Evaluating and Selecting Protein Supplements for Wintering Beef Cows

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The goal of any livestock producer or veterinarian when evaluating the alternatives for supplying supplemental nutrients for wintering beef cows should be that of selecting a package or program which will maintain adequate nutrition at least cost. Feeds, whether they are commercial supplements or forages, should be selected on the basis of quality. Most of the problems observed in terms of poor performance on commercial feeds relate to two problems: (1) An improper selection of optimum feed to fulfill the nutritional needs most economically, or (2) Low or inferior quality of supplement. Poor quality feeds are marketed because producers and their advisors frequently fail to recognize that high quality feeds cost money.

Feed manufacturers have in recent years been under tremendous pressure to reduce or hold the line on the cost of protein supplements for range cows. It is generally agreed that, for supplementing cows on an adequate quantity of low quality forage, the best commercial supplement value is frequently the one which will fill nutritional gaps with the smallest amount of supplemental feed. Figure 1, based on work done at Oklahoma State University, shows that, for example, one pound of a 40% protein supplement was of equal value to two pounds of a 20% protein supplement.

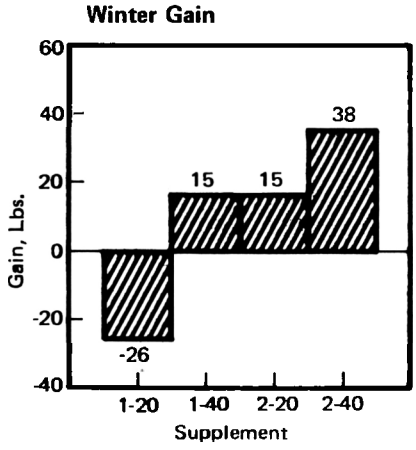


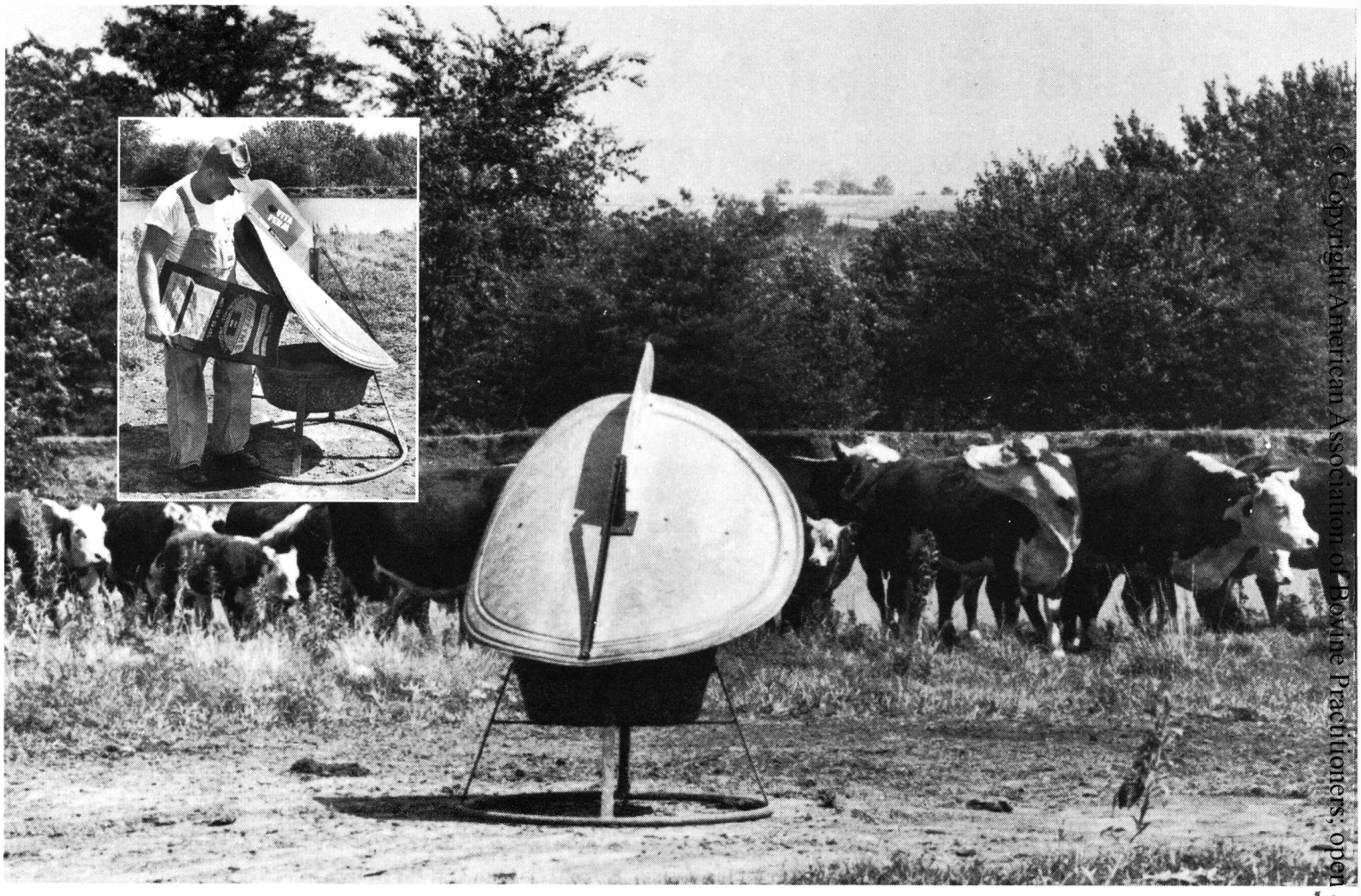
Figure 1. Average winter gains of heifers grazing native grass pasture and fed different quantities and kinds of protein supplements. On an equal intake basis, the supplement containing the higher amount of protein promoted the greater winter gain.

