replace their culls, and often times they are buying someone else's culls.

After some financial analysis, we determined that most of these clients would be financially ahead to save top heifers from their herd for replacements, but we had to overcome the seven problems listed above. That is when the idea of the heifer co-op was initiated. I had read about other groups doing "heifer tests", so we borrowed some of these ideas for the framework of our heifer co-op.

The concept was explained in a newsletter and a questionnaire was sent to interested owners so that we could match A.I. bulls to their programs. Calving ease Angus and Red Angus bulls were used on all heifers.

1990 was out first year for the program and we had 33 heifers from 9 different herds participate. They arrived April 10 and were processed as follows:

1. IN IBR vaccination.
2. Lepto5-Vibrio vaccination.
3. Pelvic measured.
4. Reproductive tract evaluation.
5. Yearling weight taken.
6. Double tag each heifer.
7. Condition score

A pre-arrival requirement was that each heifer had to be "pre-conditioned", brucellosis vaccinated, and dewormed the previous fall/winter. The beef feedlot ration software from Iowa State University was used to develop the ration for the heifers.

We allowed 8 days for the heifers to become accustomed to eating together and started MGA on April 18. We fed it for 14 days and then gave an injection of Lutalyse on May 19, (17 days after MGA removal). Heat detection started immediately with the following artifical insemination results:

May 21	6pm -	11 bred
May 22	7am -	7 bred
May 22	7pm -	10 bred
May 24	6am -	1 bred

So, 29 of 33 were bred in 3 days.

We repeated the lutalyse injection to the 4 not bred on May 30 and bred 2 of the 4.

We heat detected until June 15 and then turned in a clean-up bull until July 6 (21 days).

Results

26/33 heifers bred in 46 days	79%
21/26 settled AI	81%

(of heifers not bred at the end, one cycled every 5-7 days; one was 5 months pregnant and aborted two months before co-op started; and one had had multiple inplants).

We only had to assist 1 heifer at calving time. She had a 71# bull calf which was easily delivered. The heifer just wasn't trying to help. One owner assisted one also - 82# bull calf that came easily. The average calving ease score was 1.08 and average birth weight was 74.9#.

Overall, owners were very pleased with the results. They got a bred heifer of superior genetics to put into the herd that calved early and basically unassisted. The calves will be weighed this fall to assess growth rate. Comments have been very favorable as to the quality of calves.

Total cost to producer was $114.38 for the total program.

1991 Heifer Co-op

Changes made from 1990
- only AI one time
- had a client that was more adept at heat detection
- charge more for labor

1991 Co-op results

20 heifers delivered	4/12/91
MGA started	4/14/91
MGA stopped	4/28/91
Lutalyse	5/15/91
AI	5/18/91

2 heifers bred early 5/10 and 5/12 due to "early" standing heat, remainder given Lutalyse on 5/18.

5/17/91	-	9 bred
5/18/91	-	4 bred
5/19/91	-	3 bred

So 17/20 bred in 3 days (with 2 bred early) for a total of 19/20 bred (95%).

We feel this is a service that you the veterinarian can coordinate to allow your cattle producers to justify keeping top replacement females for their herds.

Formulating Anionic Dry Cow Rations

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Dry cow nutrition is one of the most neglected areas of dairy cattle management. This is a serious oversight in that this 60-day period sets the stage for subsequent lactational performance. Thus, inattention to dry cow diets can be very costly; conversely, properly formulated rations can be very rewarding. Dr. Dave Beede, dairy researcher, University of Florida, catches the impact of proper dry cow nutrition when he says, "It is an investment in the next lactation."

The approach to dry cow feeding that seems to offer the best results is the feeding of anionic salts. Recent research has demonstrated a very positive value to feeding an acidogenic diet 3 to 6 weeks prepartum. The following benefits have been elucidated: (1) decreased incidence of milk fever, (2) increased milk production, and (3) improved reproductive performance.

The practice of feeding anionic salts revolves around the concept of dietary cation-anion difference **(DCAD)**. Other terms abound in the literature: dietary cation-anion balance **(DCAB)**, dietary electrolyte balance **(DEB)**, anion-cation balance **(ACB)**. These terms may be used interchangeably.

