Clinical Observations and Laboratory Analysis of Factors that Affect the Survival and Performance of Beef Cattle

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Introduction

Economic losses in calves due to disease and death remain a major problem in many beef cow/calf herds. Results of the 1983 Total Beef Program Survey in Idaho indicated that calf mortality ranged from 15 to 50% in some herds. These losses occurred most frequently during the first 3 weeks of life. Many producers have listed low calf morbidity and mortality as one of several important indicators of a successful beef cow/calf operation.

Considerable practical and applied information has become available through the years to help cattle producers improve prevention and treatment of many common diseases of calves. Major problems still exist, however, in informing producers and in bringing about eventual adoption of this new and useful information. The Integrated Resource Management (IRM) concept represents an integrated problem-solving approach found useful in accelerating technology transfer. Using an IRM model, county extension faculty and livestock specialists, practicing veterinarians, research scientists, representatives from the allied industries (manufacturers of feedstuffs and animal health products), and the lending agencies work as a problem-solving team. Together, they help producers to identify and address production and health related problems in their livestock herds. The economic benefits to producers from the team approach used in this study include more live calves, heavier weaning weights, improved reproductive efficiency of replacement heifers, and greater communication and cooperation between producers and resource personnel.

Procedures

Organization

A field research and demonstration project was developed to address the problems of excessive stress and mortality in young beef calves. Field data such as those planned for this project were not available from other published sources. This project was conducted in a five county area in southeastern Idaho and included Bannock, Bear Lake, Bingham, Caribou, and Oneida counties. The planned duration of the project was 3 years in order to take into account variations in management and disease patterns within the herds and yearly changes in environmental conditions. The objectives of the project were to:

1. Develop baseline data of health and management factors in beef cow/calf herds during calving and for a one month period after calving that may be important to survival and performance of beef calves; and
2. Conduct extension-type field demonstrations and public forums on methods for improving herd health management practices and expansion in the use of protective shelters in beef cow/calf herds to improve calf survival and performance.

Work began in the fall of 1984 when the Total Beef Advisory Committee from each of the five counties met with support personnel to discuss organization of the project. Ranch cooperators were identified at that time. A meeting was also held with practicing veterinarians to acquaint them with the results of environmental stress

research in calves conducted at the University of Idaho and to inform them of the planned project. Written summaries of the cooperating ranch operations, prepared by the county extension faculty, included information on cattle numbers and handling facilities and current feeding and disease management practices. This information was used to place each cooperator into one of two categories of operation depending on the extent of the data to be collected, the management practices used, and availability of cattle handling facilities on the ranch. Most of the cooperators placed into category 1 continued to participate for the duration of the project. A summary of the number of cooperators by year and by category is as follows:

Year	Category number	Number of cooperators
1985	1	5
	2	29
1986	1	5
	2	29
1987	1	5
	2	25

Data Collection

Maximal data were collected on dams and their respective progeny from herds placed in category 1 while limited data were obtained from category 2 herds. In many cases, cooperators placed in category 2 began as early adopters and have subsequently continued to use portable shelters for protection of their young calves from environmental stress. In category 1 herds, data were obtained each year from as many as 20 first calf heifers and 20 mature cows and their respective progeny. These cows were randomly selected from the main herd at parturition. It was assumed that the animals placed on experiment provided a representative sampling of animals from each herd. No conscious effort was made to select the same animals for testing in consecutive years. With the exception of one herd, all dams delivered their young while temporarily confined to a calving barn. The cow/calf pairs remained in the calving barn for 12 to 36 hours after parturition depending on the rate of calving and availability of pen space.

Clinical Data Obtained From Dams

Clinical data obtained from dams included breed, age, current and previous year's parturition dates, bodyweight (lb) at parturition and at one month after parturition (first year only), and calving interval (days) and score (1[natural] to 4[Cesarean section]). Other clinical data obtained from the dams included lactation and mothering scores (1[poor] to 3[good]), teat size and udder suspension (50[small] to 0[very large]); according to a scoring system developed by the American Polled Hereford Association), and colostrometer ([1]; Nasco West, Modesto, CA 95352) readings (mg/ml) of colostrum collected at parturition. These clinical data obtained from the dams were considered important 1) as a general measure of the health status of the adult members of the herds and 2) as an indication of their potential effects on the health status and survival of the calves.

