

Raising Dairy Calves

Dairy Section

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Gamma Globulin and Early Calf Mortality

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Early mortality in dairy calves resulting from agammaglobulinemia or hypogammaglobulinemia averages about 20% in large drylot dairy operations. While the problem remains serious, the analysis of day-old calf blood for the presence of gamma globulin can serve as an excellent diagnostic tool. These calves apparently die because the level of passive immunity is insufficient to carry them through the disease challenge until the active immune system begins functioning adequately.

There are several general methods by which calf serum gamma globulin can be determined. Electrophoresis, immunodiffusion and precipitation are the most common ones. Electrophoresis and immunodiffusion are the most sensitive methods for determining gamma globulin, but they are too time-consuming and costly to be of practical value in a calf-testing program for an average dairy. Precipitation methods are based on the salt or solvent precipitation of gamma globulin and are not as accurate as electrophoresis or immunodiffusion. Various factors can interfere with the precipitation of gamma globulin causing false-negative or false-positive results. Fibrinogen is the least soluble of the serum proteins, and if it is not removed by the clotting mechanism, it may be precipitated under some conditions by several of

the various salts used to precipitate gamma globulin. It has been the experience in our laboratory that, at various times of the year, a substantial percentage of the calf blood samples received failed to clot or clotted poorly. Thus, after centrifugation, the so-called "serum" contained a great deal of fibrinogen that could have falsely precipitated as gamma globulin. Serum from calves with varying degrees of dehydration will contain varying concentrations of salts which could interfere with the precipitation of gamma globulin. The serum pH may also influence the precipitation of gamma globulin. In our laboratory, the pH values of calf serum samples have varied from 7.0 to 7.8. Under average conditions, calf gamma globulin is more soluble at the higher serum pH values and may be, accordingly, more resistant to precipitation.

Delst Chemical & Research, Inc., Anaheim, Calif., has developed a spectrophotometric method of assay for gamma globulin in day-old calf serum. The method has been in use for over two years and has been used in the gamma globulin determination of several thousand calf serum samples. Coordination of the results with those of electrophoresis appears to be excellent. The results of the spectrophotometric assay are used to give each calf

a Survival Expectancy Number. This number will be between 1 and 100, depending on the serum level of gamma globulin. Increasing numbers represent increasing levels of gamma globulin. Calves with readings of 1 to 10 are agammaglobulinemic; calves with readings of 20 to 50 are hypogammaglobulinemic; and calves with readings above 90 have a great deal of passive immunity and should be able to withstand any average disease challenge. It might be of some interest to note that when agammaglobulinemic and hypogammaglobulinemic calves are separated for treatment, they appear to be normal, healthy day-old calves. Even an experienced calf producer cannot distinguish between calves with high and low levels of serum gamma globulin. Using the Delst spectrophotometric analysis for gamma globulin, early mortality in calves raised under average conditions can be predicted at the first day of age with an accuracy of about 87%.

While these immunologically weak calves can now be detected, the real goal, of course, is to keep the calves alive until their own active immune systems are functioning adequately to protect them. We have had some measured success, but our results to this date have not been totally satisfactory. Based on our experience, however, some guidelines can be recommended. A number of drylot dairies place the mother cows in group pens for calving and, thus, each calf is dropped literally in a manure pile. During wet weather it is especially bad and it is difficult to understand, especially to a microbiologist, how a baby calf can withstand this type of disease challenge even when its level of serum gamma globulin is high. We suggest that the dairyman follow the practice of the swine producer in which the brood sow is placed in a farrowing barn where she has her baby pigs under conditions that are almost hospital clean. The early disease challenge to the baby pig is greatly reduced in this type of environment. It would seem reasonable that if the mother cow could be placed in a brood cow barn where there are clean, dry, disinfected individual pens that have sufficient straw bedding, the baby calf should have a better chance for survival.

If several baby calves are born and removed from the mother cows each day, we suggest that they be placed in a receiving pen. This receiving pen should be clean and disinfected and contain adequate straw bedding. The calves should be blood tested 12 to 24 hours post-parturition to determine their individual serum levels of gamma globulin. Those calves that are agammaglobulinemic or hypogammaglobulinemic should

be separated from the rest of the calves into quarters that have been cleaned and disinfected and where the disease challenge can be kept at a very low level. For best results, the "all in, all out" procedure should be used. A single barn may be separated into sections and each section used in an "all in, all out" procedure.

