General Session

Field Diagnosis: Problems and Solutions

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Results obtained from diagnostic laboratories can be influenced not only by sample quality but also the method of testing itself. In this presentation, I will try to provide practical tips on increasing your effectiveness in using diagnostic services.

Calfhood Diarrhea Diagnosis

A diagnosis of *E.coli* in calves is often easy, however, its significance can be more difficult to establish as the underlying cause of diarrhea, especially if other pathogens are not pursued, including *Salmonella, Cryptosporidia,* Rota virus and Corona virus. *Clostridium perfringens* appears to be increasing in prevalence in dairy calves less than one week of age. In our experience, Type A has been the predominant *Clostridium* organism isolated. The current textbook literature attempts to explain that this disease is not found in this country. Recent toxin identification studies using DNA gene probe techniques has identified this as type A, as well as the NVSL technique of mouse bioassay.

E.coli organisms, once isolated and sensitivities performed, should optimally be tested for virulence and pilus antigens including:

K99
987P
F107
CS31A
F1845
eae

Although *E.coli* vaccines may be given to the dam and/or calf, only 7% of the *E.coli* isolates submitted to our laboratory for virulence factors are of the K99 type. Therefore, *E.coli* diarrhea can still be seen, from a differing virulence factor, even in cows receiving *E.coli* vaccines.

Fecal swabs from the rectum in live calves as well as intestinal segments (duodenum, ileum, and large bowel), tied off with suture material, would be considered the samples of choice. When submitting intestinal samples, both ends of a four inch segment of intestine should be acquired from a necropsy specimen. Each segment of intestine should be placed in an individual zip-loc bag to limit cross contamination.

A piece of large bowel is extremely important if attaching and effacing E.coli **are being considered as a differential**. It is also helpful to get a piece of intestine from this same location (the location where the sample for bacterial culture was acquired) for histopathology. This segment should be no longer than 1/2 inch.

Other tissues to be submitted in 10% buffered formalin should include abomasum, duodenum, jejunum, ileum, spiral colon, and rectum. These tissues should be submitted in formalin at one part tissue to ten parts formalin. Liver, lung, and heart would also be helpful.

The submission of several mesenteric lymph nodes, submitted as fresh tissue can be helpful.

A 3 milliliter syringe full of bile from the gall bladder would be helpful in culturing for *Salmonella.*

Serum acquired from 3 to 8 calves that are greater than 36 hours of age for total protein or IgG concentration could also be helpful in establishing a quality check of colostrum management by the calf raising personnel.

All samples should be shipped by overnight express mail for 10:30 AM delivery. Please include cold packs with the samples. DO NOT USE DRY ICE as this will freeze the samples, rendering most of them useless. If necropsies are performed late in the afternoon and cannot be mailed that day, please refrigerate the fresh tissue for culture, refrigerate the bile, spin the blood down re-

moving the serum and refrigerate the serum and leave the formalized tissue at room temperature.

Rota virus and corona virus can be detected with the use of electron microscopy. However, if an oral rota/corona vaccine has been administered to this calf, this vaccine will give positive results for approximately 10 days following the oral dosing due to multiplication of the virus. Therefore, a complete history can be helpful to the diagnostician in attempting to prevent testing which will not give meaningful results.

Cryptosporidia and coccidia are easily identified via histopathology. ATEC can also commonly be diagnosed by histopathology. However, special fecal stains, fecal float and culture respectively also give accurate results if tissue for histopathology is not available.

Serum from 4 to 6 calves should also be acquired to determine the status of colostrum intake. Total protein values should be at least 6.0 g/dL within 36 hours after birth.

Salmonella Diagnosis

Salmonella is a common disease condition in calves, most often in large operations with large mixing/holding tanks. In these operations, fomites provide an excellent means of spreading the disease from pen to pen. The most common *Salmonella* isolates for cattle by group would be:

Group A:

Group B: *S. typhymurium, S.agona*

Group C: *S. montevideo, S.mbendaka*

Group D: *S. dublin*

Group E: *S. anatum*

Most veterinary microbiology laboratories can only speciate an isolate out to a particular serogroup. If an absolute identity is needed, several laboratories, including NVSL in Ames, IA, can provide this service. An exact identification can be helpful in determining management changes that need to occur to prevent continued spread and/or reintroduction of the disease into the population.

The use of an ELISA test on serum at the U. of California at Davis could be useful in attempting to identify carrier cows and calves. The test would need to be repeated in 60 days to identify animals that are maintaining high titers. Animals with high titers would be considered carriers, as Salmonella is not the best organism for extensive antibody production. If the animal is not a carrier, then the titer would decline within 60 days after the clinical syndrome was experienced.