Clinical Data Obtained From Calves

Clinical data obtained from calves included birth date; breed; body weight (lb) at birth, one month of age, and at weaning; and rectal temperature (°F) at birth and at one, two, and three days of age. Other clinical data obtained from calves included age at first suckling (hours), and vigor and suckling scores (1[poor] to 3[normal]) recorded daily for the first three days of life. Immunoglobulin concentration in calves was determined by analysis of serum with the sodium sulfite turbidity test which is a rapid test that can readily be used under field conditions. Test results were recorded numerically and ranged from (1[clear-low concentration] to 4[opaque-high concentration]). Serum samples were obtained at 6–18 hours and at 24–36 hours of age. In addition, samples were obtained soon after birth and before suckling during the first year of the project. Sampling of serum from calves at birth was discontinued after the first year because no useful information was obtained by this procedure.

Laboratory Studies

Sera were further tested in the laboratory for concentrations of IgM, IgG_1, IgG_2, and IgA by use of the single radial immunodiffusion (SRI) test.[2] The SRI test was also used to quantify the concentrations of individual immunoglobulins in aliquots of colostrum from the dams.

Protective Calf Shelters

During the first year of the project arrangements were made to compare, under controlled conditions, the effectiveness of portable shelters for rearing beef calves under range conditions. These shelters were designed to protect beef calves from the effects of environmental stress. Earlier work by University of Idaho scientists had shown that these portable shelters are potentially useful in helping to prevent the effects of environmental stress in young beef calves raised under range conditions during winter and early spring.[4,5] The plan was to use morbidity and mortality rates and age adjusted body weights at one month and at weaning as a possible direct measure of the benefits that may result from use of the protective shelters. Ten of the randomly selected first calf heifers and an equal number of mature cows and their respective progeny were kept in a separate holding lot after calving. These calves had access to two portable shelters placed on the ground adjacent to the area where the dams were fed. The portable shelters were bedded with straw and each was designed to accommodate up to ten calves at a time. The remaining calves and their dams were also kept separate but the calves in this group had no access to protective shelters. Clinical data and serum samples were obtained from the

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sheltered and the nonsheltered calves as described.

Statistical Analyses of Data

Mean and standard deviation values were determined for the respective clinical and laboratory data from each herd. The means were then compared according to various groups of dams or calves within each herd by the General Linear Model method of statistical analysis.[7] Dams were grouped according to breed and to age group (2 years vs 3–5 years vs 6–13 years) while calves were grouped according to the age group or udder conformation of the dams, sex, and breed. Statistical programs were also used to determine the correlations between similar and different sets of data.

Results and Discussion

The results obtained during the three year period were important in providing cooperators with useful information about the health status of their respective herds during a critical period of the production cycle and in identifying management practices with application to other ranches. With the exception of use of protective shelters and collection of clinical data, the cooperators placed in category 1 were not required to make changes in their usual herd management practices. However, the process of data collection did make the cooperators more directly aware of the health status of their animals on a continuing basis and presented them with an opportunity to initiate early corrective measures when health related problems were identified. Statistical comparisons of data between herds were not made on a yearly basis during the course of the study because of obvious differences in geographical location, feed sources and quality, and genetic background of the animals. However, in reviewing all the data, we found similarities in results obtained from herds; thus, some of these data were combined and are presented and discussed here.

Results of Analysis of Clinical and Laboratory Data from Beef Cows

Calving, Lactation, and Mothering Scores

All animals on test were carefully observed at parturition for signs of dystocia and most animals gave birth by natural delivery. In the few instances where calves were born by assisted delivery, there was little difference in their clinical condition when compared to the clinical condition of animals born by natural delivery. Similarly, most dams had high lactation and mothering scores. As a result, no analysis could be made in determining the effects of these observations of the dams on calf survival and performance.