If one pound of 40% protein supplement cost the same or less than two pounds of 20%, then it would have been the best buy. Too often, the producer and his advisor fail to recognize that it costs feed manufacturers from $20 to as much as $40 a ton to make range feeds. When such items as processing, delivery, pelleting, sacks, etc., are added to the basic wholesale price of the ingredients which go into the feed, there is never any economy in adding filler or unnecessary nutrients such as calcium carbonate to range feeds, even though they can reduce the price to the producer a mere few dollars per ton.

Nutritional Needs of Beef Cows

The nutritional needs of the beef cow are relatively simple. Unfortunately, beef cows are sometimes fed as if they were non-ruminants, with the same response expected from the feeding of such items as B-vitamins and high quality protein as is obtained in the case of poultry or swine. Instead, we should recognize the simplicity of the nutritional requirements of the beef cow and take advantage of the fact in building the most economical feeding program that is possibly consistent with optimum production and maximum profit. This is especially important today with higher input costs (particularly higher land prices) and smaller margins.

Beef cows can and, in most cases, should be maintained chiefly or entirely on roughage the year around. The summer grazing period offers few nutritional problems. It is necessary to provide only minerals (primarily salt) and water in addition to ample grass. It is very important to provide ample grass to allow beef cows to recover weight losses normally sustained during the winter. If cows are not allowed to recover winter losses during the summer (due to such practices as overgrazing), lower weaning weights and smaller



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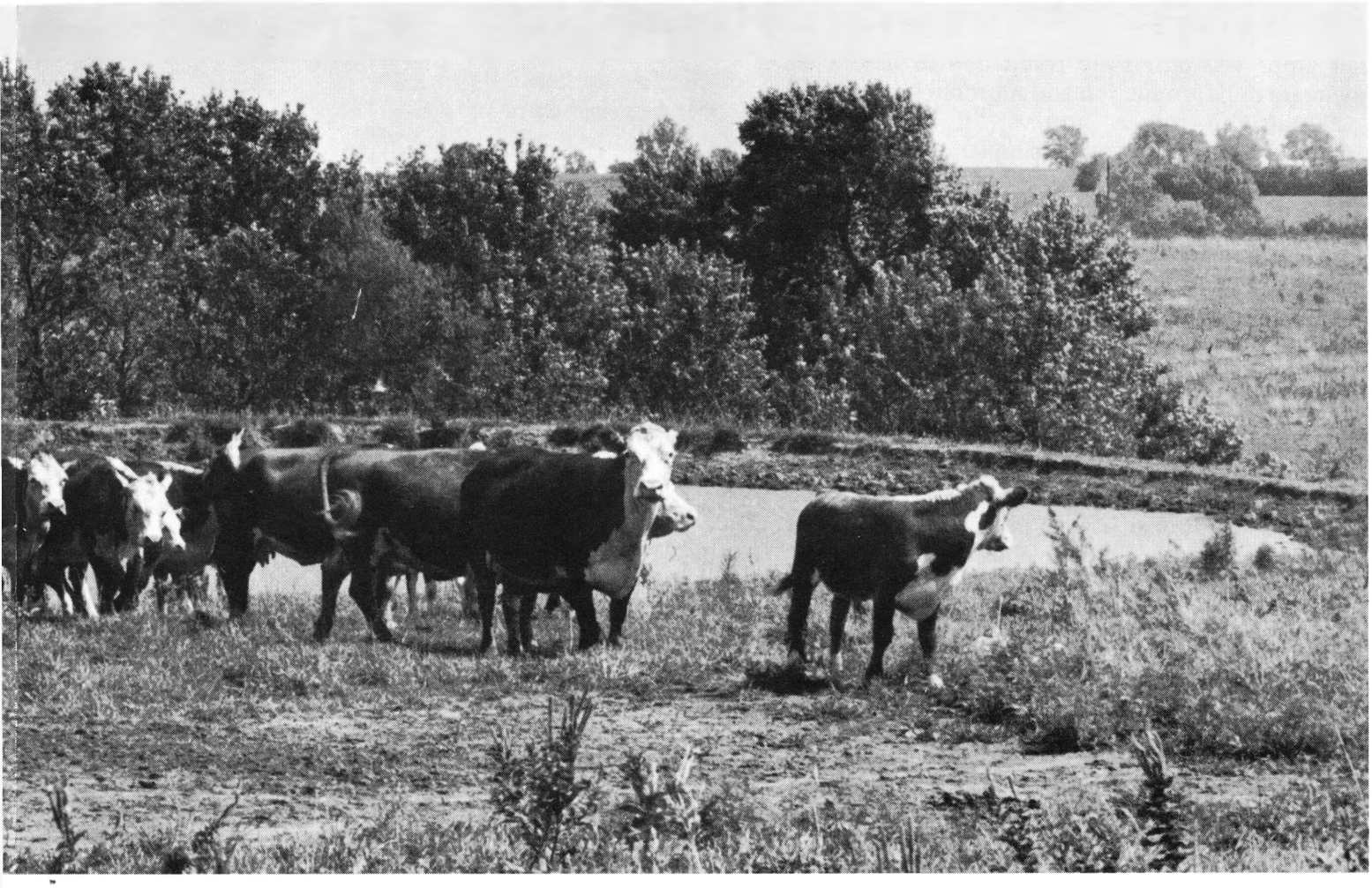

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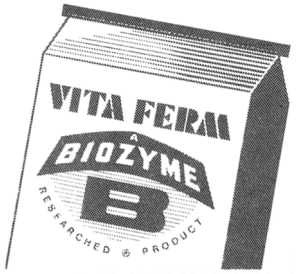

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calf crops will ultimately result due to failure of adequate milk production and reproduction.

