fed free choice, cows will consume about 3 pounds of air dry roughage (hay equivalent) per 100 pounds of body weight (no grain).

Hay equivalent is an easy way to adjust for silages of various moisture contents. For example, the following roughages are about equal in dry matter content:

1 pound of hay
2 pounds of 45 percent dry matter low-moisture silage
3 pounds of regular 30 percent dry matter silage
4 pounds of direct-cut silage or green chop.

Within reasonable limits, the amount of moisture in the feed does not affect the pounds of dry matter consumed. However, on nearly all silage rations, high-moisture content will decrease dry matter consumption.

Amount of Grain to Feed

Feeding high quality forage can reduce the amount of grain needed to maintain top milk production. Table 1 indicates the amount of grain needed based on level of production, fat test, and forage quality. Remember, forage intake will decrease 6 to 7 pounds (air dry) for each additional 10 pounds of grain fed. Using the DHI grain recommendation is an excellent guide since the computer calculates each cow's needs based on forage quality, intake, body weight, milk production, and fat test.

Table 1. Grain feeding schedule (pounds per day) for various levels of production for cows fed different quality forages (air dry basis)

Excellent forage intake* of 3 lbs./100 lbs. body wt. Net energy .63Mcal/lb.				Good forage intake* of 2½ lbs./100 lbs. body wt. Net energy .54Mcal/lb.				Good forage intake* of 2 lbs./100 lbs. body wt. Net energy .54Mcal/lb.				Fair to poor forage intake of 1½ lbs./100 lbs. body wt. Net energy .43Mcal/lb.			
Pounds milk	Milk fat			Pounds milk	Milk fat			Pounds milk	Milk fat			Pounds milk	Milk fat		
per day	3.5	4.0	5.0%	per day	3.5	4.0	5.0%	per day	3.5	4.0	5.0%	per day	3.5	4.0	5.0%
20	0	0	0	20	0	1	2	20	4	5	6	20	11	12	13
30	0	0	0	30	4	5	7	30	9	10	11	30	16	17	19
40	0	1	3	40	8	10	12	40	13	14	16	40	20	21	24
50	4	6	9	50	13	15	17	50	17	19	22	50	24	26	29
60	7	10	14	60	17	19	22	60	21	24	27	60	28	31	34
70	12	15	19	70	21	24	28	70	25	28	32	70	32	35	39
80	16	20	24	80	25	28	33	80	29	33	37	80	37	40	
90+**				90+**				85+**				85+**			

*At higher grain levels a cow's forage intake ability will decrease approximately .6 to .7 pound per pound of additional grain consumed.

**Feed as much grain as the cow will consume.

Allowances for 2- and 3-Year-Olds, Thin Cows, and Reproduction

The above thumb rules provide for maintenance and milk production. You should feed extra grain to increase weight of thin cows, maintain growth of 2- and 3-year-olds, and provide nutrients for unborn calf growth during last 2 to 3 months of pregnancy. About 2 to 3 pounds of extra grain daily is justified for these needs.

Protein Content of the Grain Mix

The following worksheet will help you determine the level of protein needed to balance your grain ration. Below is an example of a cow weighing 1,400 pounds and consuming 36 pounds of corn silage, 12 pounds of low-moisture grass silage, and 3 pounds of hay.

1. Estimate amount of dry roughage equivalent eaten per cow per day.

(a) Corn silage 36 lb. x 1/3 = 12

(b) Low-moisture hay silage 12 lb. x 1/2 = 6

(c) Direct-cut hay silage ______ lb. x 1/4 = ______

(d) Hay 3 lb. x 1 = 3

Total air dry forage = 21 (answer 1)

2. A cow will eat 3 pounds of air dry feed per 100 pounds of body weight per day. Average body weight (100 lbs.) 14 x 3 = 42 (answer 2

3. Percent forage (answer 1) 21 / (answer 2) 42 x 100 = 50 (answer 3)

4. Percent concentrate (100 minus answer 3) = 50 (answer 4)

5. Convert your protein forage test results from a wet to an air-dry basis by looking in the table below. Use the answer in step 6.

Moisture %	Crude Protein (wet)										
	2	4	6	8	10	12	14	16	18	20	22
15	2	4	6	8	11	13	15	17	19	21	23
20	2	5	7	9	11	13	16	18	20	22	25
25	2	5	7	10	12	14	17	19	22	24	26
30	3	5	8	10	13	15	18	21	23	26	
35	3	6	8	11	14	17	19	22	25		
40	3	6	9	12	15	18	21	24			
45	3	7	10	13	16	20	23	26			
50	4	7	11	14	18	22	25				
55	4	8	12	16	20	24					
60	5	9	13	18	22						
65	5	10	15	21							
70	6	12	18								
75	7	14									

You can also estimate protein quality for various roughages. Circle the one(s) appropriate for your feeding program.