Body Weight

As expected, the two-year-old dams weighed significantly less than ($P<0.05$) the older dams at parturition and at one month thereafter. Further, animals either lost (45 lb. average) or gained (99 lb. average) weight after parturition. Postpartum weight loss may have been due to age/breed differences, heavy lactation and/or use of poor quality feed. Weight of the dams is apparently important in determining the efficiency of beef production. For example, recent work in Texas indicated that, although heavy weight beef cows may wean the heaviest weight calves in a herd, they also have the highest maintenance costs in terms of daily protein and energy feed requirements when compared to medium weight cows.[8]

Calving Intervals

There were no differences in calving intervals between middle and older aged cows (Table 1). The mean values and the ranges for the two age groups are in almost all cases far less than 365 days. This suggests an important measure of reproductive efficiency in these animals and their ability to produce a calf each year. These data also reflect the benefits of culling nonpregnant beef cows which is a routine management practice that is usually done after roundup and pregnancy examination in the fall.

TABLE 1. Calving interval by age group of beef cows.

Age group (years)	N	Calving interval (days) Mean*	Range
3 – 5	130	358.9 ± 12.7	332 – 380
6 – 13	132	358.8 ± 3.9	358 – 362

* Data are expressed as mean ± standard deviation.

Udder Conformation

Differences were observed in teat size and udder suspension (Table 2) between age groups of cows. The mean scores for teat size and udder suspension were generally in the middle of the scoring range although the numbers decreased, indicating an increase in teat size and lowering of the udder suspension, with an increase in age. This change in udder conformation with an increase in age was significant ($P<0.05$) in most of the herds tested in 1985 and 1986. Poor udder conformation is widely known to have an adverse effect on the ease and efficiency of suckling by young calves. Consequently, poor udder conformation may directly affect the passive immune status and nutritional condition of calves. Mean udder scores in the mid 20's in the older-aged cows indicated that the teat size was not excessive nor was the suspension inordinately low. Results indicate, however, that the cooperators were aware of the problems associated with poor udder conformation and routinely culled animals with undesirable udders from their herds.

Laboratory Analysis of Cow Colostrum

Results of laboratory analysis are summarized (Table 3) according to age group for total immunoglobulin (TIG;

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IgM ± IgG_1 ± IgG_2 ± IgA) concentrations in colostrum collected in 1986 and 1987 from cows at parturition. There was little difference between the age groups of cows in

TABLE 2. Udder score - By age group of beef cows.

Age group (years)	N	Teat size score Mean*	Range
2	77	33.1 ± 5.0	25 – 39
3 – 5	164	27.7 ± 3.2	23 – 33
6 – 13	174	24.7 ± 5.8	15 – 35

In 1985 four of seven herds and in 1986 five of five herds had significant (P<0.05) age group differences.

Age group (years)	N	Udder suspension score Mean*	Range
2	77	34.3 ± 4.8	25 – 42
3 – 5	164	29.7 ± 3.2	25 – 35
6 – 13	174	25.4 ± 3.1	20 – 30

In 1985 three of seven herds and in 1986 four of five herds had significant (P< 0.05) age group differences.

* Data are expressed as mean ± standard deviation.