Finally, it is important to remind producers and managers of the zoonotic potential of this organism. *S. enteriditis* and *S. typhimurium* are the most common serovars that occur in humans.

Campylobacter Diagnosis

In adult cattle, *Campylobacter jejuni* should also be considered in a differential in which bloody diarrhea is occurring. This organism is not a routine microbiological attempt. If it is suspected, the practitioner should request this as a specific test at the time of sample submission.

Bovine Leukosis Diagnosis

Bovine leukosis (BLV) testing is often required for purebred production sales. The use of AGID is currently the most common test performed to detect BLV exposure. The Oklahoma State University Diagnostic Laboratory has developed a P24 tumor antigen test. This testing has the advantage of determining if tumor tissue is present in the animal. However, once again, if this test is positive it would not confirm the clinical signs being seen in a given animal, however it would be more suggestive than just a positive AGID test. Illinois and Missouri prevalence studies in dairy cattle range from 40 to 88% prevalence in individual dairy herds.

Leptospirosis Diagnosis

Leptospirosis appears to be increasing in recent years, especially this year. Since the removal of streptomycin from the veterinary antimicrobial market, this may have allowed the continuation of this disease in a sub-clinical carrier state. The continued increase of leptospirosis in confinement dairies can most likely be expected.

Leptospirosis diagnosis can be difficult, as not every clinical case will have a high MAT (microscopic agglutination) or ELISA titer. Therefore, if titers are low, this does not rule out this disease process. Other tests in conjunction with serology should include FA of tissue, darkfield microscopy of urine, and special silver stains of histopathology tissue. Several factors affect these results and should be considered when submitting samples for a diagnosis of leptospirosis including: 1) isolation of leptospira organisms is difficult if antibiotics of any kind have been administered, 2) not every clinical case will have a high titer, 3) hemolysis interferes with both MAT and ELISA testing, 4) do not freeze tissue for FA for leptospirosis, 5) transport of urine in bovine serum albumin — available from most laboratories — can increase the opportunity of isolating the organism, 6) do not freeze urine for dark field microscopy, and 7) submit a representative number of samples

from the herd even if only one or two animals are showing clinical signs of the disease.

Mastitis Diagnosis

Frustrating to many dairy producers and veterinarians is the turn around time associated with mastitis culture results. However, turnaround times are directly associated with the number of bacterial species isolated from each individual sample. This is often directly related to the size of the opening in the container in which the sample is being collected as well as to the amount of milk collected. Therefore, turnaround times are directly related to technique at the time of sample collection.

The culture tube for a milk culture should be as small as possible with a very narrow bore opening. **Zip-loc bags, Whirl-pak bags, DHIA milk containers and blood tubes are not appropriate culture containers.**

Proper milk culture techniques would include having someone hold the switch of the cow while the sample is being acquired. The udder should be washed and prepped in the normal manner of the farm. Two streams of milk should then be squirted from each teat. This removes bacteria from the streak canal. If water was used to wash the udder, make certain that the udder is completely dry. Once the udder is dry, 70% rubbing alcohol should be used to disinfect the teat end. Each individual teat end should be scrubbed with an individual cottonball soaked in 70% alcohol. Scrub the far teats first. If you are on the cow's left side when acquiring the sample, scrub the right front and right rear teats first using a separate cottonball for each teat. Next, scrub the near teats (the two left teats.) Wait 15 seconds to let the alcohol dry, dehydrating and rupturing any bacteria on the teat end. It is the dehydration of the bacteria that is killing them. Therefore, contact time is very important before acquiring the sample. If you are right handed, remove the cap to the plastic culture tube (Falcon tube®) with your outside finger. Holding the tube with your left hand with the tube almost flat level with the ground, squirt one stream of milk out to the side of the udder and into the tube. Six to eight drops of milk are adequate. Each time a squirt of milk is taken into the sample tube, we risk increasing the opportunity of a contaminating bacteria from the skin, hair, udder, your arm, etc.

Milk cultures should be mailed next day air on ice or frozen immediately. A history with each sample can be extremely helpful and should include: 1) Cow identification, 2) Days in milk, 3) Milk production, 4) Somatic cell count, and 5) Record of intramammary treatment.

No growth from cultures happens frequently when somatic cell counts are greater than 1,200,000. As SCC increases, the opportunity also increases for a pathogen to be engulfed by a neutrophil. Freezing of these samples for 12 hours and then reculturing the sample can also increase the recovery rate. If animals have been treated with an intramammary product within 48 hours of sample collection, this will drastically decrease culture yield of pathogens. If a large number of no growths are reported, *Mycoplasma* testing should then be addressed. *Mycoplasma* testing of milk cultures is not a routine analysis in most milk culture laboratories. *Mycoplasma* cultures are, therefore, a special microbiologic request.