During the winter, however, it is ordinarily necessary to either provide supplements to range or feed harvested roughages with or without supplements as may be required.

Important Nutrients for Beef Cows

Basically, cattle require in their various metabolic processes most of the same nutrients required by non-ruminant animals such as swine. However, if we eliminate those synthesized in the rumen (such as B-vitamins and amino acids), those provided by normal rations (such as most minerals and vitamin E), and those provided by other means (such as vitamin D due to sunlight), a group of only six nutritional items remains. This group consists of energy, protein, phosphorus, calcium, vitamin A and salt. These items are of primary importance in building a supplement for beef cows because they are the ones most apt to be deficient in normal feeding practice. In several areas in the United States the forage is deficient in certain trace minerals such as iodine, cobalt or copper, and these mineral elements must also receive attention.

Understanding the Limitations of Grass

Grasses have their highest nutritional value when they are growing rapidly. In the case of native ranges in Oklahoma, optimum values occur during April through August. Figures 2 through 5 show the chemical composition of native ranges in the different seasons of the year.

The utilization of cool season grasses, small grains and bermuda grass varieties offers the cattleman an opportunity to hold up high nutritional value forage for greater periods of times than is available with native range. The principles illustrated in Figures 2-5 will hold for all forages even though the timing and the magnitude of change may be quite different.

Energy

Energy (often expressed as TDN, or total digestible nutrients) is the most important nutritional factor to consider for beef cows for several reasons: (1) It is the nutritional factor most commonly lacking, usually due to a shortage of grass ("hollow belly"). (2) It is the most expensive item to provide for beef cows. Were it not for energy, the nutrient requirements of the cow could be met with 2-3 lb. of total feed per day. (3) The intake of energy may be too high as well as too low. Excessive energy intake not only decreases profits but may actually decrease productivity and reduce the life span of cows. (4) When enough feed

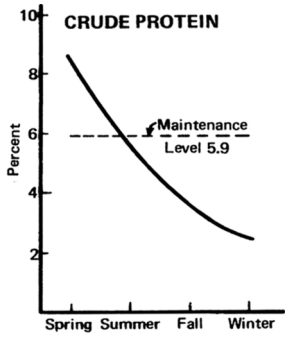


Figure 2. Crude Protein.

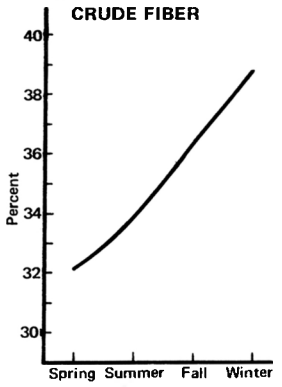


Figure 3. Crude Fiber.

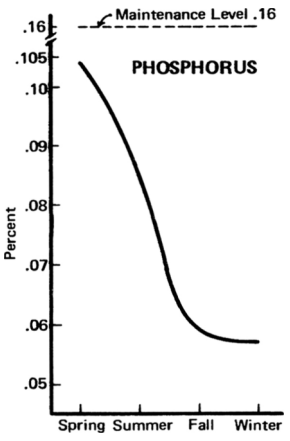


Figure 4. Phosphorus.

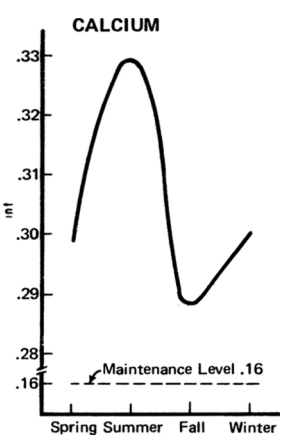


Figure 5. Calcium.

is provided to meet energy needs, most other nutrients are automatically provided in sufficient quantity.

If roughage is adequate, the energy needs of the cow will usually be met. In some cases, such as with low-grade roughages not consumed in sufficient quantity, the energy intake may not be adequate to maintain body weight. This is often true with dry winter grass, especially in the case of lactating cows. However, this situation can be tolerated. Extensive research at the Oklahoma Agricultural Experiment Station has indicated the following weight changes as desirable for spring calving beef females from the standpoint of performance, economy of wintering, and profit:

Age Female – Winter	Winter Wt. Change as % of Fall Wt.
Heifer calf	Gain of 10-15
Bred yearling - calving 2-yr.-old	Loss of 10
Bred 2-yr.-old - calving 3-yr.-old	Loss of 15
Bred 3-yr.-old - calving 4-yr.-old	Loss of 20
Mature cow	Loss of 20

We recognize then, that if other nutrient requirements are met, we can winter cows with less than the level of energy suggested by many feeding

standards, and actually can tolerate considerable weight loss. *It is important to remember, however, that the winter weight loss must be regained during the summer.* Otherwise, reproduction and lactation cannot continue at near-maximum levels, and if a prolonged deficiency of energy occurs, reproduction may stop entirely.

The low palatability of low-grade roughages has been mentioned previously. The thumb rules in Table 1 serve as a guide to indicate "how much roughage a beef cow will eat."

Table 1

Approximate Capacity of Beef Cows for Dry Matter and Various Types of Roughage.

Type Roughage	(DM) Capacity	Example: Feed Capacity of 1000 lb. Cow
	% of Body Wt.	lb. feed
Low-grade (dry grass, straw, hulls)	1.5[1]	Dry grass 18 (15 lb. ÷ 85% DM)[1]
Avg. (Non-legume hay)	2.0	Prairie hay 22 (20 ÷ 90% DM)
High-quality (legume hay, silage, green pasture)	2.5	Alfalfa hay 28 (25 ÷ 90% DM) Silage 83 (25 ÷ 30% DM) Wheat pasture 125 (25 ÷ 20% DM)

[1]In the first example, 1.5% of 1000 lb. = 15 lb. ÷ 85%, the estimated % dry matter of dry winter grass, gives 18 lb. as the capacity of a 1000 lb. cow for the grass.