concentrations of TIG in the colostral samples tested, although the range of TIG concentrations in each age group was large. In general, colostrum is rated as superior if it contains 50 mg/ml or more of TIG while colostrum with lower TIG concentrations is of either moderate (20–50 mg/ml) or inferior (< 20 mg/ml) quality.[1] These results contradict the notion that colostral quality is generally poor in first calf beef heifers and in aged beef cows. According to personal communications with Dr. Clive Gay and other research scientists at Washington State University (WSU), Pullman, WA who have worked extensively with dairy cattle, the TIG concentration in colostrum from dairy cows at parturition is only about one-half that of the TIG concentrations we obtained in our colostral samples from beef cows at parturition. Colostral quality was not uniformly high in the beef cows tested at parturition during the test period, however (Table 4). In 1985 over one-third of the samples tested had TIG concentrations of <50 mg/ml while in 1986 and 1987 the percentage of samples rated less than superior were 9.7 and 2.5, respectively. The reason(s) for improvement in the quality of colostrum is unclear although it could be explained by selective culling practices or improvement in the plane of nutrition. Neither of these possible reasons was tested. As expected, the TIG concentration in colostrum decreased rapidly with time (Table 5). At 12 hours after parturition, the colostrum was only of moderate quality and the TIG concentration had decreased significantly (P<0.05; 72.5% decrease). By 24–36 hours after parturition the colostrum was of inferior quality and the TIG concentration had decreased (P<0.05) by 83.4%. These results highlight the importance of making certain that beef calves have the opportunity to suckle as soon after birth as possible due to the limited time that the quality of the colostrum remains high.

TABLE 3. Total immunoglobulin concentration in colostrum of beef cows at parturition.

Age group (years)	N	Laboratory analysis Mean*	Range
2	34	96.9 ± 28.8	10.8 – 156.3
3 – 5	73	99.0 ± 25.7	14.1 – 147.4
6 – 13	87	96.5 ± 28.9	27.6 – 158.2

Age group (years)	N	Colostrometer reading Mean*	Range
2	34	95.4 ± 11.6	78 – 103
3 – 5	73	89.4 ± 18.4	66 – 115
6 – 13	87	77.3 ± 10.8	60 – 88

* Data from 1986 and 1987 are expressed in mg/ml ± standard deviation.

TABLE 4. Frequency and percentage of time by year that the total immunoglobulin concentration in colostrum from beef cows atparturition was < 50 mg/ml.

Year	< 50 mg/ml	Number of samples Total # tested	Relative %
1985	54	140	38.6
1986	11	114	9.7
1987	2	80	2.5

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TABLE 5. Change with time in total immunoglobulin concentration in colostrum from beef cows.

Sampling time (hrs) after parturition	N	Total immunoglobulin concentration* Mean*	Range
0	131	101.7 ± 22.1[a]	94.1 – 115.8
12	103	28.0 ± 17.6[b]	15.8 – 39.0
24 – 36	110	16.9 ± 14.6[b]	2.3 – 27.8

* Data from 1987 are expressed in mg/ml ± standard deviation.
[a,b] Significantly (P<0.05) different.

Use and Limitations of the Colostrometer

A colostrometer is a modified hydrometer designed to measure the specific gravity of colostrum.[1] This instrument was used as a semi-quantitative field test in the present study to measure the TIG concentration in fresh colostral samples taken at parturition. The county extension faculty, primary operators of the colostrometers, were given detailed instructions on proper use of the instrument. According to directions, it is important that the sample temperature be 72°F. Corrections to the colostrometer reading must be made if the sample temperature is not as specified. Appropriate corrections were made for deviations in temperature of samples collected in 1986 and 1987 but not for samples collected in 1985. The results obtained from colostrometer readings of samples obtained from cows at parturition in 1986 and 1987 are summarized according to the age group of the cows (Table 3). Although the apparent decrease in TIG concentration with age, as measured by the colostrometers, was not significant (P>0.05) and the values are within the superior quality range, these concentrations tend not to agree closely with data obtained by laboratory analysis of the same samples.