Dietary cation-anion balance is generally expressed as follows: **meq (Na + K) - Cl/100 g of DM or meq (Na + K) - (Cl + S)/100 g of DM.** Both equations are frequently used in the literature, but it would appear that the latter one will become the de facto standard.

The goal in dry cow formulation is to provide an excess of anions, mainly Cl and S, relative to cations, mainly Na and K. The basic unit of measure is the equivalent **(eq)** or milliequivalent **(meq)**, which is simply the atomic weight **(AT)** adjusted for ionic charge (Table 1). **This is necessary because DCAD is affected by electrical charge rather than mass.**

Table 1. Milliequivalents of key elements

EL	AT (g)	VL	EW (g)	MEQ (mg)
Na	23	1	23	23
K	39	1	39	39
Cl	35.5	1	35.5	35.5
S	32	2	32	16

EL = element AT = atomic wt
VL = valence EW = equivalent wt
MEQ = milliequivalent

If in a diet the meq of the anions (Cl + S) are greater than that of the cations (Na + K), then the DCAD will be a negative value. Such rations are called anionic and are acidogenic. Conversely, rations containing an excess of cations yield a positive DCAD and are called cationic and are alkalotic. Recent research trials have shown that dry cows should be fed anionic diets, whereas lactating cows should receive cationic rations.

Table 2 contains the 1989 NRC recommendations for dry pregnant cows. **Note that the DCAD is positive, +5.39** ((Na + K) - (Cl + S) = (4.35 + 16.67) - (5.63 + 10) = (21.02 - 15.63) = 5.39). Such a diet is mildly cationic; however, under field conditions one seldom is able to formulate rations with less than 1% K, so in actuality the DCAD is generally +14 to +27. **Such diets are strongly alkalotic, and these cationic diets are counterproductive in the prepartum and peripartum periods.**

Table 2. 1988 NRC recommendations for key elements for dry pregnant cows.

EL	DC (%)	DC (mg/100g)	MEQ (mg)	Quantity (meq/100g)
Na	.10	100	23	4.35
K	.65	650	39	16.67
Cl	.20	200	35.5	5.63
S	.16	160	16	10

EL = element DC = dietary content
MEQ = milliequivalent

Minerals commonly used to formulate anionic rations are shown in Table 3. These minerals, as would be expected, are a source of Cl and S anions. Note that sodium chloride (NaCl) and potassium chloride (KCl) are not included as anionic salts. **It should be pointed out that they are neutral salts and, as such, DO NOT contribute to DCAD.** Consequently, one should categorize Na, K, and Cl so as to delineate their source. For example, Na1, Na2, to define sodium.

Table 3. Nutrient profile[1] and relative value of common anionic minerals.

Mineral	Chemical Formula	Cost[2] ($/ton)	Cost (¢/eqv)	N (%)	Ca (%)	Mg (%)	S (%)	Cl (%)
Aluminum Sulfate	$Al_2(SO_4)_3 \cdot 16H_2O$	1700	39.4				7.62	
Magnesium Chloride	$MgCl_2 \cdot 6H_2O$	1850	20.7			11.84		34.96
Magnesium Sulfate	$MgSO_4 \cdot 7H_2O$	500	6.8			9.76	13.03	
Ammonium Chloride	$(NH_4)_2Cl$	750	4.4	26.2				66.4
Calcium Chloride	$CaCl_2 \cdot 2H_2O$	450	3.6		27.2			48.3
Ammonium Sulfate	$(NH_4)_2SO_4$	350	2.6	21.2			24.2	
Calcium Sulfate	$CaSO_4 \cdot 2H_2O$	200	1.9		23.2		18.6	

[1]Nutrients expressed on an as fed basis (AFB)
[2]Prices courtesy of The Pillsbury Company, Minneapolis, MN

Standard recommendations have evolved for using anionic minerals. For example, (1) feed 4 oz magnesium sulfate and 4 oz ammonium chloride; (2) feed 4 oz magnesium sulfate, 2 oz ammonium sulfate, and 2 oz ammonium chloride; or (3) feed 4 oz ammonium chloride and 4 oz ammonium sulfate. Though these recommendations will often work, there are times when they will not. Therefore, a more scientific approach is best. Selection of anionic salts should be based on availability, cost, potential toxicity, dietary deficiencies, palatability, and type of feeding system. To assist in ration formulation the following guidelines are suggested:

1. Balance Mg at 0.40% of DM. Use magnesium sulfate, magnesium chloride, or a combination. Magnesium sulfate, due to cost (Table 3), is the mineral of choice.

