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Low Cost Cow/Calf Program: The School – Part XIV

There are numerous commercial protein supplements on the market with many that include minerals. Furnishing one of these commercial products instead of developing a custom mix may be easier and possibly cost less but will it meet the herd's nutritional needs as nutrient deficiencies can lead to production losses that could be more costly. In this issue we'll look at some commercial products (not identified) to see how well they meet the cow herd's protein, energy, and mineral needs (Shrunk Body Weight (SBW) 1200 pounds @ Body Condition Score (BCS) 5.0; calving season either Feb-Mar or May-Jun; average calf birth weight 100 lb; peak milk 17.5 lb/day; Oct or Dec weaning; on range year round.

Protein and DIP from Range Forage
The Feb calving cows should be able to obtain an adequate amount of protein to meet their needs from rangeland forage, except in Mar and Apr (Table 1) but they would need to be provided a protein supplement Nov – Apr to satisfy the degradable intake protein (DIP) needs of the rumen bugs. If they are not provided such they would lose weight and their BCS at calving would be 5.0, which would be alright but by the beginning of the breeding season (May) it would be no more than 3.5. A protein supplement could allow the cows to not only consume more of the low quality range forage but also benefit from all the available energy in it if it is the right protein supplement.

If calving began in May instead of Feb it appears the cows would be able to obtain an adequate amount of protein to meet their needs from rangeland forage throughout the year but they would still require a protein supplement Nov – Apr (data not shown) to satisfy the rumen bugs DIP needs. If they are not provided such they could end up in a BCS of 3.5 at calving and no more than a 3.8 at the beginning of the breeding season (Aug).

Table 1. Monthly physiological conditions of February calving beef cows (1333 lb EMBW; 1200 lb SBW @ BCS 5.0), their daily intake of nutrients from the rangeland forage and their daily nutrient requirements. ***Note: May of following year cow EBW 859 lb; SBW 1010 lb; BCS 3.5.***

	Units	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
	Days	31	30	31	31	30	31	30	31	31	28	31	30
Cow Physiological Conditions													
Gestation	Month in					5	6	7	8	9			
Lactation	Month in	4	5	6	7	8					1	2	3
EBW	Pounds	1076	1103	1123	1149	1165	1180	1185	1150	1098	1021	988	921
SBW	Pounds	1265	1296	1320	1350	1369	1387	1393	1351	1290	1199	1161	1083
Wt. Change	lb/day	0.86	0.70	0.82	0.53	0.51	0.15	-1.19	-1.69	-2.50	-1.16	-2.18	-2.08
BCS	1.0 – 9.0	5.5	5.7	5.9	6.2	6.3	6.5	6.5	6.2	5.7	5.0	4.7	4.1
Forage consumed (dry matter basis) based on percent of cow Shrunk Body Weight (SBW)													
%SBW		2.7	2.7	2.7	2.3	2.3	2.0	1.5	1.5	1.5	2.0	2.0	2.0
Consumed	lb/day	34.1	35.0	35.6	31.0	31.5	27.7	20.9	20.3	19.3	24.0	23.2	21.7
Net Energy maintenance (NEm) – Mcal/day; Protein – lb/day; and Degradable Intake Protein (DIP) – lb/day													
NEm from forage		24.9	22.7	23.2	19.9	19.8	16.1	11.3	10.5	9.7	11.5	10.7	10.8
Required (Maintenance)		8.0	8.1	8.3	8.4	8.5	8.6	8.6	8.4	8.1	7.7	7.5	7.1
Required (Gestation)						0.5	1.0	1.8	3.1	5.1			
Required (Lactation)		4.9	3.8	2.8	2.0	1.4					3.2	5.8	5.8
Required (cold weather)							0.7	0.8	0.5	0.5	0.3		
Required (activity)		4.0	4.1	4.1	4.2	4.2	4.3	4.3	4.2	4.1	3.8	3.8	3.6
Required Total		16.9	16.0	15.1	14.6	14.6	14.5	15.5	16.3	17.8	15.0	17.0	16.5
Net Balance		8.1	6.8	8.0	5.3	5.3	1.6	-4.2	-5.8	-8.1	-3.5	-6.4	-5.6
Protein from forage		5.63	4.02	3.92	3.26	3.15	2.91	1.46	1.22	1.16	1.32	1.16	1.30
Required (Maintenance)		0.63	0.64	0.65	0.66	0.67	0.68	0.68	0.66	0.64	0.61	0.59	0.56
Required (Gestation)						0.05	0.09	0.17	0.30	0.49			
Required (Lactation)		1.15	0.89	0.65	0.46	0.32					0.76	1.37	1.37
Required Total		1.78	1.53	1.30	1.12	1.04	0.77	0.85	0.97	1.13	1.37	1.96	1.93
Net Balance		3.85	2.49	2.62	2.13	2.11	2.14	0.61	0.25	0.03	-0.05	-0.80	-0.63
DIP from forage		4.06	2.90	2.82	2.35	2.20	1.98	0.95	0.77	0.73	0.83	0.73	0.84
Required		2.49	2.27	2.32	1.99	1.98	1.61	1.13	1.05	0.97	1.15	1.07	1.08
Net Balance		1.56	0.62	0.51	0.36	0.22	0.37	-0.18	-0.29	-0.24	-0.32	-0.34	-0.24