Assuming that the laboratory method for analysis of TIG concentration in colostrum was more accurate than the colostrometer method, a comparison was made to determine the number and percentage of times that the colostrometer values differed from the laboratory results by > or < 10 mg TIG/ml (Table 6). Results indicate that the colostrometer values were either above or below the allowable range from the laboratory test result approximately 75% of the time. Further evidence of the problem of agreement between the colostrometer and the laboratory test results comes from attempts to correlate the respective data by herd and by year. With the exception of one herd, the consistently low R values (range = 0.10 to 0.74) for all other herds clearly indicate a poor correlation between the two test systems. Possible explanations for the apparent discrepancy in results between the two test systems seem to apply more to use of the colostrometer than with errors associated with the laboratory analysis of samples. Faulty operation of the colostrometer, failure to account for deviations in sample temperature, and insufficient sample volume are factors that could explain some of the discrepancies observed. It was assumed however, that these potential sources of error were taken into account each time the colostrometer was used. According to Dr. Gay and others at WSU, the colostrometer is most accurate in detecting colostrum of moderate or inferior quality but may indicate erroneously high readings for approximately one-third of the samples found to be in the superior range. Despite questions that still remain unanswered, it seems that the colostrometer does have practical value under field use in 1) helping to remind producers of the importance of colostral quality and 2) as a semi- quantitative approximation of the quality of colostrum.

TABLE 6. Comparison by year of colostrometer readings and laboratory analysis for total immunoglobulin (TIG) concentration in colostrum.

Year	Frequency and percentage of times that the colostrometer reading differed from the laboratory result by > or < 10 mg TIG/ml: Less than	Relative %	Greater than	Relative %	Total # of samples
1985	15	21.1	41	57.8	71
1986	58	54.2	18	16.8	107
1987	32	54.2	13	22.0	59

Results of Analysis of Clinical and Laboratory Data From Beef Calves

Rectal Temperature and Vigor Scores

Rectal temperatures measured in calves at birth and during the first 3 days of life were usually within the normal, expected range (99.8°F to 102.5°F). Differences between breeds or sex of the calves and between the age groups of the respective dams had no significant effect on rectal temperature. Elevated rectal temperatures (103.0°F or >) were routinely observed in sick calves and often gave cooperators the first indication of disease before other clinical signs were apparent.

Vigor scores of the calves were generally high regardless of their breed or sex or the age group of the respective dams. As expected, vigor scores were lower (1 to 2) in calves with clinical illness.

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Calf morbidity and mortality

Data on the morbidity and mortality rates of calves by year are summarized (Table 7). The morbidity rates were high in four of the six herds tested in 1985 (range = 30.0–87.8%) while the morbidity rates in the same and other herds were remarkably lower in 1986 (6.2% average) and 1987 (8.7% average). Mortality rates remained low throughout the test period (range = 1.6–2.4%).

The majority of the illness seen in the test calves was associated with enteric diseases characterized by elevated rectal temperature, diarrhea, anorexia, and dehydration. Swab cultures taken from several calves with diarrhea were submitted to the Washington Animal Disease Diagnostic Laboratory, Pullman, WA. The diagnostic laboratory test results indicated enteropathogenic *Escherichia coli* organisms as the cause of diarrhea in calves in most cases. On a few occasions Rota and Coronaviruses were also observed by electron microscopic examination of fecal smears.

Factors that could explain the decrease in morbidity in the calves on test include improved sanitation procedures and handling of animals during and after the calving period, protection from environmental stress by use of portable shelters, and improvement of the passive immune status of the calves. In addition, calves in some herds were actively immunized at 1 day of age which could have improved their resistance to natural pathogens. Calves that are 24–36 hours of age must have a minimal TIG concentration of 5–10 mg/ml in their serum in order for sufficient passive protection from exposure to most pathogens under natural conditions (Personal communications; Dr. Otto Radostits, Saskatoon, Saskatchewan, Canada). Accordingly, data from the present study were summarized to assess the overall passive immune status of calves from four selected herds over time (Table 8). In herds I, III, and VI, a high percentage (range = 47.5–97.1%) of calves tested in 1985 had lower than the minimal required serum TIG concentration while the same was not true of calves in herd VII. The passive immune status or calves in herds I and III improved considerably in 1986 and 1987, suggesting this as a possible reason for the decreased morbidity seen in these herds during the second and third years. High serum TIG concentrations do not necessarily ensure that calves are protected from disease, however. For example, in herd I in 1985, 11 of 25 sick calves had TIG concentrations < 5 mg/ml while the other 8 calves with < than the minimal, required TIG concentration did not get sick. In herd III, 11 of 12 sick calves had TIG concentrations < 5 mg/ml while the other 22 calves with < minimal TIG concentrations did not get sick. Similar findings were also noted in calves in herd VI.