2. Balance S at 0.40% of DM. Use ammonium sulfate, calcium sulfate, aluminum sulfate or a combination. Calcium sulfate and ammonium sulfate are more cost effective on an equivalent basis. It should be pointed out that the National Research Council's *Mineral Tolerance of Domestic Animals* (1980) indicated that the maximum tolerable level of dietary sulfur for cattle was 0.40%. However, from personal experience this level seems conservative.

3. Balance Cl so as to provide a DCAD of at least -15 meq/100 g DM. Use ammonium chloride, calcium chloride or a combination. If the incidence of milk fever in cows freshening three or more times is to be maintained at less than 5%, then an excess of anions of at least 1.5 equivalents per cow per day must be provided. The major drawback in this regard is the level of potassium in the forages. High K feeds, such as rye, require high levels of dietary chlorine to offset their effect of K. Specifically, every 0.10% increase in total dietary potassium will require raising the level of Cl in the diet 0.09%. Chlorine, then, is the pivotal element since it must counterbalance K.

4. Provide a daily intake of 50 g of phosphorus and 150 g of calcium. Use conventional sources of calcium and phosphorus, such as calcium carbonate, monocalcium phosphate, dicalcium phosphate, etc.

5. Reduce the use of ammoniated salts if intake protein (IP) or degradable intake protein (DIP) become high. It is best to not let the protein content of the prepartum ration exceed 14% or DIP exceed 10%. Some situations to watch are as follows: when urea or other NPN source is present, when ammoniated forages or legume forages are being fed, and when animal proteins are being fed to acclimate prepartum cows. In these cases the use of ammoniated salts should be reduced or even eliminated.

It would be remiss not to mention that these ingredients are not palatable. It is best to incorporate them in a total mixed ration with some moist, highly palatable feeds. If this is not possible, then they should be combined with such appetizing ingredients as distillers grains and molasses in a grain mix. Pelleting the grain also improves consumption. The pellet should be formulated to be fed at the rate of 7 to 8 pounds per cow per day.

In summary, dry cow diet greatly affects postcalving performance, and, as such, it should be viewed as the most important phase of dairy cattle nutrition. The best way to provide proper nutrition for the dry cow is to formulate rations which provide the required nutrients, are nontoxic and have a DCAD of at least -15 meq/100 g DM.

Synchronizing Mineral Supplements With Forages For Beef Cattle

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Satisfying various levels of animal production (reproduction, lactation, growth and immune status) requires synchronizing nutrient inputs with the animal's physiological requirements. Aligning the animal's major nutrient requirements with forage growth may provide adequate supplies of energy and protein, but some elements are inadequate (antagonism, chelation, deficiency or toxicity) in the leaves of forages and may not satisfy the animal's total requirements. An important economic loss to a cow/calf operation is the non-pregnant cow; several trace elements required for early embryonic development are dependent upon daily intake to satisfy the animals requirement for pregnancy (not readily mobilized from tissue stores during estrus). Both major and trace elemental supplementation should be considered essential to insure optimal animal production. Consistent intake of a mineral supplement is the initial step to insure some quantity of elemental availability for a diversity of animal metabolic requirements and forages grazed.

A perfect mineral supplement for all forage situations and various physiological requirements of all animals does not exist! An elemental percentage only guarantees a quantity and does not insure satisfying an animal/pasture situation if not consumed. 'Consistent intake' of a known quantity of a mineral supplement is required for proper supplementation. The hypothesis that 'animals eat what they need' or have 'nutritional wisdom' is an erroneous statement. Animals select a palatable diet with little nutritional value in preference to an unpalatable nutritious diet, even to the point of death (i.e. grass tetany & milk fever).

Consistent intake of minerals is generally depressed during the forage growing season. Growing forages may satisfy animals major nutrient requirements, but contents are minimal in trace elements. Commercial mineral supplement may contain an adequate concentration of trace elements, however obtaining sufficient intake among