The only type of roughage that presents a problem in terms of adequate intake is low-grade roughage such as dry grass, especially if the proportion of climax grasses has decreased due to poor pasture management. Other types of roughage will be consumed in adequate quantity and may in fact need to be restricted.

Protein

Protein is the nutrient most likely to be lacking in wintering rations when roughage is adequate. The requirement for protein must be met for adequate performance. The symptoms of a lack of protein are decreased appetite, slow growth rate in young animals, loss of weight, poor reproduction and decreased milk production. On the other hand, protein supplements are expensive, so it is important that we avoid feeding more than is needed. Supplemental protein for wintering cows is usually the largest cash expense in the yearly cost of maintaining a cow. Protein consumed in excess of the protein need is simply used as an energy source, and protein is too expensive to use in this manner.

Plant protein supplements such as cottonseed and soybean meal are the primary sources of protein for beef cows. Animal proteins are not only ordinarily more expensive than plant proteins but fail to offer any advantages in terms of cow performance.

Urea is a non-protein compound which ruminants may convert to protein with varying degrees of efficiency (depending on the ration) through the action of microorganisms in the rumen. The use of urea for beef cattle will increase as the cost of "natural" protein continues to increase and as research provides information concerning methods of formulating supplements for maximum utilization of urea.

Much research at the Oklahoma Station has shown that: (1) Urea can be efficiently utilized by cattle consuming harvested roughage (hay, silage) when it furnishes up to one-half of the protein equivalent in the supplement. The actual value of urea protein under these conditions is approximately 80% that of natural protein. (2) Urea has a very low value for cattle on dry winter grass when it replaces natural protein in a high protein (40% or more) supplement. Perhaps it has a higher value in a low protein (such as 20%) supplement but research to date has failed to demonstrate good utilization of urea even in low protein supplements.

Phosphorus

Phosphorus may be borderline or definitely deficient in some beef cow wintering rations, especially in those areas where soil phosphorus is low. Phosphorus deficiency results in decreased appetite, lowered milk production, thin condition, and, ultimately, lameness and stiffness of joints. When high protein supplements such as cottonseed meal or soybean meal are fed, they usually supply adequate phosphorus to supplement the native forage. Possible phosphorus deficiencies can be prevented by supplying a mineral mix containing dicalcium phosphate, bonemeal or other phosphorus sources (See Tables 2 and 3). A mix of 1/3 phosphorus source and 2/3 salt is desirable for

Table 2

Average Composition of Several Mineral Supplements and Representative Current Prices.

Mineral Supplement	Calcium	Phosphorus	Cost/cwt. Supplement
	%	%	$
Salt	0	0	1.30
Trace mineralized salt	0	0	2.60
Calcium carbonate	38.0	0	.75
Bonemeal	30.0	14.0	6.30
Dicalcium phosphate	21.0	18.5	7.00
Defluorinated rock phosphate	32.0	18.0	6.00

Table 3

Composition and Costs of Several Mineral Mixtures (Based on values in Table 2).

Salt	Ca Carb.	Bone-meal	Dical. Phos.	Defl. Rock Phos.	Composition of mix Ca	Composition of mix P	Cost/cwt.[1] Mix
					%	%	$
1/3	2/3				25.4	0	0.93
2/3	1/3				12.6	0	1.12
1/3	1/3	1/3			22.6	4.7	2.78
2/3		1/3			10.0	4.6	2.96
2/3			1/3		9.0	6.4	2.72
2/3				1/3	10.7	6.0	2.50
1/3		2/3			20.0	9.3	4.64
1/3			2/3		18.0	12.7	4.13
1/3				2/3	21.4	12.0	3.70

many areas, while 2/3 phosphorus source and 1/3 salt is recommended for areas where the forage is definitely deficient in phosphorus. The addition of 5 lb. cottonseed meal or similar feed per cwt. of mineral mixture will increase the intake of the mineral mixture and sometimes improve cattle performance in phosphorus deficient areas.

Calcium

Calcium is not a serious problem in beef cow feeding. It is very seldom deficient because most roughages contain adequate quantities. Furthermore, most commonly used phosphorus sources also provide much calcium (Table 2). Although the inclusion of calcium carbonate (limestone) in a mineral mix or supplement may be tempting due to its low price (See Tables 2 and 3), this practice is definitely not recommended. Calcium carbonate furnishes no phosphorus. Note the calcium and phosphorus content of mineral mixes containing calcium carbonate (Table 3). These mixes are not recommended for beef cows. Additional calcium beyond the quantity needed is useless to the cow, and may be detrimental. Calcium carbonate should not be added to range supplements for the same reason it does not belong in mineral mixes.

Carotene—Vitamin A

Serious vitamin A deficiencies in beef cow herds do not occur often. A cow stores up several month's supply of vitamin A during the summer grazing season when the carotene content of forage is tremendously high (carotene is converted into vitamin A in the body). Some "green picking" is often available during the winter and spring, especially during open winters. Good hay furnishes considerable carotene. So vitamin A deficiencies in beef cows are not widespread, and spring calves that are dropped within 2 months of spring grass seldom present any difficulty. On the other hand, a lactating cow rapidly depletes her body stores of vitamin A, and it is possible for vitamin A deficiencies to occur, especially in fall calves, during dry years, and with young cows. When vitamin A problems do occur, they usually are found in the calves; symptoms include watering eyes, scouring, and respiratory infections. Deficiency in the cow can result in lack of conception, or abortion, or birth of dead, weak, or blind calves.