Commercial Protein Supplements

There are numerous protein supplements on the market so deciding which one would be the best for your cow herd can be a daunting task. This is especially made difficult due to the feed companies not indicating how much Net Energy maintenance (NEm) their supplements contain nor how much of the protein is degradable. If the DIP amount is no more than what the rumen bugs would need to ferment all the available NEm in the supplement there would not be any excess for them to use in the digestion of NEm in low quality range forage. This would possibly result in the cattle not being able to consume any more of the range forage then they would if not supplemented and they would end up in lower body condition then desired at calving and/or at the beginning of the breeding season.

For example, if we provided the Feb calving cows a protein supplement that contained only enough DIP to satisfy the rumen bugs needs with regard to the amount of NEm in it (e.g. 1.0 Mcal/lb of product) and we fed the cows two pounds of this product each day, their daily NEm shortfall Nov – Apr would average two Mcal less than without and their BCS the first of May would be 4.7. However, if there was a sufficient amount of excess DIP that the cows could consume more of the low quality range forage (1.8% vs 1.5% Nov – Jan, and 2.2% vs 2.0% Feb – Apr of their body weight) they could end up in a BCS of 5.7 due to the rumen bugs being able to utilize nearly three more Mcal NEm/day from the range forage. Results would be similar if the cows calved in May.

Estimating NEm Content of Products

Although feed companies do not state how much NEm their supplements contain many list the ingredients and if that is the case you can use feed tables (see References) to obtain the NEm values of each and get an idea as to how much NEm the supplement might contain. However, this can be somewhat challenging due to the companies not stating how much of each ingredient is in the product, especially if they are numerous.

I did find a feed company that listed the Acid Detergent Fiber content of their supplements, so determining the NEm content in them can be calculated. The ADF content of one of their products (a block) was listed as 8.5%, so the Mcal NEm/lb would be 0.97 (See Appendix for calculations).

The listed feed ingredients from plant/seed sources and their NEm contents in Mcal/lb were: Condensed corn/milo distiller's solubles (CDS) – 0.98, corn/wheat/milo distiller's dried grains with solubles (DDGw/S) – 1.00, and corn gluten meal (CGM) – 0.93. The average of these is 0.97, the same as that calculated from ADF.

This example shows that if you know the feed ingredients in the product you can probably come close to what the NEm content of it is. However, some products have such a litany of ingredients with a wide array of NEm contents that it can be questionable as to how close you can actually come to what the product's NEm content is. Fortunately there is another way to estimate a product's NEm content. The feed companies list the amount of crude fiber their products contain, as well as fat (ether extract), and by dividing the crude fiber content by 0.62 you can obtain an estimate of its ADF content. For example: The crude fiber content of the 8.5% ADF protein block was listed as 5.5%. Dividing 5.5 by 0.62 yields an ADF content of 8.9%, just slightly higher than that listed on the feed tag and the resultant NEm content was just slightly lower at 0.96 Mcal/lb.

I reviewed numerous supplements from this company and six others that listed the product ingredients and I believe the above method provided a good estimate of their NEm content. The only products that this method may underestimate NEm content is the ones with a crude fiber content greater than 10%. Of the five products that this was the case the method dividing %CF by 0.62 resulted in an average NEm content of 0.78 Mcal/lb but the estimated amount from the ingredients would indicate an average NEm content of 0.87 Mcal/lb. I think the higher values are probably closer to what the actual NEm contents of these products are.