Age at First Suckling

Close attention was given to the age when newborn calves were able to suckle for the first time without assistance. This activity is generally believed to be an early and reliable indication of the strength and vigor of newborn calves and an important step in assuring a high level of

TABLE 7. Summary by year of beef calf morbidity and mortality.

	Total number of calves				
Year	On-test	Sick	Relative %	Died	Relative %
1985	252	114	45.2	6	2.4
1986	243	15	6.2	0	0.0
1987	183	16	8.7	3	1.6

TABLE 8. Number and percentage of times by herd and by year that the total immunoglobulin (TIG) concentration in beef calf sera obtained at 24 to 36 hours of age was < 5 mg/ml.

	1985			1986			1987		
	# calves			# calves			# calves		
Herd	With low TIG	Total tested	Relative %	With low TIG	Total tested	Relative %	With low TIG	Total tested	Relative %
I	19	40	47.5	0	29	0.0	0	26	0.0
III	33	34	97.1	2	18	11.1	0	13	0.0
VI	22	24	91.7	NT*	NT	NT	NT	NT	NT
VII	1	40	2.5	0	29	0.0	0	17	0.0

* Not tested.

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passive immunity in these animals. Results (Table 9) indicate that beef calves in general have the ability to suckle unassisted at a remarkably young age. Slightly more than one-half of the calves suckled by two hours of age or younger and almost three-fourths of the calves suckled by three hours of age. No difference was observed between the age at first suckling of bull calves and heifer calves (Table 10).

Calves from dams between 3–5 years of age tended to suckle at an earlier age when compared to calves from 6–13 year-old dams (Table 10). In one of five herds tested in 1986 and in 1987, the differences in age at first suckling between calves from middle-aged dams and calves from older-aged dams were significant ($P<0.05$). The difference in age at first suckling by calves according to the age of the dam may be associated with udder conformation. For example, in the herd tested in 1986 where the age at first suckling was increased in calves from older-aged dams, the teat size and udder suspension scores were significantly ($P<0.05$) lower in the same dams.

TABLE 9. Number and percentage of beef calves by age at first suckling.

Age at first suckling (hours)	N	Relative %	Cumulative %
1	22	19.5	19.5
2	39	34.5	54.0
3	22	19.5	73.5
4	11	9.7	83.2
5	5	4.4	87.6
6 – 24	14	12.4	100.0
TOTAL	113		

TABLE 10. Age at first suckling of beef calves by sex and by age group of the dams.

		Age at first suckling (hours)	
Sex	N	Mean*	Range
Male	201	2.7 ± 0.8	1.6 – 3.9
Female	185	2.7 ± 0.6	1.7 – 3.5
Age group of dams (years)			
3 – 5	60	2.1 ± 0.7	1.0 – 3.2
6 – 13	125	3.6 ± 0.6	2.9 – 4.8

In 1986 and in 1987 1 of 5 herds each had significant ($P<0.05$) age group differences.

* Data are expressed as mean ± standard deviation.

Age of Calves When First Observed Sick

The ages at which calves were first observed sick were generally uniform throughout all herds. A summary of these data (Table 11) indicates that in a typical herd situation, at least one-half of the illness that might be expected in calves will occur during the first week of life and that nearly 100% of the illness will occur by the time the calves are two weeks of age. These results clearly highlight the importance of sanitation, providing protection from environmental stress, and other good health management practices for calves during the early neonatal period. Interestingly, there was no correlation (R value = 0.15) between the age at first suckling and the age when the same calves were first observed sick. Thus, it would seem that the age at first illness is dependent on other factors that are equally or more important than the age at first suckling.

TABLE 11. Age, number and percentage of beef calves when first observed sick.