If the vitamin A status of cows and calves is at all questionable, supplemental vitamin A should be provided. Twenty-thousand I.U. for pregnant cows and forty-thousand for lactating cows will meet the daily requirement for cows even if the cow has no stores of vitamin A and there is no carotene in the ration. Vitamin A is cheap. The cost of vitamin A to provide 20,000 I.U./cow daily for 150 days is only about $0.15-$0.30. Some research has indicated a slight improvement in reproduction and weaning weight from vitamin A administration, but it should be recognized that supplementation with vitamin A will not result in improved performance if the ration already contains an adequate quantity.

Supplemental vitamin A can be: (1) Added to the protein supplement, (2) Injected intramuscularly (1 million I.U. will last about 3 months), or (3) Added to the mineral mix, in which case a stabilized coated form of vitamin A must be used, the mineral mix must be in a covered feeder, and fresh mixes must be prepared each week.

Salt

Young growing cattle need about 10 gm. of salt per day (slightly more than 1/3 oz., since 29 gm. = 1 oz.), while mature lactating cows need 26 gm. (almost 1 oz.). Cattle often consume more than these quantities when salt is fed free-choice.

Salt should always be provided free-choice, either in loose or block form. Loose salt is consumed in larger amounts than block salt, but cattle with access to block salt consume sufficient quantities because they perform as well as those receiving loose salt. Salt deficiency results in abnormal appetite for salt and ultimately a lack of appetite, loss in weight, decreased milk production and unthrifty appearance.

In addition to providing sodium and chlorine, salt also serves other functions. The proper placement of salt boxes greatly assists in encouraging uniform grazing; salt can be used to "pull" cattle into areas infrequently grazed. Salt can be effectively used as a carrier of other nutrients such as phosphorus, trace minerals and

even vitamin A, because cattle relish it. Salt can also be used to control the intake of self-fed supplemental feed.

Salt is not expensive, usually costing around $1.30/cwt., or in some areas, much less. If a cow consumes 40 lb. per year, the annual cost of salt is not over $0.50 per cow.

Trace Minerals

Deficiencies of trace minerals do not exist in many areas. However, deficiencies of iodine, cobalt, and copper exist in certain regions, and these elements should be included in the mineral mix, or in the supplement. It is also possible that other local areas are borderline or slightly deficient in certain trace minerals, or will become so with continued cropping and leaching. It may be desirable to provide trace minerals as a precautionary measure by using trace mineralized salt if there is any reason to suspect a deficiency.

Feeding the Supplement

Any needed supplemental nutrients which are not provided in the mineral mix must be fed at regular intervals. The supplement can be fed either in meal or pellet (cube, cake) form. In some situations, such as a wet climate, it may be desirable to feed the supplement in a bunk, either in meal or pellet form. The pellet form is more desirable in windy areas because there is less feed loss.

On the other hand, the feeding of pellets on grass without bunks has definite advantages where feasible. The expense of feed bunks is saved, shy cows have more opportunity to eat, the cows can be fed in different locations to eliminate trampling of grass in one area, and cows can be fed in undergrazed areas to encourage grazing.

Frequency of Feeding the Supplement

Contrary to some opinions, cattle need not receive supplement daily. Many ranchers follow the practice, based on adequate research, of feeding double the daily allowance on alternate days, or feeding three times per week to eliminate Sunday feeding. Cows perform just as well as with more frequent feeding and seem to rustle better, and timid cows are more likely to receive their share of supplement. Research at several stations has further shown that cattle can be fed even less frequently, even at weekly intervals. Typical results from the Oklahoma Station are presented in Table 4. Even if cows are not fed daily, they should be observed as often as necessary, especially during the calving season.

Table 4

Effect of Feeding Interval on Range Beef Cows[2]

	Interval Between Feeding, days		
	2	4	6
Supplement per cow per feeding, lb.	5	10	15
Gain to calving, lb.	-72	-47	-70
Winter gain, lb.	-185	-148	-170
Yearly gain, lb.	31	14	10
Birth wt. of calves, lb.	433	440	428

[1]The use of trace mineralized salt in place of plain salt will increase the cost of the mineral mix $0.43 when salt comprises 1/3 of the mix, and $0.86 when salt comprises 2/3 of the mix.

[2]From L. S. Pope et al., (1963), Okla. Agr. Exp. Sta. Misc. Pub. MP-70:49.

Self-Feeding the Supplement

In some situations, it may be desirable to self-feed the supplement. For example, a very rough, inaccessible pasture may create problems in hand-feeding.

Salt can be used to control the intake of supplement, because cows will only consume about 1 lb. of salt daily. If a 2 lb. intake of supplement is desired, for example, salt and supplement can be mixed in a 1:2 ratio. The ratio can be varied to achieve any desired intake of supplement. Adequate water must be provided. An experiment covering many years at the Oklahoma Station demonstrated the system is not harmful to cows.

Supplementation is Important

The highest "out-of-pocket" cost in maintaining a cow year long is for winter supplement. The type and amount of supplement fed not only determine the cash cost of wintering the cow but also directly influence the productivity of the cow in terms of percentage calf crop and weaning weight of calves.

Under-supplementation results in reduced calf crop due to failure of conception, late calves due to delayed conception, and low weaning weights due to poor milk production. Over-supplementation, particularly with respect to energy, may cause increased calving difficulty with losses of cows and calves, decreased milk production, and shorter life span.

Between these two extremes is the optimum level of supplementation, the one which results in maximum profit. Supplementation near this level may result in improved production but not enough to pay for the additional cost of feed.

A cowman is usually faced with one of two possibilities. He either determines his supplementation program with home-produced supplements, or he must choose the most profitable commercial supplement to purchase. In either case,

the producer should be familiar with: (1) The nutrient requirements of cows, (2) The composition and feeding value of his pasture or other roughage throughout the year.