Roughage	Estimated protein (air dry basis) percent
Alfalfa (early bloom)	18 hay silage
(1/2 bloom)	16
(full bloom)	14 hay
Alfalfa-grass (early cut, 1/2 each)	14
(late cut, 1/2 each)	10
Bromegrass (immature)	16
(average)	10
(mature)	6
Orchardgrass (early cut)	13
(average)	9
Timothy (before bloom)	10
(early bloom)	8
(full bloom)	6
Red clover (before bloom)	18
(mid bloom)	13
Corn silage (with ear)	8
(without ear)	6
Oat silage	8

6. Determine the percentage of each type of forage. Divide 1(a)/answer 1, 1(b)/answer 1, 1(c)/answer 1, etc.

% protein / % forage (step 5)

1(a) 12 / (ans. 1) 21 x 100 = 60% corn silage .60 x 8 = 4.8

1(b) 6 / (ans. 1) 21 x 100 = 30% low-moisture hay silage .30 x 18 = 5.4

1(c) ______ / (ans. 1) x 100 = ___% direct-cut hay silage _____ x _____ = ______

1(d) 3 / (ans. 1) 21 x 100 = 15% hay .15 x 14 = 2.1

Percent protein in air dry forage = 12.3 (ans. 6)

7. Select the correct table based on your forage and grain ratio (answers 3 and 4). Circle the percent protein in forage (answer 6) in the table you selected. The percent protein needed in the grain mix to balance the ration is listed below.

WORKSHEET

Use with "Thumb Rules for Dairy Cow Feeding"

Here is a worksheet you can use to balance your herd ration. Follow the example on page 2.

1. Estimate amount of dry roughage equivalent eaten per cow per day.

(a) Corn silage	________	lb. x 1/3	=	________
(b) Low-moisture grass silage	________	lb. x 1/2	=	________
(c) Direct-cut grass silage	________	lb. x 1/4	=	________
(d) Hay	________	lb. x 1	=	________

Total air dry forage = ________ (answer 1)

2. A cow will eat 3 pounds of air dry feed per 100 pounds of body weight per day.

Average body weight (100 lbs.) ________ x 3 = ____________ (answer 2)

3. Percent roughage $\dfrac{\text{(answer 1)}}{\text{(answer 2)}}$ x 100 = ____________ (answer 3)

4. Percent concentrate 100 - (answer 3) __________ = ____________ (answer 4)

5. Omitted, see example on page 2.

6. Determine the percentage of each type of forage.

Divide 1(a)/Answer 1, 1(b)/Answer 1, 1(c)/Answer 1, etc.

				Percent forage		Percent protein		
$\dfrac{\text{1(a)}}{\text{(ans. 1)}}$	x 100 =	_____	% corn silage	________	x	______	=	____________
$\dfrac{\text{1(b)}}{\text{(ans. 1)}}$	x 100 =	_____	% low-moisture silage	________	x	______	=	____________
$\dfrac{\text{1(c)}}{\text{(ans. 1)}}$	x 100 =	_____	% direct-cut silage	________	x	______	=	____________
$\dfrac{\text{1(d)}}{\text{(ans. 1)}}$	x 100 =	_____	% hay	________	x	______	=	____________

Percent protein in forage (ans. 6) ____________

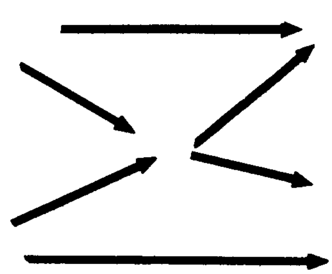


Table 1 56 percent or more forage in the ration

Roughage protein (Answer 6)	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Percent protein needed in grain mix	28	26	24	22	20	18	16	14	12	10	8	6	4	2

Table 2 45 to 55 percent forage in the ration

Roughage protein (Answer 6)	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Percent protein needed in grain mix	21	20	19	18	17	16	15	14	13	12	11	10	9	8

Table 3 44 percent or less forage in the ration

Roughage protein (Answer 6)	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Percent protein needed in grain mix	18	17	17	16	16	15	15	14	14	13	13	12	12	11

Note: Tables 1, 2, and 3 formulate rations for cows producing 45 to 70 pounds of milk per day.

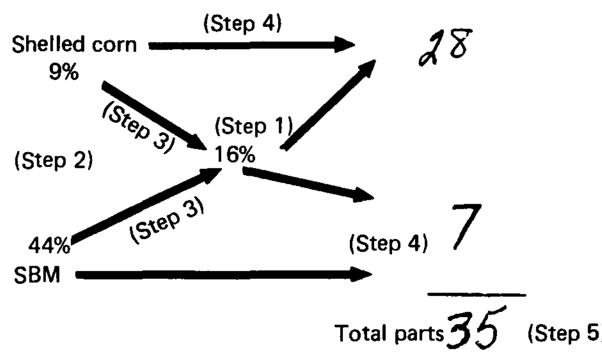
For this example, the cow should receive a grain mix containing 16 percent total protein. The next section discusses how to formulate a grain ration based on feeds available on your farm.

Mixing the Grain Ration

Once you determine, from a forage test or estimate, the desired level of protein, you can calculate the proportions of homegrown grain and protein supplement needed. The Pearson square (box method) is an accurate estimating tool. The following example shows how to formulate a grain mix of 16 percent crude protein using shelled corn (9 percent protein) and soybean meal (44 percent protein).