Estimating DIP Content of Products

As earlier noted the feed companies do not state how much of the protein in their products is degradable. However, if some of the protein in the product is from non-protein nitrogen, such as urea, this will be listed on the tag and you know that at least that amount will be fully degradable. The percent of the protein from plant and animal ingredients that is degradable can vary from 26% for distillers dried grains to 100% for cane and beet molasses (Appendix Table 1A). Knowing what ingredients are in the product you can probably come reasonably close to how much of the protein is degradable but if they are not listed I am hesitant to speculate as to what it might be due to the wide range in levels among the possible ingredients.

What is the possible DIP content of the 8.5% ADF protein block?

The minimum amount of crude protein is listed as 30% but as much as half of it is from non-protein nitrogen (NPN) sources; biuret and ammonium sulfate in this case (Table 2 – Block A). Based on this we know that at least 50% of the total amount of protein in the product is degradable.

The degradable portion of crude protein in CDS and DDGw/S from corn and milo is 45%, in DDGw/S from wheat it is 72%, and in CGM it is 38% (See Appendix Table 1A). Average DIP content from these protein sources would be about 50%. With these feed ingredients providing at least half the crude protein in the supplement the total portion of crude protein that is degradable would be around 75% (See Appendix for how this was determined).

Is there enough DIP to meet the rumen bugs needs and is there any excess?

The amount of DIP available to the rumen bugs is determined by calculating lb DIP/Mcal NEm and then multiplying this amount by Mcal NEm/lb. The available amount for this product is 0.22 lb:

[(30% CP ÷ 0.97 Mcal/lb) x 75% DIP)] x 0.97 Mcal/lb = (0.31 x 0.75) x 0.97 = 0.23 x 0.97 = 0.22 lb DIP/lb feed ingredients consumed.

The amount of DIP required by the rumen bugs per Mcal NEm would be about 0.13 lb (0.97 Mcal/lb x 0.13 lb DIP/Mcal). Because the product has a high NEm content it is probably best to use 0.13 lb DIP/Mcal instead of 0.10 lb that Dr. Diven preferred to use for forages. However, this product also contains NPN sources and mineral compounds that do not contain any NEm. Because of this the Mcal of NEm per pound of product is less than 0.97. I estimated that the CDS, DDGw/S, and CGM in the product constituent approximately 42% of it (See Appendix for how this was calculated) so the Mcal NEm/lb of product would be 0.41 (0.97 Mcal/lb x 0.42 lb/lb product) and the resultant amount of DIP needed by the rumen microbes for each pound of product would be a little over 0.05 lb (0.41 Mcal/lb product x 0.13 lb DIP/Mcal).

The available amount of DIP remains the same at 0.22 lb: [(30% CP ÷ 0.41 Mcal/lb) x 75% DIP)] x 0.41 Mcal/lb = (0.73 x 0.75) x 0.41 = 0.55 x 0.41 = 0.22 lb DIP/lb of product consumed.

Subtracting from this available amount of DIP the amount required by the rumen bugs (0.05 lb/lb product) yields an excess of 0.17 lb that the rumen bugs can utilize to degrade Mcal NEm in a low quality forage.

Table 2. Composition of some commercial protein supplements.

Product Type	%CP[1] (Min)	%NPN[2] (Max)	%Fat (Min)	%CF[3] (Max)	%ADF[4]	Mcal/lb NEm[5] ADF	Mcal/lb NEm[5] Ingred.	% DIP[6]	Lb DIP/ Mcal	Lb DIP/lb Product Avail.	Lb DIP/lb Product Needed[7]	Lb DIP/lb Product Extra[8]
Block A	30	15.0	3.0	5.5	8.5	0.97	0.96	75	0.23	0.22	0.05	0.17
Block B	30		1.0	10.0	16.1	0.85	0.85	80	0.28	0.24	0.09	0.15
Block C	16		4.0	5.5	8.5	0.97	0.96	46	0.08	0.07	0.06	0.01
Cake A	38		2.5	13.0	21.0	0.77	**0.85**	77	0.34	0.29	0.10	0.19
Cake B	15		4.0	9.0	14.5	0.88	0.84	71	0.12	0.11	0.08	0.03
Cube A	30	3.0	9.0	8.0	12.9	0.90	0.90	74	0.25	0.22	0.10	0.12
Cube B	33		5.0	14.0	22.6	0.75	**0.93**	73	0.26	0.23	0.10	0.13
Cube C	37		2.0	12.0	19.4	0.80	**0.87**	75	0.32	0.28	0.09	0.19
Tub A	28		5.0	2.0	3.2	1.05	1.08	70	0.19	0.20	0.13	0.07
Tub B	32	15.0	5.0	2.0	3.2	1.05	0.91	81	0.25	0.26	0.08	0.18
Tub C	38	20.0	12.0	2.5	19.4	1.04	0.93	85	0.31	0.32	0.08	0.24

