Improving Performance of Cattle Consuming Meduim or Low Quality Forages

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Supplements often improve performance and/or profitability of grazing cattle. The goal should be to improve profit, not just performance. When forage quailty is *high*, supplementation needs are minimal; simply providing a source of minerals, vitamins, antibiotics and/or ionophores may often be adequate. The optimal items will depend upon the situation. This paper will not address the above items, but will address selected topics on protein supplementation.

What about feeding protein or perhaps energy supplements to cattle on pasture or when feeding harvested roughages? Protein and/or energy supplementation may be justified or may improve performance and profitability in a variety of cases. Usually, protein supplementation is more likely to be profitable or cost effective under a wider variety of grazing conditions than is energy supplementation (i.e. merely feeding supplemental grain). Therefore, this article will be devoted primarily to a discussion of some aspects of protein supplementation which offer excellent potential for increasing profits.

Some broad generalities which usually are noted with regard to feeding supplemental protein to cattle on pasture or to those fed harvested roughages are:

- Protein supplementation is normally beneficial when calves or yearling stocker cattle are grazing pastures which have low (< 7-8%) or perhaps intermediate (8-13%) protein contents. Much the same applies when harvested roughages are fed. Opportunities for animal selectivity of grazed forages may make some difference in assessing the protein content of grazed forages. Because of animal selectivity, protein content of the grazed forage (i.e. that actually consumed) will usually be somewhat higher than the average of the standing, available forage if clipped or harvested.

- Younger and/or lighter weight (and perhaps thinner) calves (e.g. 250-500 lb) often will show beneficial responses in gain (+.3- .5 lb gain/day) under a broader set of grazing/pasture conditions from protein supplementation than will older, heavier calves (e.g. 700-800 lb), because their protein requirements are higher. However, even larger yearlings will often show improved gains (+.2-.3 lb/day) from additional protein.

- Apparent feed conversions from supplemental protein will usually be 2 or 3/1, usually about 2/1 if fed correctly. This means that feeding 2 lb of protein supplement will produce about 1 lb of *added gain* in stocker cattle. If the protein supplement costs 10 cents/lb and the added gain is worth 50 cents, it will cost about 20 cents/lb of added gain (i.e. supplement costs only) and will be cost effective. With supplemental grain feeding, on the other hand, it often will require 7-9 lb of grain to obtain an additional pound of gain and is less likely to be profitable.

- Profitability of feeding a small amount of supplemental protein to grazing stocker cattle, under the right pasture conditions, will usually approximate about $2 of added return for each $1 spent on supplemental protein.

- Lactating and/or higher producing (and perhaps thinner) cows may show a greater response or may be more likely to display a beneficial response from supplemental protein than non-lactating, mature cows in good flesh. Again, their protein requirements are higher.

- As the protein content of a pasture or forage declines, supplemental protein is more likely to produce improvements in forage intake, forage digestibility and animal performance.

- In some instances with light weight stocker calves on good quality pastures of intermediate protein content (10-14% CP), a small amount of some high bypass or escape animal protein, which has a low degradability in the rumen, has improved daily gains about .2 to .4 lb per day and may appear advantgeous. Unfortunately, in many cases, high bypass protein are unpalatable, and it may be difficult to obtain desired intakes, especially on high quality pastures.

- Generally speaking, on high quality pastures such as wheat pasture (20-30% crude protein), however, high by-pass proteins have not improved performance over feeding an equal amount of grain. Apparently, adequate microbial protein is synthesized in the rumen in these cases or an adequate amount of bypass or escape protein is supplied by the forage to meet animal needs.