Steps to follow:

(1) Write the desired protein level for the total grain mix in the middle of the box. Example: 16%.
(2) Write the grain and protein supplement and their correct protein level (see Extension Bulletin 218) in the left corners of the square. Example: 9% and 44%.
(3) Subtract diagonally and write the differences in the appropriate corner. Example: 16 - 9 = 7 and 44 - 16 = 28. These numbers are parts or portions to mix together.
(4) Read across (horizontally) to align the parts or portions with the appropriate feed. Example: 28 parts shelled corn and 7 parts SBM.
(5) To convert to percentage, add all parts and divide total parts into each component. Example: 28 + 7 = 35; percent SBM would be 7/35 x 100 = 20%.
(6) Multiply the size of the batch you mix times the percent to get the necessary pounds. Example: 2,000 pounds x 20 percent SBM = 400 lbs. of SBM per ton of grain mix.



(Step 5)
Percentage shelled corn = 28/35 x 100 = 80%
Percentage SBM = 7/35 x 100 = 20%

(Step 6)
In this example a 1-ton mix would contain 1,600 pounds of shelled corn and 400 pounds of soybean meal.

You can use any grain, protein supplement, or combination of feeds. For example, if you want to mix half oats (12 percent protein) and corn and cob (8 percent protein), simply average the protein percentage of the combination of feeds (in this case, 10 percent) and put the percentage in the upper left corner. Then work the square. When amount per batch has been calculated, half should be oats and half corn and cob. If you feed high moisture feed, you must convert weights to an air dry basis since the square method is usually figured on an air dry as fed basis. The square method will work on a 100 percent dry matter base; however, you must remember to convert back to an as fed basis.

Minerals & Vitamins

A. Salt

All rations are deficient in salt. Provide requirements by adding 0.5-1 percent to the grain mix and additional salt free choice.

B. Trace Minerals

Cobalt and iodine, as well as other trace minerals, can be lacking or borderline. Provide one source of trace minerals in the ration. You may use:

- Trace mineral salt
- Commercial protein balancers
- Complete mineral (commercial) mixtures

C. Calcium and Phosphorus

To meet requirements, your total dry ration should contain about .5 percent (2.25 grams/lb.) of calcium and .4 percent (1.8 grams/lb.) of phosphorus. High calcium interferes with phosphorus use; likewise, high phosphorus interferes with use of other minerals. A ratio of 2 or 3 parts of calcium to one part of phosphorus has not been proven excessive. Very high calcium, 6 to 9 parts of calcium to one part of phosphorus, is undesirable.

Most dairy rations are slightly deficient in phosphorus; therefore, high phosphorus minerals should be provided. Add 1 percent (20 lb. per ton) of 12 percent to 20 percent phosphorus mineral to the grain mix plus free choice.

With liberal feeding of legume hay and moderate feeding of grain, the higher phosphorus feed such as monoammonium phosphate (no calcium - 24 percent phosphorus) would be preferable. Increased phosphorus intake has reduced milk fever problems when fed to dry cows to reduce calcium-to-phosphorus ratio to about two to one.

With heavy feeding of corn silage and grain with no legumes, a two to one calcium-to-phosphorus mineral supplement may be needed. For example: Bonemeal may be better for this program than dicalcium phosphate and, certainly, preferable to sodium phosphates.

Vitamin A

Cows depend on good quality roughage for vitamin A. Brown silages, brown hay, limited roughage feeding, or feeding old hay are very likely to be low in vitamin A. Liberal feeding of good quality green hay, green pasture, or green silages provides adequate vitamin A.

If you are feeding between these two extremes, you may be providing adequate amounts or slight deficiencies. When in doubt, you can provide vitamin A quite cheaply by using synthetic vitamin A (vitamin A palmitate). Usually 50,000 International Units per day are adequate for a 1,400 pound cow.

Vitamin D

Vitamin D is normally obtained from the action of sunlight on the cow and/or from sun-cured hay.

Exact requirements are not known. To insure adequate amounts, about 15,000 to 20,000 units are advised daily. The primary source is irradiated yeast.

All thumb rules are guides only. Good dairymen use and modify them to fit their conditions.

Summary

How does YOUR dairy ration measure up? Can you check yes to all these points?

	Yes	No	?
1. 13 to 16 percent crude protein in the total ration			
2. 60 to 70 percent TDN in the total ration (.60 to .80 ENE)			
3. 1.5 to 3.0 hay equivalents per 100 pounds of body weight			
4. 15 percent crude fiber (minimum)			
5. 0.5- 1 percent trace mineral salt in the grain mix			
6. 1 percent calcium-phosphorus supplement in the grain mix			
7. No more than 5 percent molasses in the grain mix.			
8. Maximum of .4 pounds of urea per cow per day, or 1 percent urea in the grain mix.			
9. Adequate vitamin A and D, especially in the winter			
10. Concentrates and roughage not ground too finely			

If you can honestly check yes to all of these points you are well on the way to a complete, well-balanced dairy ration.

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