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Planning a Feeding Program (calculation of supplemental needs)

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Most beef cow and sheep producers in the Northern Great Plains have a substantial forage base (both grazed and harvested) that provides the majority of nutrients to their operation. Appropriately matching available forages to animal demands for nutrients throughout the year is essential for profitable and sustainable livestock production. Secondary to this balancing act, is the need for determining when nutrient demands of livestock are not being fully met and how to go about alleviating these inherent deficits. Appropriately allocating forages and identification of a potential need for supplemental feed is the basis behind planned feeding programs.

When considering a single nutrient, the process of determining the need for supplemental feed and the necessary nutrient composition in the supplement to alleviate a possible deficit is not an extremely complicated process. However when consider the array of dietary nutrients required by livestock, the task can seem overwhelming. The purpose of this article is to layout a process producers can use to match the composition of a base feed with an animal's requirement, determine whether potential deficiencies are present and formulate the composition of a supplement necessary to address possible concerns.

Planning a feeding program begins with inventorying forage availability and nutrient demands. A forage inventory includes not only quantity of forage(s), but also the quality of the forage available. Often times forage quality is defined in terms of protein, digestibility and/or relative feed value (an index of potential intake of digestible dry matter). Producers need to keep in mind that livestock have specific requirements for vitamins and minerals, in addition to energy and protein.

To fully implement a successful feeding program, all nutrients that have dietary requirements need to be considered in the forage inventory. Consideration does not necessarily mean expensive nutrient analysis. Producers need to segregate nutrients into 3 groups: 1) those that must be evaluated (e.g. energy, protein, calcium, phosphorus), 2) those that typically are not a problem (e.g. most B vitamins, vitamin K) and 3) those that may be problem in certain situations (e.g. vitamin A, copper, zinc, cobalt). Once potential problem areas are identified, nutrient concentrations of forages in the inventory must be determined or estimated. Determination will require nutrient analysis, while estimation requires an educated guess or contingency plan. One contingency plan for trace minerals may be to assume that the base

forage provides either 50% or 0% of animal's nutrient requirement and supplements formulated to alleviate this perceived level of deficiency. This approach works reasonably well as insurance, but is not particularly useful in least-cost or finely tuned nutritional programs.

Nutrient demands of livestock can be somewhat complicated to determine. In the simplest situation, a nutrient is used only for maintenance (i.e. requirement does not vary with level or stage of production) and storage capabilities in the animal is limited. In this situation, the only variance in required dietary nutrient concentration would be potential changes in dry matter intake. Otherwise, nutrient demands vary not only with changes in intake but also with level (e.g. milk, growth) and stage (e.g. gestation) of production. Tables of nutrient requirements (NRC, 1984, 1996; Poland, 2000) have been employed in the past to help simplify the task of accounting for changes in nutrient requirements of livestock. Although not perfect, this approach does allow reflection of known changes that occur throughout the production cycle.

Armed with an available forage inventory and budget of nutrient requirements, producers can begin the task of determining supplemental feed needs. Table 1 provides a means that producers can use to achieve this goal. First one must estimate total dry matter intake of the animal in question (row 2) and a desired amount of supplemental intake (row 1). Columns A and B define the nutrients and the units of expression used for each nutrient, respectively. Column C allows input of an animal's requirement, while column D records nutrient concentrations in the base forage. Care must be taken to ensure that the unit of expression is the same for both animal requirement and forage concentration. Subtracting Column C from Column D calculates any possible deficits (Column E; a negative value indicates a deficiency). Multiplying deficits by dry matter intake calculates a supplemental balance required (Column F). Dividing supplemental balance required in Column F by a proposed level of supplement intake calculates the necessary nutrient concentration for the supplement (Column G). This supplemental composition can then be used to custom formulate a supplement or compared to feed tags of standard supplements in the selection of an appropriate feed supplement. Steps involved are listed below:

1. Input estimated total dry matter intake and desired supplemental intake (rows 2 and 1, respectively).

2. List the nutrient requirements of animal (column C).

3. List forage concentration of nutrients (column D).

4. Subtract nutrient requirement from forage concentration (column D - column C) and place in Column E.

5. Multiple deficits (negative values in column E) by dry matter intake and place in column F.

6. Divide column F by desired supplemental intake and place in column G. This then is the necessary supplemental composition to offset deficiencies in the base forage.

Tables 2 - 4 provide examples of how this technique can be used. Table 2 illustrates the supplemental needs of a 1200-lb dry beef cow during mid gestation grazing winter range. A supplement formulated to be fed at 3 pounds per day would require 17% crude protein, 78

ppm zinc, 54 ppm copper, and 22,000 IU/kg vitamin A. Magnesium, potassium and sulfur would be conditional since we have no information regarding forage concentrations for these minerals and no inherent indication that these minerals should be deficient. Table 3 illustrates the technique for this same cow during early lactation being fed a medium-quality alfalfa hay. This cow is slightly energy deficient when consuming alfalfa hay ad libitum and 1 to 1 ½ pounds of grain would correct this deficiency. All other nutrients evaluated look good. Table 4 shows the formulation of a trace mineral supplement that will supply 50% of the dietary requirements of copper, zinc, cobalt and vitamin A for our 1200-lb cow during mid gestation. A supplement formulated to be fed at a rate of 2.5 ounces per day would require 1,859 ppm zinc, 620 ppm copper, 6.2 ppm cobalt and 173,511 IU/kg vitamin A.