Calves when first observed sick — Age intervals in days	N	Relative %	Cumulative %
1 – 3	30	20.7	20.7
4 – 6	22	15.2	35.9
7 – 9	31	21.4	57.3
10 – 12	39	26.9	84.2
13 – 15	16	11.0	95.2
16 – >	7	4.8	100.0
TOTAL	145		

Sodium Sulfite Turbidity Test

The sodium sulfite[6] and the zinc sulfate turbidity[3] tests have been reported as useful field tests in approximating the TIG concentration in serum and thus, the passive immune status of young calves. These tests are directly useful in cases when there is doubt whether a calf has suckled and indirectly useful in cases when sufficient quantity and/or quality of colostrum is not available from the respective dam. The tests are based on development of a precipitate after a measured amount of calf serum is added and incubated at room temperature for up to 30 minutes with a standard volume and concentration(s) of either sodium sulfite or zinc sulfate. The test results are quantified according to the degree of cloudiness of the mixture caused by precipitation of the reactants and are usually reported according to a numerical scale of 0 to 4, with 4 representing the maximal amount of cloudiness.

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A positive correlation would be expected between the concentration of immunoglobulin in a sample and the cloudiness of the test mixture; i.e., the higher the concentration of immunoglobulin, the higher the test score. However, only moderate to poor correlations were found between the two test systems when used on serum samples obtained when the calves were 24–36 hours of age (range = –0.06 to 0.70). These results suggest that the sodium sulfite turbidity test may be useful primarily to indicate the presence or absence of passively acquired colostral immunoglobulins in serum, and not as an accurate, semi-quantitative measure of the passive immune status of calves.

Development of an accurate and reliable method for predicting the passive immune status of calves is important yet difficult. For example from the work reported here, it seemed logical that there should be a strongly positive correlation between the TIG concentrations in the colostrum of dams at parturition and in the serum during the first 1–2 days of life of their respective, suckled progeny. Results from the present study indicate, however, either poorly positive or negative correlations between the TIG concentration values in colostrum and the TIG concentration values in serum obtained when the respective calves were 24–36 hours of age (range = –0.33 to 0.49). The poor or negative correlations between TIG concentrations in colostrum and calf serum may have been due, in many cases, to the small volume of colostrum produced by dams and made available for consumption by their calves. Thus, even though our calves ingested colostrum of superior quality, the total volume of colostrum consumed may not have been sufficient to result in correspondingly high TIG concentrations in their sera.

Protective Calf Shelters

The clinical and laboratory data were not conclusive in proving that the protective shelters were helpful in improving the health status and performance of calves. Calves were routinely seen inside the shelters at night, and during inclement weather their skin and hair coat remained reasonably dry and they generally appeared less stressed than nonsheltered animals. The passive immune status and weight gains of the sheltered calves were not significantly greater ($P>0.05$) than the corresponding values obtained for the nonsheltered animals although morbidity and the severity of clinical disease was often less in the sheltered calves. Despite the absence of confirmatory experimental evidence after the first year of the project, cooperators became convinced of the value of protective shelters and it was not possible to persuade them to rear any of their calves placed on experiment without access to either man-made or natural, protective shelter. Thus, what seemed at the outset to be a reasonable and beneficial health management practice became a routine part of the standard operating procedure for these producers.

The results of the field research and demonstration project conducted in southeastern Idaho and summarized here represent a clear example of the type of information that can be gained through a well organized team approach to problem solving. Further, it is assumed that the results reported here will provide useful information for the benefit of veterinary practitioners and for other beef cow/calf producers with similar operations.

Acknowledgements

The support and assistance with organization of this project by the following veterinary practitioners is acknowledged: Drs. Robert Bradley, Arnold Glarborg, Thomas Shelton, and Brian Risa of Blackfoot, ID; Dr. Jeff Anderson of Pocatello, ID; Dr. Stanley Hull of Grace, ID; Dr. Mark Ipsen of Malad, ID; and Dr. Chad Clark of Fruitland, ID. This field research and demonstration project was funded in part by the Idaho Total Beef Committee and the Idaho Agricultural Experiment Station and was published, with the approval of the Director, as research paper No. 8881.

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