Macro and Micro Minerals

Product Type	%Ca Min	%Ca Max	%P (Min)	%K (Min)	%Mg (Min)	%Na Min	%Na Max	%S (Min)	mg/kg (ppm) Minimums Co	Cu	I	Fe	Mn	Se	Zn
Block A	1.55	2.00	1.4	1.0	4.0	4.7	5.2	1.75	4	600	8	400	750	5.0	1,000
Block B	0.80	1.20	0.7	1.4	1.0	5.5	6.3	X[9]	X	140	24	X		2.0	490
Block C	1.25	1.75	1.3	1.1	2.5	5.1	6.1	0.50	4	600	8	400	750	2.0	1,000
Cake A	0.75	1.25	1.0	1.5		0.5	0.7	X	X	165	4		X	1.0	495
Cake B	1.25	1.75	0.6	1.0	0.3	0.5	0.7	X	X	75	X		140	0.5	230
Cube A	1.50	2.00	0.7	X		0.3	0.5	X	X	140	24	X	X	2.0	490
Cube B	0.80	1.20	0.8	1.0	0.3			X	X	140	24	X	X	2.0	490
Cube C	0.25	0.75	1.1	1.0		0.4	0.7								
Tub A	1.00	2.00	0.8	6.0	0.2			0.45	3.6	700	21		1350	6.9	1125
Tub B	0.75	1.25	1.0		3.0	0.9	1.1	X	X	45	X		170	3.4	130
Tub C	1.50	2.50	1.3	2.5	1.0				X	260	X		X	4.4	875

[1]%CP: Crude Protein; [2]%NPN: Crude protein from a non-protein nitrogen source, e.g. urea; [3]%CF: Crude Fiber;
[4]%ADF: Acid Detergent Fiber (%CF ÷ 0.62), except for Block A which is label amount; [5]Mcal/lb NEm: Calculated from %ADF or Estimated from listed feed ingredients (if **Highlighted** estimated value used over calculated value to determine lb DIP/Mcal);
[6]%DIP: Degradable Intake Protein estimated from listed ingredients; [7]Lb DIP/lb Product Needed: (Mcal/lb NEm x 0.13 lb DIP/Mcal NEm) x estimated amount of feed ingredients in product; [8]Lb DIP/lb Product Extra: Lb Available minus Lb Needed;
[9]X: Minerals not listed on the feed tag but mineral compounds that would furnish these are listed as an ingredient

How much of this protein block would the cows need to make up for the DIP shortfall in the Nov – Apr rangeland forage?
For the Feb calving cows the average amount would be 2.2 lb/day (Table 3A – Block A). This amount would provide them an additional 0.90 Mcal NEm/day and they would be in BCS 5.3 by the beginning of breeding. However, the suggested maximum amount is 1.4 lb/day. At this amount there would not be quite enough excess DIP to meet the rumen bugs needs based on the total amount of NEm consumed. As a result the cows' BCS the first of May would be slightly less at 5.1. This is assuming the cows would be able to consume the same amount of forage. If they ate less forage because of the deficiency in DIP they would end up in a lower BCS then 5.1.

The amount of the product needed by the May calving cows between Nov and Apr would be 1.8 lb/day (Table 3A – Block A) and they would be in BCS 5.2 by beginning of breeding. At the suggested maximum amount of 1.4 lb/day their BCS at the beginning of breeding would be 5.1 but probably lower due to them consuming less forage.

What about other Protein Supplements with regard to satisfying the DIP shortfall and the resultant cow BCS at breeding?
Block B is a free choice product and if the Feb and May calving cows consumed 2.4 and 2.0 lb/day, respectively, they would be in BCS 5.5 by breeding (Table 3A).

Block C is a low protein supplement with low degradability and it would require a substantial amount of it to satisfy the DIP shortfall in the range forage (Table 2). The maximum amount is no more than 1.3 lb/day but this would provide enough additional protein to satisfy the Feb calving cow's needs in Mar and Apr.

Cake A, Cubes A, B and C, and Tub C had enough extra DIP at or below the suggested daily maximum to make up for the shortage in the range forage (Table 3A). In addition, these products provided enough NEm so that the cows would be in at least BCS 5.5 at breeding.