- Unfortunately, in most research trials where calves were supplemented with high bypass or rumen escape protein supplements while grazing intermediate or high quality pastures, the control treatment to which the high bypass or rumen escape protein supplements were compared consisted of either:

  a) no supplement, in which case the calves might have shown the same magnitude of improvement in gain if simply fed grain and/or a more traditional (more degradable) protein supplement like soybean or cottonseed meal at the same level instead of being fed a high bypass protein.

  b) a high urea/starch supplement designed to be isonitrogenous with the high bypass protein supplements. This is probably a *very poor* choice to use as a control for comparison purposes. Many years of previous research with urea have generally shown that urea either doesn't work or doesn't work very well at all under pasture conditions. Moreover, starch (when fed in this form) probably is not favorable for improving forage use because of the form of starch being fed and because of rapid availability. Hence, a control consisting of a urea/starch mixture automatically favors any other treatment (i.e. meaning that one might profoundly conclude that a high bypass protein was beneficial when indeed a more traditional grain or protein supplement might have given the same magnitude of improvement). This is not to say that high by-pass or escape proteins may not be justified in some instances.

Most of the discussion, herein, will be devoted to animal responses to protein supplementation programs on medium and low quality summer and/or winter forages. This is the area where the most potential benefit exists and where supplements may often be used most profitably.

Effect of forage Quality on Intake

Interesting and classical data (Table 1) obtained by Blaxter et al (1961) shows the typical influence of forage quality on passage rate and forage intake. Passage rate is greatly increased, residence time in the digestive tract is greatly reduced, and intake is noticably increased - along with performance - on higher quality roughages. Long stemmed forages must be reduced in particle size during ruminal digestion. The particle size reduction process involves digestion by microorganisms in the rumen and chewing via rumination.

Particles must be reduced to a certain minimal size before they can exit the rumen. The particle reduction process becomes slower as quality of roughages decreases. Moreover, supplementation can either speed up or, in some cases, slow down this process.

Table 1. Effect on Quality of Roughage on the Voluntary Intake of Sheep[1]

	Quality of Hay[2]		
	Poor	Medium	Good
24-Hour intake of dry matter[3]	50.5	77.2	94.0
Intake as % if poor hay	--	153	186
Rumen "fill" upon slaughter	99.7	100	94
Rumen transit time, hr.	83	55	41
Intake of digestible energy (Kcal)[3] -per 24 hours	102	206	319
-above maint. requirements	1	106	218

[1]Blaxter, et.al., 1961.
[2]Grass hay cut at different stages of maturity.
[3]Adjusted for metabolic size ($g/kg^{0.73}$).

Effect of Protein Supplement Upon Intake and Utilization

Inadequate protein will normally decrease feed intake and weight gain in cattle (or increase weight loss). This can be true in diets containing either a fairly high TDN or energy level (Figure 1) or in diets containing low or medium quality forages. As noted in Table 2, bred yearling heifers, being fed prairie hay, showed a dramatic increase in forage intake (11.4 vs 18.4 lb/day) when 1 lb of supplemental cottonseed meal was fed per day. Dramatic differences also were noted in body weight. In fact, there was approximately a 1 lb increase in body weight for each 1 lb of cottonseed meal fed.

In studies by Guthrie and Wagner (1988), increasing levels of soybean meal (SBM) were fed at 0.3 lb increments up to 1.5 lb of SBM per day to heifers consuming ad libitum prairie hay containing approximately 6.0 CP. Up to a 50% increase was noted in daily hay intake with added SBM (Figure 2). Forage digestibility was increased from 38% (on hay only) to 48% by added protein. Moreover, rate of passage increased approximately 50% as forage intake increased. Rate of passage and forage intake were very highly correlated (.98).

Figure 1. Effect of Protein Upon Feed Consumption and Utilization on Full - Fed Rations.