This approach to evaluating supplemental feed needs is straight forward and adaptable to computer spreadsheet applications. Producers are encouraged to begin using planned feeding programs as they look for ways to meet the nutrient needs of their livestock. Appropriately utilizing available forage resources and minimizing the cost of supplemental feed, while adequately meeting nutrient demands, provide the basis for sustainable and economical livestock production.

Table 1. Format for calculating supplemental needs.

Column A		Column B	Column C	Column D	Column E	Column F	Column G
Nutrinet		Unit	Requirement	Forage concentration	Deficit	Balance (amount/d)	Supplemental concentration
			(input)	(input)	(conc - requir)	(deficit * dmi)	(balance/si)
1.	Supplemental intake[a]	lb					
2.	Dry matter intake	lb					
3.	TDN	%					
4.	NEm	Mcal/lb					
5.	Crude protein	%					
6.	Calcium	%					
7.	Phosphorus	%					
8.	Magnesium	%					
9.	Potassium	%					
10.	Sulfur	%					
11.	Zinc	mg/kg					
12.	Copper	mg/kg					

13.	Cobalt	mg/kg					
14.	Vitamin A	IU/kg					

Table 2. Supplemental needs of a 1200-lb dry beef cow during mid gestation grazing native range.

Nutrient	Unit	Requirement	Forage concentration	Deficit	Balance (amount/d)	Supplemental concentration
		(input)	(input)	(conc - requir)	(deficit * dmi)	(balance/si)
Supplemental intake[a]	lb					3
Dry matter intake	lb	23.30				
TDN	%	48.8	50.0	1.2	-	-
NEm	Mcal/lb	0.42	0.45	0.03	-	-
Crude protein	%	6.9	4.7	(2.2)	51.3	17.1
Calcium	%	0.16	0.26	0.10	-	-
Phosphorus	%	0.12	0.15	0.03	-	-
Magnesium	%	0.12	0.00	(0.12)	2.80	0.93
Potassium	%	0.60	0.00	(0.60)	13.98	4.66
Sulfur	%	0.15	0.00	(0.15)	3.50	1.17
Zinc	mg/kg	30	20	(10)	233	78
Copper	mg/kg	10	3	(7)	163	54
Cobalt	mg/kg	0.10	0.24	0.14	-	-
Vitamin A	IU/kg	2,800	0	(2,800)	65,240	21,747

[a] Suggested maximum supplemental intakes 2.5 lb for protein and .188 lb (3 ounces) for trace mineral supplements.

Table 3. Supplemental needs of a 1200-lb beef cow during early lactation being fed a medium-quality alfalfa hay.

Nutrinet	Unit	Requirement	Forage concentration	Deficit	Balance (amount/d)	Supplemental concentration
		(input)	(input)	(conc - requir)	(deficit * dmi)	(balance/si)
Supplemental intake[a]	lb					1.5
Dry matter intake	lb	27.80				
TDN	%	61.1	58.0	(3.1)	86.2	57.5
NEm	Mcal/lb	0.61	0.56	(0.05)	1.39	0.93
Crude protein	%	10.6	20.0	9.4	-	-
Calcium	%	0.30	1.37	1.07	-	-
Phosphorus	%	0.21	0.22	0.01	-	-
Magnesium	%	0.20	0.35	0.15	-	-
Potassium	%	0.70	1.56	0.86	-	-
Sulfur	%	0.15	0.28	0.13	-	-
Zinc	mg/kg	30	31	1	-	-
Copper	mg/kg	10	17	7	-	-
Cobalt	mg/kg	0.10	0.39	0.29	-	-
Vitamin A	IU/kg	3,900	46,000	42,100	-	-

[a] Suggested maximum supplemental intakes 2.5 lb for protein and .188 lb (3 ounces) for trace mineral supplements.

Table 4. Trace mineral supplemental formulation to meet 50% of the nutrient requirements for a 1200-lb dry beef cow during mid gestation.

Nutrinet	Unit	Requirement	Forage concentration	Deficit	Balance (amount/d)	Supplemental concentration
		(input)	(input)	(conc - requir)	(deficit * dmi)	(balance/si)
Supplemental intake[a]	lb					0.188
Dry matter intake	lb	23.30				
TDN	%	48.8	-	-	-	-

NEm	Mcal/lb	0.42	-	-	-	-
Crude protein	%	6.9	-	-	-	-
Calcium	%	0.16	-	-	-	-
Phosphorus	%	0.12	-	-	-	-
Magnesium	%	0.12	-	-	-	-
Potassium	%	0.60	-	-	-	-
Sulfur	%	0.15	-	-	-	-
Zinc	mg/kg	30	15	(15)	350	1,859
Copper	mg/kg	10	5	(5)	117	620
Cobalt	mg/kg	0.10	0.05	(0.05)	1.17	6.20
Vitamin A	IU/kg	2,800	1,400	(1,400)	32,620	173,511

[a] Suggested maximum supplemental intakes 2.5 lb for protein and .188 lb (3 ounces) for trace mineral supplements.

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