Table 3A. Commercial protein supplement amounts needed by the February and May calving cows to make up the DIP shortage in the range forage; the maximum suggested amounts; and the resultant cow Body Condition Scores at start of breeding.

Product Type	February calving cows					May calving cows			
	Needed Lb/day	1 May BCS	Max Lb/day	1 May BCS		Needed Lb/day	1 Aug BCS	Max Lb/day	1 Aug BCS
Block A	2.2	5.3	1.4	5.1		1.8	5.2	1.4	5.1
Block B	2.4	5.6	FC[1]	?		2.0	5.4	FC[1]	?
Block C	20.6	7.2	1.3	5.1		17.0	6.7	1.3	5.2
Cake A	2.0	5.5	4.0	5.9		1.7	5.4	4.0	5.9
Cake B	10.8	7.3	6.0	6.2		8.9	6.3	6.0	6.1
Cube A	2.8	5.8	3.0	5.8		2.4	5.5	3.0	5.7
Cube B	2.8	5.9	3.0	5.9		2.4	5.6	3.0	5.7
Cube C	1.9	5.5	3.0	5.8		1.6	5.3	3.0	5.8
Tub A	5.4	7.1	??[2]	?		4.5	6.3	??[2]	?
Tub B	2.0	5.4	1.0	5.2		1.7	5.3	1.0	5.1
Tub C	1.5	5.6	1.5	5.6		1.2	5.4	1.5	5.5

[1]FC: Free Choice offering, thus resultant BCS not able to estimate
[2]??: No recommended maximum amount suggested

Cake B, like Block C, is a low protein product although the degradable portion is higher and its NEm content lower (Table 2). Thus, there was slightly more excess DIP and it would take half as much of it compared to the block to address the DIP shortfall. The recommended maximum amount is 6.0 lb/day and at this level the Feb and May calving cows would be in BCS 6.2 and 6.1, respectively, at breeding (Table 3A). This would indicate that for the cows to be in BCS 5.5 at breeding they might only need around 2.5 lb/day. However, at this level it would not satisfy the rumen microbe DIP needs and as a result the cows would not be able to consume as much rangeland forage. Thus, they would obtain less total Mcal NEm resulting in them being in too low of body condition at breeding.

The Feb and May calving cows would need to consume 5.4 and 4.5 lb/day of product Tub A, respectively, to satisfy the DIP shortfall in the rangeland forage although the cows would end up in a BCS of 7.1 and 6.3 by breeding (Table 3A). This daily amount might be achievable by the cows but because the feed company does not state what the daily maximum amount should be we don't have a basis to know. Less than 2.0 lb/day of the product would possibly have them in BCS 5.5 at breeding but as with Cake B they would not be able to consume as much of the range forage as possible and thus not enough Mcal NEm to be at this condition.

The maximum daily suggested amount for Tub B is one pound but it took 2.0 and 1.7 lb/day, respectively, to satisfy the DIP needs of the Feb and May calving cows but their BCS at breeding would still have been less than 5.5 (Table 3A).

How well do these Protein Supplements meet the cows' mineral needs?

The rangeland forage provided the cows an adequate amount of Ca, so the amount in the supplements needed to be enough to balance with the P content in them and apparently did. Except for Cube B, none of the supplements provided an adequate amount of P, and only Tub A enough K but only for the Feb calving cows (Table 3B). Blocks A and C furnished an adequate amount of Mg for both cow herds and Tub B for the Feb calving cows. Block A and Tub A supplied an adequate amount of S. If the products contained salt it usually was enough to meet the cows' Na needs.

Table 3B. Macro mineral deficiencies (lb/day) for the February and May calving cows after provision of needed or *maximum recommended* amounts of some commercial protein supplements.

Product Type	February Calving Cows					May Calving Cows				
	P	K	Mg	S	Na	P	K	Mg	S	Na
Block A	*0.029*	*0.121*				*0.023*	*0.102*			
Block B	0.032	0.118	0.006	0.008		0.029	0.100	0.006	0.005	
Block C	*0.033*	*0.121*		*0.008*		*0.027*	*0.101*		*0.003*	
Cake A	0.028	0.116	0.024	0.008	0.012	0.028	0.102	0.019	0.004	0.011
Cake B	*0.013*	*0.105*	*0.022*	*0.006*		*0.007*	*0.101*	*0.018*	*0.001*	
Cube A	0.029	0.122	0.023	0.007	0.014	0.026	0.104	0.020	0.003	0.012
Cube B		0.133	0.021	0.008			0.112	0.018	0.004	
Cube C	0.027	0.122	0.019	0.008	0.013	0.025	0.103	0.016	0.004	0.012
Tub A	0.006		0.031		0.002	0.008	0.077	0.028		0.003
Tub B	*0.038*	*0.125*		*0.010*	*0.012*	*0.032*	*0.106*	*0.022*	*0.005*	*0.017*
Tub C	0.029	0.114	0.015	0.010	0.021	0.027	0.100	0.013	0.006	0.019