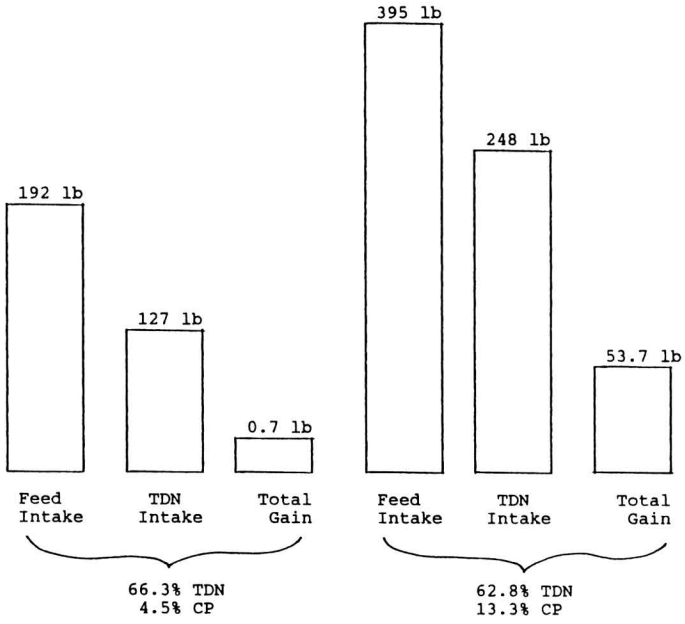


Table 2. Effect of Two Levels of Protein Supplement (Cottonseed Meal) Fed with Prairie Hay for Wintering Pregnant Yearling and 2-year-old Heifers

Supplement		Lot 1 None to calving 1 lb/day to spring		Lot 2 1 lb/day to calving 2 lb/day to spring	
No. heifers per lot		21		21	
Av. weights, lb		777			
initial, 11/9	99 days	777	-57 lb	782	+58 lb
at calving, 2/16		720		840	
in spring, 4/2		634		782	+148 lb
Av. gain to calving, lb		-57		+58	
Av. loss, calving to spring		-86		-58	
Av. birth date		3/16		3/18	
Av. birth weight, lb		67		69	
Av. hay intake/day, lb		11.4		18.4	

Similarly, Church and Santos (1981) noted great improvements in straw intake with supplemental SBM (Figure 3). This would have been a much lower quality forage than that used by Guthrie.

Figure 2. Prairie Hay Intake and Dry Matter Digestibility for Heifers Fed Different Levels of Supplemental Soybean Meal (Guthrie and Wagner, 1988).

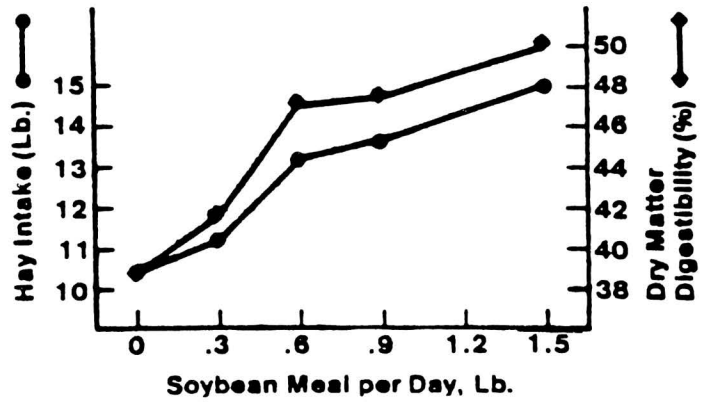
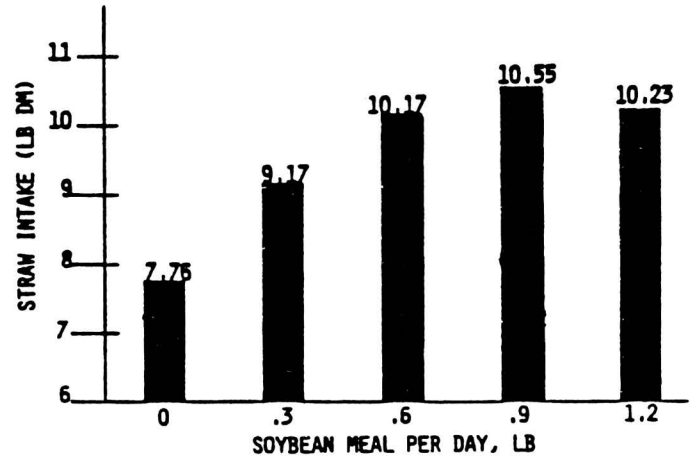


Figure 3. Wheat Straw Intake of Holstein Heifers Fed Different Levels of Supplemental Soybean Meal (Church and Santos, 1981).