The agammaglobulinemic calf appears to have special problems with digestive upset. Since data indicate that it can use only milk nutrients, it is suggested that the baby calf receive milk, or an all-milk milk replacer, during the first ten days to two weeks. If fresh colostrum from healthy cows (no mastitis) is available, it should be fed to the calves for the first three to five days, but the colostrum should be fresh. It should be fed to the calves preferably within one to two hours after milking. The addition of drugs or antibiotics to colostrum will not keep it fresh. There are at least three reasons why colostrum should be fed to baby calves the first three to five days; namely, for the absorption of antibody (gamma globulin) into the system, to enhance the integrity (immunity?) of the intestinal wall, and for nutritional purposes. The feeding of colostrum for the absorption of antibody is, in general, a practice in futility after the first day. If the calf is agammaglobulinemic at 24 hours it will probably remain so until gamma globulin is injected or produced by its own active immune system. There is some evidence that oral gamma globulin may help to improve the "immune" barrier of the intestinal lumen. We are especially interested in what influence first-milking colostrum might have on the mortality rate of agammaglobulinemic calves when fed for five to seven days. The nutritional need of colostrum will not be discussed here, but there is a dramatic difference in the nutrient analysis of colostrum and regular whole milk. There is little known about the metabolic fate of the products of digested gamma globulin.

We have had only limited success on some farms with antibiotic programs. Almost all the available drugs have been used orally and parenterally to increase the survival rate of agammaglobulinemic calves. No one drug program has been successful to this date.

When baby calves begin to develop symptoms of scouring it is of value to replace the milk with fluids containing salts and dextrose. The milk is then returned to the diet slowly and, if dehydration continues, fluids should be administered intravenously.

During the past two months we have been testing injectable bovine gamma globulin for the

control of agammaglobulinemia in baby calves. Crude fractions of gamma globulin have been tested and toxic levels have been established. It appears unlikely at this point in our research that we can quantitatively inject into a calf sufficient gamma globulin to establish a "normal" level. The injection of 13 grams or more of gamma globulin in a single dose produces symptoms similar to anaphylaxis, and double that dosage results in death in just a few minutes. We are now testing the efficacy of smaller doses of gamma globulin and we are testing both crude and very pure fractions. We

are also testing the efficacy of oral gamma globulin fed to the calf for the first week.

It would appear that the immediate problem in improving the survival rate of agammaglobulinemic calves is to enlarge the immune system. It is hoped that bovine gamma globulin will sufficiently serve this purpose. If it proves to be inadequate, we plan to begin research on the rudimentary active immune system in the day-old calf. In the meantime, the most practical approach is to reduce the disease challenge as much as possible through good sanitation and good management practices.

An Epidemiologist Looks at Calf Disease

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The meeting theme, "The Present and Future of Bovine Practice," provides an ideal framework for discussion of an epidemiologist's view of calf diseases. The future belongs to those who prepare for it, but preparation for the future does not require clairvoyance. Facing the future challenge of calf health requires that we acknowledge the next decade will bring momentous changes in the feeding, housing and management of calves. Agriculture will advance far more rapidly than veterinary science and individual veterinarians will be effective advisors in calf health programs only if they can avoid "future shock" and cultivate a mentality for applying the age-old concepts of preventive medicine to increasingly complex situations.

Epidemiology is that branch of veterinary science which records the distribution of animal disease in populations, attempts to explain the recorded distributions, and uses the knowledge thus obtained to control disease. In short, epidemiology is an approach which says: if we carefully tabulate who gets a disease and when and where they get the disease, we can likely learn why they get the disease and can hopefully control future occurrences.

In over a decade of applying the epidemiologic

approach to cattle disease, we have observed certain repetitive phenomena which occur in all varieties of cattle diseases, in all aged cattle and under varying management conditions. Three of these "epidemiologic truths" or fundamental concepts of epidemiology are appropriate for discussion of calf diseases.

Concept No. 1 — The apparent incidence of any disease is directly proportional to the intensity of the case-finding activities.

The realism that "the harder you look, the more you find" is superbly appropriate to the diagnosis of calfhood diseases like white muscle disease (which becomes prominent when looked for), and salmonellosis which seems to be "on the increase" among calves when bacteriologic studies are intensified.

Concept No. 2 — The consequences of infection with pathogenic organisms vary from mild inapparent infection to severe, sometimes fatal, disease.

When an infection spreads through a population, many infected individuals remain healthy yet serve as the immediate source of infection for herdmates, some become sick and survive and others (frequently those with complicating disease) succumb.