Table 3C. Micro mineral deficiencies (mg/day) for the February and May calving cows after provision of needed or *maximum recommended* amounts of some commercial protein supplements (Note: There were no deficiencies for Co, Cu, or Fe).

Product Type	February Calving Cows				May Calving Cows			
	I	Mn	Se	Zn	I	Mn	Se	Zn
Block A	*1.6*				*0.8*			
Block B		9.3	0.6				0.7	
Block C	*1.9*				*1.1*			
Cake A	3.2	23	1.9	74	3.0		1.7	84
Cake B	*6.3*		*1.8*		*5.5*		*1.4*	
Cube A		42	0.3				0.4	
Cube B		40						
Cube C	6.9	35	2.0	430	6.0		1.8	373
Tub A								
Tub B	*6.5*		*1.1*	*393*	*5.7*		*0.8*	*337*
Tub C	6.8	40			5.9			

Rangeland forage provided a sufficient amount of Co, Cu, and Fe to the cows, and with regard to Mn the level in the forage was high enough that the amounts in these protein supplements met the May calving cows' needs (Table 3C). Over half the products did not supply an adequate amount of I or Se to make up for the lack in the range forage but only three not enough Zn.

Conclusions

I recognize that determination of NEm and DIP contents of a protein supplement based on the listed ingredients can be difficult, especially if the product also contains salt and minerals. I don't expect individual ranchers to do this on their own but if you would like assistance in determining if the product you are using is potentially addressing the nutrient shortages in your range forage let me know. If you consult with an independent ruminant nutritionists they should be able to help you with this as well. However, you need to know what the quality of your forages are, especially during the dormant season, before you can truly assess if a protein supplement is meeting your cow herd's nutrient needs.

Because many protein supplements contain a high level of NEm the amount of DIP in them needs to exceed 0.13 lb per Mcal. If not, there won't be any extra for the rumen microbes to use in the degradation of low quality forage. As a result the cows would not be able to consume as much as the forage as they possibly could.

Generally, it is probably best if the protein product contains at least 30% crude protein and even better if some of it is from NPN, especially if NEm content of the feedstuffs in the product are greater than 0.90 Mcal/lb.

A big concern with these supplements, even those fortified with minerals, is that they did a poor job in addressing the cows' mineral needs, especially for macro-minerals. This might not be true for other rangelands but it shows that a custom made supplement might be justified over using a commercial product.

Disclaimer: Although I believe I am relatively close in my assessment of these products' DIP and NEm contents, it could be that they all would satisfy the cows' nutrient needs at, or below, the suggested maximum daily amounts. However, Caveat emptor of all supplements.

Next issue:

I was asked by a recipient of this newsletter to compare what ingredients would be needed in a supplement for a Feb-Mar calving cow herd on rangeland or provided late bloom smooth bromegrass hay in lieu of range forage Jan – Apr (Installment XIII – Jan 2014) to what would be needed if calving was shifted to start June 15th in Johnson County Wyoming. He believes we would then find the true least cost scenario as he has figured that total dry matter intake per 1250 lb cow would decrease by 900 pounds if calving occurred 15 Jun to 30 Jul (45 days) versus a 15 Mar to 30 Apr.

Appendix

Calculations for Mcal NEm/lb from %ADF:
96.35 – (% ADF x 1.15) = %TDN

Example using 8.5% ADF protein block (A):
96.35 – (8.5% ADF x 1.15) = **86.6% TDN**

86.6% TDN x 0.0164 = **1.42 Mcal/lb Metabolizable Energy (ME)**

(1.37 x **1.42 Mcal/lb**) – (0.3042 x $\mathbf{1.42^2}$) + (0.051 x $\mathbf{1.42^3}$) – 0.508 = **0.97 Mcal/lb NEm**

Calculations for total degradable portion of crude protein (CP) when a NPN is included:
%CP from NPN x 100% degradable
%CP from plant protein x its degradability
Add these two products and divide by total %CP in supplement