Responses on Winter Native Range Pasture

Responses to protein for heifers fed grass hay or grazed on native winter range are shown in Table 3. Of special note is the positive and direct relationship between the amount of protein fed and winter weight change. For these animals, weight gain performance was equal on either 1 lb of 40% CP or 2 lb of 20% CP. While not measured, forage intakes may have been somewhat reduced with the higher quantity of supplement, due to substitution of supplement for forage, while performance remained unchanged (i.e. substitution of energy in the supplement for grass, resulting in less grass consumption). Most studies, however, generally show that substitution does not usually occur until higher levels of supplement are fed (> 4-6 lb supplement day). At lower levels of supplement, performance is usually improved; then at higher levels, substitu-

tion begins to occur with no or little change in performance. The point at which this occurs may vary some, depending upon the situation. In cases where grass or energy is limiting, or where animal competition during feeding does not ensure equal or adequate supplement intakes, or where the physiological status of the animal dictates higher energy requirements (e.g. lactating vs dry cows), one might observe or expect a slight improvement in performance for cattle being fed on a program of 2 lb of 20% CP vs 1 lb of 40% CP.

Table 3. Weight Responses of Heifers to Protein Supplementation

On grass hay	Winter wt change LB
1 lb 20% CP	-11
1 LB 30% CP	+34
1 LB 40% CP	+81
On native range	
1 LB of 20%	-26
1LB of 40%	+15
2 LB of 20%	+15
2 LB of 40%	+38

In a most interesting study with beef cows on native winter range pasture, 2.8 lb of a 15% CP supplement was compared with 2.8 lb of a 40% supplement (Table 4). Forage intake was 32% higher (16.2 vs 21.4 lb/day) on the 40% CP supplement. Moreover, digestibility was increased from 37.2% to 41.9%, and digestible dry matter intake was increased 49% when the higher protein level was fed. A higher forage intake combined with a higher digestibility resulted in a tremendous difference in weight loss (120 lb less weight loss on the higher protein program). A difference in weight loss of this magnitude would probably approximate a difference of 2 condition scores (on the standard scale of 1-9). It is best to keep in mind that more pounds of supplement must be fed per day when lower protein supplements (e.g. 20% CP) are fed. Reduced protein intakes will reduce performance. This doesn't mean one shouldn't feed 20% CP cubes, but only that more must be fed. In cases where pasture or quantity of forage is limited, as is often the case in some herds, the extra energy (i.e. 4 lb of 20% vs 2 lb of 40% cubes) would be beneficial.

Responses to Urea Based Supplements

Many studies have been done over the past 25 years or more at OSU and eleswhere on feeding urea based supplements to beef cows on native range during the winter. Most of the studies have involved the use of urea as a substitutte for part of the natural protein. Results of a typical study are shown in Table 5. Weight losses are invariably greater and condition scores lower when urea is used to supply all or part of the N (as compared to an equal amount of nitrogen coming from natural protein sources). If N in the urea was used as well as in the natural protein source, then weight losses should have been similar. But, they were greater and almost as large as on the negative control (15% CP) diet. Typically, a little value may be obtained from the added urea, but not much.

Table 4. Wintering Cows on Native Range

	Crude protein in supplement	
	15%	40%
Supplement, lb/day	2.8	2.8
Weight change, lb	-196	-79
Forage digestibility, %	37.2	41.9
Forage intake, lb/day	16.2	21.4
Intake of digestible dry matter, %	100	149

Table 5. Natural Protein vs Urea for Wintering Cows on Native Range.

	30% C.P.[a] (All natural protein)	15% C.P.[b]	30% C.P. (1/2 from urea)[c]
Daily supplement, lb	2.60	2.69	2.73
Winter weight loss	-11.4%	-17.2%	-15.2%

[a]Positive control.
[b]Negative control.
[c]1/2 of total protein equivalent form urea.