Milk cultures for the identification of bacteria can be extremely difficult and time consuming if sample technique is not followed exactly. The attention to detail at the time of sampling plays the greatest role in turn around times from laboratories. Large mouth jars, bottles, and DHIA collection tubes **are not** appropriate samples for milk cultures. Secondly, large volumes of milk as a sample also increase the number of contaminating bacteria. Contaminating bacteria are even more of a problem in milk cultures. Not only do they increase the amount of time until pure growth isolates can be acquired, but contaminating bacteria may also produce enzymes and proteases which could actually kill the "true" pathogen during transit to the laboratory. Contaminating bacteria, therefore, increase turnaround times, increase the expense of isolating the true pathogen and may even kill the true pathogen while the sample is in transit to the laboratory.

Diagnosing Abortions in Cattle

The following tissues submitted from the aborted fetus can increase the number of abortions diagnosed with a causative agent.

Aqueous humor from both eyes can be used for a determination of nitrates from an aborted fetus. Autolysis of tissue can increase this level, however, in most cases of nitrate abortions, the level in aqueous humor is significantly elevated. This fluid should be aspirated from both eyes and submitted in a red top test tube.

Fetal abomasal fluid submitted for routine culture can be quite helpful in attempting to diagnose placentitis and septicemia. This sample should be submitted in a red top test tube. Samples for microbiologic culture should **never** be submitted in a purple top test tube, as the EDTA will inhibit bacterial growth in a microbiologic laboratory.

Fetal pericardial fluid should be submitted in a red top test tube for IgG analysis in an attempt to note if an immune response by the calf from a fetal infection has occurred.

Thoracic fluid can also be used but may give results that are more difficult to interpret.

A fresh piece of placenta, lung, and liver should be submitted in a Zip-Loc bag, with each tissue in a bag completely by itself for routine culture.

Tissues that should be submitted for FA techniques should include: 1) thymus, 2) spleen, 3) lung, 4) kidney, and 5) liver. If leptospirosis is being considered, these tissues should not be frozen.

Tissues that should be submitted for histopathology in 10% neutral buffered formalin with 10 parts formalin and 1 part tissue should include: 1) thymus, 2) heart, 3) lung, 4) diaphragm, 5) liver, 6) kidney, 7) spleen, 8) skeletal muscle, 9) placenta, and 10) brain. The brain **should not** be sectioned, as it tends to fall apart in transport. All other tissues should be sectioned to be no more than 1/4 inch in thickness.

Neospora Diagnosis

Neospora is the most commonly diagnosed cause of abortion in dairy cattle in the U.S. An ELISA test that is 89% sensitive and 97% specific in adult cattle has been developed at the California Veterinary Diagnostic Laboratory System in Tulare and Davis, CA. Fetal serology is of little diagnostic value in determining the cause of abortion. Fetal serology reflects *in utero* exposure to Neospora which, like BVD, may not always cause abortion. Acute dam serology is of value to rule out the possibility of Neospora exposure. Very infrequently do seronegative dams have Neospora infected fetuses. Seropositive dams may or may not have Neospora exposure of their fetuses.

Recent results from Dr. Mark Thurmond at the California Veterinary Diagnostic Laboratory System indicates that: 1) precolostral seropositive calves can be considered persistently infected, 2) postnatal transmission may be as low as 1-2% during the first two years, and 3) congenital transmissions may account for 98.4% of infections in the first two years.

Brain tissue from the aborted fetus submitted in formalin for immunohistochemistry testing is considered to be the method of choice for definitive diagnosis.

BVD Diagnosis

Diagnostic techniques for BVD include serology, virus isolation, and microtiter techniques. BVD isolation can use either serum or whole blood. Recovery rates of virus by isolation will depend on virus numbers in the sample, cell lines used, incubation times, passages, etc. Therefore, it is very crucial that blood samples reach the laboratory as soon as possible. Samples should never be frozen if virus isolation is being attempted. Secondly, samples that are acquired on Thursday afternoon and are not mailed that evening by Express Mail usually do not reach the laboratory until noon Monday, four days later. This may affect recovery rates in samples from animals with acute disease. In persistently infected animals, the number of virus particles in these samples will be extremely high and virus can often still be identified.

Samples acquired for serology should have the serum removed as soon as possible to limit hemolysis. This makes reading serum neutralization tests much easier. A different needle and syringe should be used for drawing each sample. On occasion, a "toxic reaction" may be reported by a laboratory when running serum neutralization. This is often seen when the same needle and syringe are used from animal to animal.