Example using Block A:
15% CP from NPN x 100% degradable = 15%
15% CP from plant protein x 50% degradable = 7.5%
(15% + 7.5%) ÷ 30% = 75%

Calculations for Mcal per pound of product:
%Crude protein in product ÷ %Crude protein from plant feedstuffs

Example using Block A:
%Crude protein in product = 15%

Crude protein contents for the following plant based feedstuffs:

CDS	29%
DDGw/S	34%
CGM	46%
Average	36%

15% ÷ 36% = 42% of total product

References

[NRC] National Research Council. 1996 (Update 2000). Nutrient Requirements of Beef Cattle (7th revised edition). Washington, DC, USA: National Academy Press. 234 p.
(Note: For Net Energy maintenance, crude protein, degradable intake protein, and mineral values – Appendix Table 1 – Feed Library pp. 192 – 203).

Sims, D.D. 2009. Feeding the Beef Cowherd *for Maximum Profit.* SMS Publishing, Amarillo, TX 79114.
(Note: For Net Energy maintenance, crude protein, degradable intake protein, and mineral values – Appendix Table 11. Typical composition of feeds for cattle pp. 199 – 205, and Appendix Table 12. By-products and unusual feedstuffs pp. 206 – 220).

Animal Feed Resources Information System: http://www.feedipedia.org/

Appendix Table 1A. Typical composition of feeds found in commercial protein supplements for cattle.

Feedstuff	%CP[1]	%DIP[2]	%ADF[3]	Mcal/lb NEm[4]	%Fat	%CF[5]	Macro Minerals					
							%Ca	%P	%Mg	%K	%Na	%S
Plant Protein Products:												
Canola Meal	41	68	20	0.73	3	12	0.70	1.20	0.57	1.37	0.03	1.17
Corn Gluten Meal	46	38	3	0.93	3	1	0.16	0.51	0.06	1.40	0.26	0.47
Cottonseed Meal	45	75	15	0.87	9	11	0.20	1.16	0.65	1.65	0.07	0.42
Pea by-products	11		45	0.68	1	36	1.47	0.63				
Soybean Meal	53	65	7	0.94	2	6	0.35	0.71	0.32	2.34	0.02	0.47
Yeast, brewers, dried	49	80	3	0.87	3	2	0.13	1.49	0.27	1.79		
Processed Grain by-products:												
Barley Malt, sprouts	28	64		0.75	1		0.19	0.68	0.18	0.27	0.95	0.85
Bran Products	16	63	16	0.74	16	12	0.12	1.56	0.79	1.73	0.04	0.23
Brewers Dried Grains	26	54	22	0.69	7	16	0.29	0.70	0.27	0.58	0.15	0.40
Corn Gluten Feed	22	72	11	0.86	3	8	0.07	0.95	0.40	1.40	0.26	0.47
Distillers Dried Grains	30	26		0.99	10		0.30	1.12	0.49	1.83	0.24	0.40
DD Solubles	29	45	7	0.98	9	9	0.32	1.40	0.65	1.83	0.24	0.40
Distillers Grains (DG), corn w/solubles	30	45	14	1.07	11	8	0.20	0.80	0.33	1.00	0.24	0.50
DG, Corn, dry	31	42	16	1.13	10	8	0.09	0.66	0.15	0.90	0.06	0.45
DG, Milo w/solubles	34	45	20	1.03	9	8	0.25	0.65	0.33	0.50	0.24	0.40
DG, Milo, dry	32	38	22	0.93	10	10						
DG, Wheat w/solubles	37	72	15	0.91	5	8	0.21	0.90	0.37	1.07	0.49	
Wheat Middlings	19	78	12	0.89	5	8	0.15	1.00	0.38	1.10	0.01	0.19
Wheat Millrun	17	72	12	0.79	4	9	0.12	1.00		1.20		0.22
Grains/Seeds:												
Cottonseed, whole	23	89	36	0.87	20	28	0.16	0.62	0.35	1.22	0.03	0.26
Flaxseed	26	50	10	1.43	38	10	0.23	0.55		0.84		
Pinto Beans	25	75		0.90	1		0.16	0.39				
Wheat, ground	13	60	4	0.99	2	3	0.05	0.44	0.09	0.40	0.01	0.14
Other Protein and Energy Feedstuffs:												
Molasses, Beet	9	100	0	0.79	0	0	0.12	0.03	0.29	6.00	1.48	0.60
Molasses, Cane	6	100	0	0.79	1	0	0.90	0.08	0.42	4.40	0.22	0.68