Supplements Must Contain Certain Nutrients

Supplements for beef cows, as the name implies, furnish those nutrients which are lacking in forage. The cowman must know specifically which nutrients are needed, and how much of each. Otherwise, either under-nutrition or over-expense will result, and in either case profit will not be maximum.

In most cases, roughage must furnish the vast majority of energy needed by cows. When adequate energy is provided by low-grade roughage during the winter, those nutrients most likely to be deficient are protein, phosphorus, carotene (vitamin A), salt, and in some parts of the country, iodine or cobalt, or copper. A detailed consideration of these nutrients for beef cows can be found elsewhere in this publication.

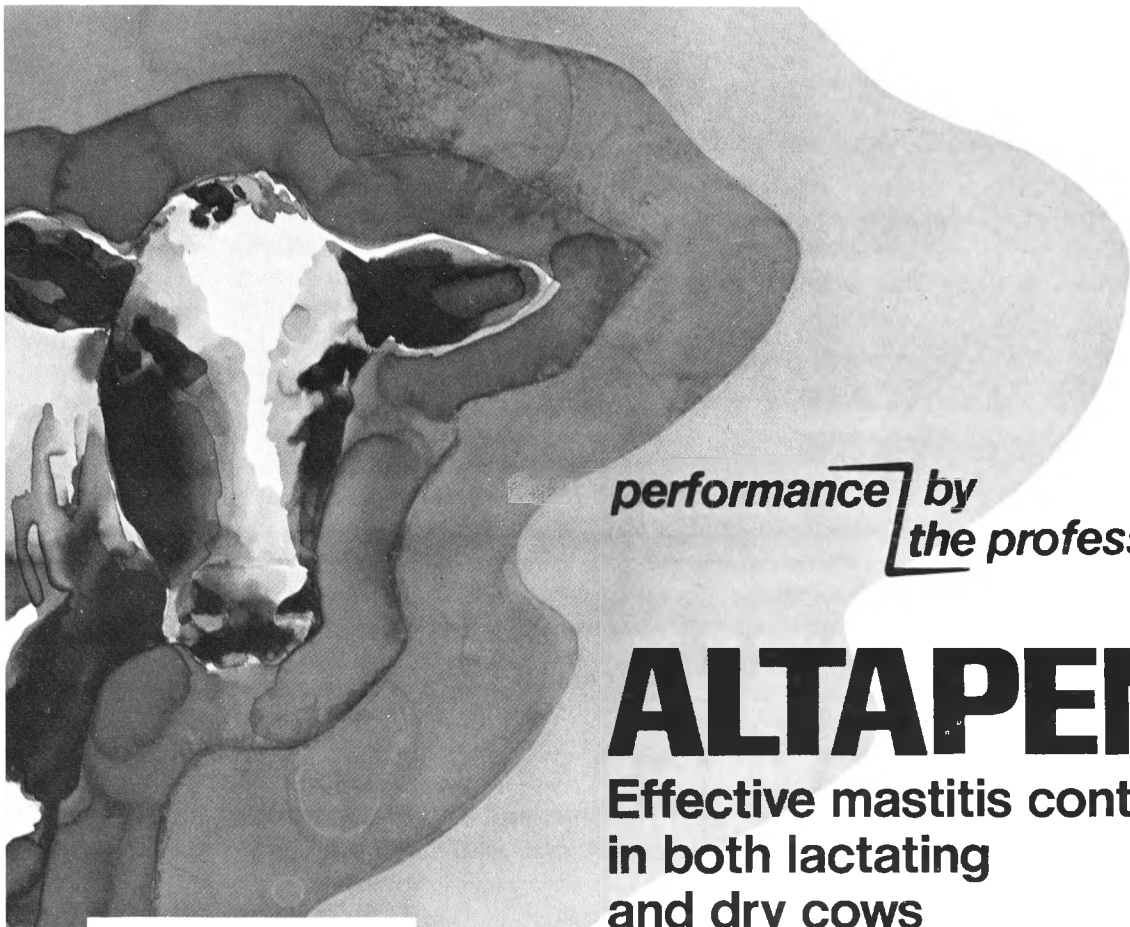
Table 5

BEEF: Nutrient Requirements of Beef Cattle
Animal Science–Oklahoma State University

Daily Nutrients per Animal of Beef Females[1]