Reponses of Stocker Calves on Summer Pasture to Supplemental Protein

During the past few years, a number of studies have been conducted to assess the potential benefits of feeding a small amount of supplemental protein to calves grazing either native range pasture or bermuda or fescue type pastures during summer months. We have conducted approximately 10 or more such studies to date here at OSU. Similar studies also have been done elsewhere. An overview of the types of typical responses observed is illustrated in Table 6.

Table 6. Response of Yearling Steers to Supplementation Alternatives when Grazing Summer Native Range (Early July to October 20) in Oklahoma[a]

treatment	Daily Gain lb	Supplement required/lb of increased gain above control lb
Control (No supp)	1.46	
3 lb corn/day	1.79	8.9
3/4 lb SBM/day[b]	1.91	1.7
1 1/2 SBM/day[b]	1.96	3.0

[a]Excess or adequate pasture existed in all treatments
[b]Fed three times/week to give average daily intake as indicated.

Generally, gains are invariably improved approximately .3 to .5 lb per head per day by feeding approximately .75 to 1.0 lb/day of a supplement like soybean or cottonseed meal. Responses are usually greater with younger or lighter weight calves. Additionally, Nebraska studies have generally shown beneficial responses to feeding high by-pass or escape proteins to grazing calves. A successful program commonly used is to feed about 2.0 lb per feeding and feed 3 times/week - to provide a total of about 6 lb of 40% CP/week. Apparent feed conversions are excellent, usually requiring only about 2 lb of protein supplement per pound of additional gain if levels are fed as indicated above. These conversions are profitable in that returns usually approximate $2 or more for each $1 spent on the protein supplement. Protein supplementation programs for grazing calves are usually started about July 1 on native range or bermuda in Oklahoma. The time may differ in different areas, depending upon the growing season for grass, type of grass, type of cattle and other variables.

Protein supplementation is usually more profitable on pastures containing low to intermediate protein levels than is grain supplementation unless there is a shortage of pasture. Traditionally, when supplemental grains are fed, gain is improved approximately. .1 lb/day for each pound of grain (as noted in Table 6) when up to about 4 or 5 lb of grain per day (up to +.4 or +.5 lb of gain/head/day) are fed. Moreover, stocking rate is increased by up to one-third. But, even so, if the cattle and grass are well balanced, the resulting feed conversions will usually be little better than 7 or 9 lb of grain being required for each additional pound of gain. Hence, the grain must be cheap and/or the value of added weight must be fairly high for this to be a profitable program. Additionally, if there is an excess of grass relative to cattle, apparent conversions may not be as good as 7 or 9/1. In fact, it may be as poor as 15+/1 because of extensive substition of grain for grass. In essence, either program, supplemental protein or grain, can work and has a logical place in a management scheme, depending upon the circumstances. Supplemental protein will usually increase grass intake and digestibility of medium and low quality forages, while grain will not (Guthrie and Wagner, 1988). In most cases, a protein supplementation program appears to offer the greatest potential profit reward during the mid summer and fall months when stocker cattle might be grazing native range or bermuda pastures, or other pastures of similar quality. Similar improvements in gain, including better condition scores, have been noted in beef cows by Dr. Lusby and co-workers (Fleck, et. al. 1985) at Oklahoma State University when small amounts of added protein were given to cows grazing native range pasture during late summer and fall months. Cows were approximately 40-50 lb heavier (i.e. in better condition) going into the winter and remained in a higher condition score throughout the winter.

Reference

Blaxter, K.L. et.al., 1961. Anim. Prod. 3:51. Church, D.C. and A. Santos. 1981. J. Anim Sci. 53:1609. Fleck, A.T. et.al. 1985. Okla. Agr. Exp. Sta. MP-117:202. Guthrie, J. and D. Wagner. 1988. J. Anim. Sci. 66:1529.