Feedstuff	%CP	%DIP	%ADF	Mcal/lb NEm	%Fat	%CF	%Ca	%P	%Mg	%K	%Na	%S
Other Protein and Energy Feedstuffs Continued:												
Molasses, Condensed Fermentable Solubles	16	100	0	0.71	1	0	2.12	0.14		7.50		0.93
Feather Meal	86	32	16	0.71	8	2	0.54	0.39		0.10	0.24	1.82
Animal Fat (Tallow)				2.85	99		0.57	0.06	0.06	0.32	0.01	0.00
Vegetable Fat/Oil				2.85	99							
Ammonium Sulfate	134	100										24.1
Biuret	248	100										
Urea	281	100										
Mineral Compounds:												
Calcium carbonate							39.4	0.04	0.05	0.06	0.06	
Calcium sulfate							23.3					18.62
Dicalcium phosphate							22.0	19.3	0.59	0.07	0.05	1.14
Mono-Ca phosphate							16.4	21.6	0.61	0.08	0.06	1.22
Magnesium oxide							3.07		56.2			
Potassium chloride							0.05		0.34	50.0	1.00	0.45
Sodium chloride (Salt)											39.34	
Cobalt carbonate												
Copper sulfate												12.84
EDTA												
Manganese carbonate												
Sodium selenite											26.6	
Zinc sulfate							0.02					17.68

[1]%CP: Crude Protein;
[2]%DIP: Degradable Intake Protein;
[3]%ADF: Acid Detergent Fiber;
[4]Mcal/lb NEm: Net Energy maintenance;
[5]%CF: Crude Fiber

Appendix Table 1B. Typical micro mineral composition (mg/kg or ppm) of feeds found in commercial protein supplements for cattle.

Feedstuff	Co	Cu	I	Fe	Mn	Se	Zn
Plant Protein Products:							
Canola Meal	0.00	8	0.00	211	56	0.00	72
Corn Gluten Meal	0.09	30	0.00	430	9	1.11	190
Cottonseed Meal	0.53	17	0.00	160	12	0.00	38
Pea by-products							
Soybean Meal	0.12	22	0.06	164	38	0.37	60
Yeast, brewers, dried							
Processed Grain by-products:							
Barley Malt, sprouts	0.00	6	0.00	200	32	0.45	61
Bran Products	0.82	13	0.04	179	260	0.43	81
Brewers Dried Grains	0.08	11	0.07	221	44	0.76	82
Corn Gluten Feed	0.10	7	0.07	226	22	0.30	73
Distillers Dried Grains	0.18	84	0.09	560	78	0.40	95
DD Solubles	0.18	84	0.09	560	78	0.40	95
Distillers Grains (DG), corn w/solubles	0.18	11	0.09	560	28	0.40	80
DG, Corn, dry	0.09	5	0.00	159	21	0.00	65
DG, Milo w/solubles	0.18	11	0.09	560	28	0.40	55
DG, Milo, dry							
DG, Wheat w/solubles		10		140	87		130
Wheat Middlings	0.11	11	0.12	110	128	0.83	109
Wheat Millrun							90
Grains/Seeds:							
Cottonseed, whole	0.00	8	0.00	160	12	0.00	38
Flaxseed							
Pinto Beans							
Wheat, ground	0.50	7	0.10	45	37	0.05	38
Other Protein and Energy Feedstuffs:							
Molasses, Beet	0.47	22	0.00	87	6	0.00	18
Molasses, Cane	1.59	66	2.10	263	59	0.00	21
Molasses, Condensed Fermentable Solubles							30
Other Protein and Energy Feedstuffs Continued:							
Feather Meal	0.13	14	0.05	702	12	0.98	105
Animal Fat (Tallow)	0.57	15	0.68	482	47	0.00	42
Vegetable Fat/Oil							

Mineral compounds on next page:

Feedstuff	**Co**	**Cu**	**I**	**Fe**	**Mn**	**Se**	**Zn**
Mineral Compounds:							
Ammonium Sulfate		1	10	1			
Biuret							
Urea							
Calcium carbonate				300	300		
Calcium sulfate							
Dicalcium phosphate	10	10		14400	300		100
Mono-Ca phosphate	10	10		15800	360		90
Magnesium oxide					100		
Potassium chloride			600				
Sodium chloride (Salt)							
Cobalt carbonate	460000		500				
Copper sulfate		254500					
EDTA			803400				
Manganese carbonate					478000		
Sodium selenite						456000	
Zinc sulfate							363600