Body Wt. (lb)	Avg. Daily Gain (lb)	Daily Dry Matter per Animal[a] (lb)	Total Protein (lb)	Digestible Protein (lb)	TDN[b] (lb)	Ca (lb)	P (lb)	Carotene (mg)	Vitamin A (Thousands IU)
Growing Heifers									
300	0.00	5.6	0.43	0.22	3.1	.011	.011	14.0	5.6
	0.55	6.2	0.73	0.48	4.0	.018	.014	15.3	6.1
	1.10	5.9	0.76	0.51	4.5	.025	.022	15.2	6.1
	1.65	6.0	0.87	0.61	5.1	.038	.029	15.3	6.1
400	0.00	6.8	0.53	0.28	3.9	.012	.012	17.2	6.9
	0.55	9.0	0.93	0.58	5.2	.018	.017	22.5	9.0
	1.10	9.5	1.09	0.71	6.3	.028	.022	24.3	9.7
	1.65	10.2	1.19	0.77	7.3	.039	.030	25.7	10.3
500	0.00	8.0	0.62	0.34	4.6	.014	.014	20.2	8.1
	0.55	11.1	1.06	0.64	6.3	.020	.020	27.9	11.2
	1.10	12.9	1.39	0.87	7.9	.030	.025	32.7	13.1
	1.65	13.8	1.53	0.97	9.2	.040	.033	34.7	13.9
600	0.00	9.2	0.71	0.39	5.3	.017	.017	23.2	9.3
	0.55	12.7	1.15	0.69	7.2	.022	.022	32.0	12.8
	1.10	16.1	1.65	1.01	9.4	.032	.030	40.7	16.3
	1.65	17.0	1.88	1.20	10.9	.039	.032	42.7	17.1
700	0.00	10.4	0.81	0.44	6.0	.019	.019	26.1	10.4
	0.55	14.3	1.25	0.72	8.1	.025	.025	36.0	14.4
	1.10	18.9	1.85	1.11	10.8	.034	.034	47.4	19.0
	1.65	19.7	2.05	1.32	12.4	.039	.035	49.5	19.8
800	0.00	11.5	0.90	0.49	6.6	.021	.021	28.8	11.5
	0.55	15.8	1.34	0.75	9.0	.028	.028	39.9	15.9
	1.10	20.9	1.94	1.14	11.9	.037	.037	52.4	21.0
	1.65	21.7	2.08	1.26	13.7	.041	.039	54.7	21.9
900	0.00	12.6	0.99	0.54	7.2	.022	.022	31.5	12.6
	0.55	17.3	1.43	0.77	9.9	.032	.032	43.7	17.5
	1.10	22.9	2.03	1.18	13.0	.041	.041	57.4	23.0
	1.65	23.7	2.07	1.20	15.0	.042	.043	59.9	24.0
Dry Pregnant Mature Cows									
700	-	11.9	0.69	0.32	5.6	.019	.019	32.5	13.0
800	-	13.1	0.77	0.36	6.4	.021	.021	36.0	14.4
900	-	14.3	0.85	0.40	7.1	.023	.023	39.3	15.7
1000	-	15.1	0.87	0.42	7.6	.026	.026	42.3	16.9
1100	-	16.7	0.97	0.46	8.4	.026	.026	46.3	18.2
1200	-	17.5	1.03	0.49	8.8	.026	.026	48.4	19.4
1300	-	18.7	1.09	0.52	9.3	.028	.028	51.3	20.5
1400	-	19.9	1.14	0.56	9.9	.031	.031	54.2	21.7
Cows Nursing Calves, First 3-4 Months Postpartum									
700	-	18.0	1.64	0.95	10.2	.054	.043	78.4	31.4
800	-	19.4	1.78	1.03	11.0	.056	.045	84.8	33.9
900	-	20.8	1.92	1.12	11.9	.058	.047	91.6	36.6
1000	-	21.9	1.99	1.18	12.4	.062	.049	96.7	38.7
1100	-	23.1	2.14	1.26	13.2	.062	.051	102.4	41.0
1200	-	24.3	2.28	1.34	14.0	.062	.053	108.1	43.2

[1]Calculated from 1970, NRC Nutrient Requirements of Beef Cattle.



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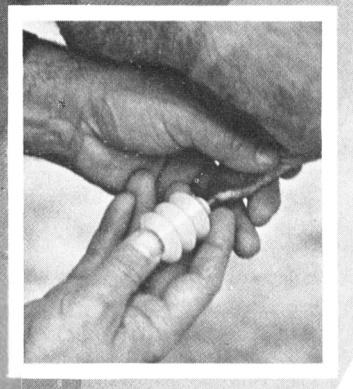
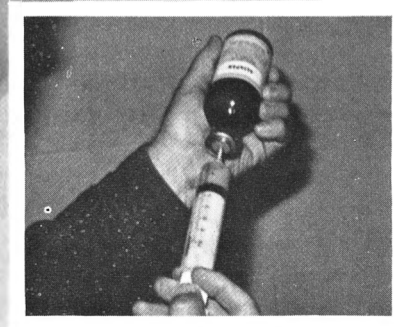
Effective mastitis control in both lactating and dry cows





Mastitis problems don't wait until the dry period before they flare up. Too bad. That's when treatment is most economical. But, lactating or dry, when mastitis is a problem, fast help is a must. Versatile Altapen®... delivers professional performance either way.

Altapen® combines furaltadone and procaine penicillin G for broad-spectrum activity. And it's easy to use; available for intramammary injection in 15 ml. Squeejets® and 120 ml. multidose vials.

Altapen® for performance... by a professional for the professional.

Warning: Milk taken from cows during treatment and for 96 hours (8 milkings) after the last treatment must not be used for food.

Performance that builds confidence... with each Eaton mastitis product:

Altapen® • Furacin® Solution Veterinary • Valsyn® Gel.

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Table 6

Composition of Several Common Feeds

Feed	Dry Matter	Digestible Protein	TDN	Ca	P	Carotene
	%	%	%	%	%	Mg./lb.
Alfalfa hay	90	11.0	51.0	1.30	0.24	12
Cottonseed meal	91	33.0	68.0	0.15	1.10	0
Dehy. alfalfa meal	91	12.0	54.0	1.40	0.26	45
Dry weathered bluestem grass	90	0.5	40.0	0.32	0.03	0
Dry weathered grama grass	90	1.0	45.0	0.35	0.06	0
Grass hay	90	2.0	45.0	0.35	0.08	6
Milo	88	7.8	70.0	0.03	0.28	0
Small grain pasture	20	3.5	13.0	0.09	0.08	20
Sorghum fodder	86	3.0	52.0	0.34	0.14	5
Sorghum silage	30	0.8	15.0	0.09	0.06	3
Soybean meal (44%)	91	42.0	78.0	0.29	0.64	0
Soybean meal (50%)	92	46.0	79.0	0.27	0.63	0

Example Rations

Some typical levels of various supplements needed with various roughages are presented in Tables 7 and 8 for pregnant and lactating cows, respectively. It is recognized that a combination of roughages (such as dry grass and prairie hay) will be used in some situations. This necessitates additional calculations or interpolations to determine the needed supplementation.

The example rations are presented as a guide. Always keep in mind that individual feeds may vary considerably in composition compared to average book values, and that conditions will vary from area to area, ranch to ranch, herd to herd, and year to year. Feeding practices should always be influenced by the appearance and/or weight of the cattle, as well as by previous experience.

Table 7

Example Wintering Rations for Pregnant Cows (1100 lb.)

	Amount supplement needed (lb. daily)[2]						
Roughage[1]	41% CSM	44% SBM	50% SBM	Alfalfa hay	32% supp.	20% supp.	Small grain pasture
Dry grass, free choice	1.6	1.3	1.1	5.0	2.4	3.7	15.0[4]
Non-legume hay[3]	0.7	0.6	0.5	2.0	1.0	1.5	7.0[4]
Legume hay	No supplement needed, except salt. Legume hay usually too expensive as entire ration.						
Silage (sorghum)	0.6	0.5	0.4	2.0	0.8	1.3	6.0[4]
Wheat pasture	No supplement needed, except salt. Wasteful ration if intake unlimited.						

Table 8

Example Wintering Rations for Lactating Beef Cows (1050 lb., Early Lactation)[1]

	Amount supplement needed (lb. daily)						
Roughage	41% CSM	44% SBM	50% SBM	Alfalfa	32% Supp.	30% Supp.	Small grain pasture
Dry grass, free choice	3.3	2.6	2.4	10.0	4.4	6.9	32.0
Non-legume hay	2.2	1.7	1.6	7.0	2.9	4.5	20.0
Legume hay	No supplement needed, except salt. Legume hay usually too expensive as entire ration.						
Silage (sorghum)	1.7	1.3	1.2	5.0	2.2	3.5	16.0
Small grain pasture	No supplement needed, except salt. Wasteful ration if intake not limited.						

[1]The amount of roughage fed should be that quantity necessary to maintain desired appearance and/or weight changes of cows. The amount needed to meet the theoretical requirement can be estimated by dividing the TDN needed, less TDN furnished by the supplement, by the % TDN in the roughage. For example, in the ration of prairie hay and alfalfa hay, the alfalfa hay furnishes 1.0 lb. TDN, so 8.5-1.0=7.5, 7.5÷45.0%=17 lb. prairie hay. Or, in the silage-alfalfa hay ration, 8.5-1.0=7.5, 7.5÷15%=50 lb. silage needed.

[2]If supplements are not adequate in or fortified with phosphorus and carotean (or vitamin A), it will be necessary to provide a phosphorus-containing mineral mix and to provide vitamin A with injection or in the mineral mix, if body storage of vitamin A is not adequate.

[3]Such as prairie, sudan or Johnson grass hay, and sorghum fodder ("bundle feed").

[4]Intake limited by heavy stocking rate or limited grazing time. Cows allowed to graze small grain pasture an average of one day in four, with access to dry grass or other low-grade roughage the rest of the time, obtain enough small grain pasture to provide a good ration, according to results at the Oklahoma Station.

Evaluating Protein Supplements

1. *Adequate Roughage:* If adequate forage is available to meet energy needs, but the forage is low in protein, the critical need is for supplemental protein. In this case, protein supplements may be evaluated strictly on the basis of cost per lb. of crude protein, or more desirably digestible protein, as illustrated in Table 9. Four supplements are available at the prices indicated (Table 9). Which is the best buy? Soybean meal is the best buy because it is the cheapest source of digestible protein. If phosphorus and vitamin A were needed in the supplement, differences in content of these nutrients should also be considered.

2. *Roughage Limited:* If forage is not adequate to meet energy needs, such as in a drought or with over-grazing, it is necessary to feed a larger quantity supplement than in the situation described above. Therefore, less protein is needed per lb. of supplement, and a low protein supplement is in order. A more complex method must be used to evaluate protein supplements in this situation.

3. *Urea Supplements:* Urea has considerable value for cattle being wintered on *harvested roughage*, such as non-legume hay, with an estimated value of 80% that of natural protein.

	Range Forage	High Quality Harvested Forage
Dry Supplement with Urea	25%	80%
Liquid Supplement	50%	80%

Figure 6. The value of equivalent crude protein from non-protein nitrogen compared to natural protein.

With this assumption, it is possible to estimate the value of urea-containing supplements, as illustrated by the following example.

A 32% protein supplement containing only natural protein is available for $155/ton. What is the estimated value of a 32% supplement containing 12% of its protein equivalent in the form of urea?

The cost per lb. of protein of the natural protein supplement is $175 ÷ (2,000 lb. x 32%) = $0.27.

The value of the urea supplement would be calculated on this basis:

True protein = 32 - 12 = 20.0%
Value of urea protein = 12 x 80% = 9.6%
Adjusted protein value = 29.6%
Value of the supplement = $159.84
(2000 lb. x 29.6% x $0.27)

Much research of the Oklahoma Agricultural Experiment Station has shown that urea is poorly utilized on a figure of 25% for utilization on dry grass appears appropriate. On this basis, we can estimate the value of the urea containing supplement desired above for use on dry grass as follows:

True protein = 32 - 12 =	20%
Value of urea protein = 12 x 25 =	3%
Adjusted protein value =	23%

Value of the supplement = $124.20
(2000 lb. x 23% x $0.27)

Table 9

Calculation of Value of Protein Supplements When Forage is Adequate

Supplement	Cost/ton	%DP	DP/ton	Cost/lb. DP
Cottonseed meal (41%)	145.00	33	660	0.219 ($145 ÷ 660 lb.)
32% supplement	157.00	26[1]	520	0.302 ($157 ÷ 520 lb.)
20% supplement	125.00	16[1]	320	0.390 ($125 ÷ 320 lb.)
Soybean meal (44%)	180.00	40	800	0.214 ($180 ÷ 840 lb.)
Alfalfa Hay	55.00	11	220	0.250 ($ 55 ÷ 220 lb.)

[1]Assuming 80% digestibility of crude protein.