Microtiter techniques are an excellent way to screen herds for persistently infected animals. Persistently infected animals can reach adult age and show no clinical signs and have excellent milk production records. Although this is not common, it can occur. Persistently infected animals are not always the "poor doing" animal so often discussed in the literature.

Pneumonia Diagnosis

Tissues for a diagnosis of pneumonia either by microbiologic culture, virus isolation, or histopathology should be performed on tissue obtained from the cranial ventral portion of the lung. The inflated lung of the dorsal lung fields are often easier to acquire since many clinicians are standing over the back of the animal. Cranial ventral lung sections have been shown to give better diagnostic results than dorsal lung sections both for microbiologic and histopathologic results.

Microbiologic Special Requests

Microbiologic laboratories often have several organisms that are not routinely cultured either due to the few numbers of pathogenic isolates or special media that would be required. However, if the practitioner requests these tests at the time of submission, many of these isolates can be attempted on special media. Special request microbiologic isolates will differ from laboratory to laboratory but often include:

Brucella sp.
Ureaplasma sp.
Mycoplasma sp.
Haemophilus somnus
Campylobacter sp.
Salmonella sp.
Clostridium sp.

Vitamin and Mineral Determinations

Vitamin A and E Analysis

Vitamin A and E determinations should be per-

formed on serum samples or liver biopsies from an appropriate number of cows/calves. This number should be 10% of the herd or a minimum of seven samples in smaller herds. Serum vitamin A and vitamin E values start to decline approximately two weeks prior to freshening and do not return to normal levels until 15 to 20 days post freshening. Therefore, the animals selected can have an influence on the result received from the laboratory. Practitioners are encouraged to provide the days in milk for lactating cattle to help with interpretation of results.

Copper Analysis

Serum copper levels can give an indication of copper status of a herd if sample size is large enough. Testing one or two animals gives very little evidence of copper deficiency. Liver samples are a better indicator of long term copper status. If copper toxicity is suspected, serum copper values will often be normal until after the acute hemorrhagic/hemolysis condition occurs. A 20 mg true cut liver biopsy specimen is an adequate sample size to determine a large number of blood minerals. These samples should be placed in a red top tube, identified, and frozen until submitted to the laboratory.

Zinc Analysis

Zinc analysis from serum can be affected by the type of tube as well as syringe used for sample collection since red top serum tubes and new syringes are coated with zinc as a lubricant in the manufacturing process. Therefore, results can be artificially elevated depending on materials used to acquire and store the samples. Royal blue top test tubes are the appropriate tube for zinc analysis.

Selenium Analysis

Selenium analysis can be either by whole blood selenium, serum selenium, or by the analysis for glutathione peroxidase, the enzyme system of which selenium is actually incorporated. Whole blood selenium is the preferred analysis of choice when attempting to determine long term selenium status of a herd or group of animals. Serum selenium underestimates selenium status in many instances. Additionally, serum has a greater amount of variation not only within the herd but within the individual sample. Serum selenium is also affected by recent selenium intake. If new supplements have been made available to the animal or injections given, serum selenium can actually overestimate the whole blood selenium status of the animal. Therefore, a representative number of whole blood selenium assays from a herd is therefore needed in order to make sound nutritional recommendations for increasing or decreasing selenium in mineral or ration formulations. One or two blood samples from a herd is not a large enough sample size to make recommendations for increasing or decreasing any vitamin or mineral within a herd feeding program. Secondly, a history of intake per day of a product as well as a known history of access to the vitamin or mineral supplement, can be helpful in making recommendations. In beef cattle operations, the number of mineral feeders, location, and frequency of them being checked can all affect vitamin and mineral serum/whole blood levels.

Mycotoxin Testing

Mycotoxin testing has evolved a great deal in recent years. The use of rapid screening tests have given quick results that appear to be accurate for aflatoxin. However, just like milk residue tests, false positives do occur in mycotoxin testing. It is important to note that *all* positive results should be confirmed by either high pressure liquid chromatography (HPLC) or via thin layer chromatography (TLC).

A 3 to 5 pound sample should be submitted for mycotoxin testing in a cloth or paper bag. Plastic bags are not appropriate samples for mycotoxin testing, due to the potential of mold growth in transit in an enclosed plastic bag. This mold growth could elevate levels higher than what is currently seen in the field condition. Secondly, it is important to note that the rapid screening tests are to be used for individual ingredients such as corn and wheat. If hay, forage, or TMR is being tested, HPLC or TLC should be used, as a higher number of false positives are noted with forage type samples when using the rapid screening tests.

A small two cup sample of the TMR or individual ingredient should also be submitted for moisture content since the large sample for mycotoxin testing will be open to the air.

Complete Blood Counts

If complete blood counts are to be performed with a differential count, blood smears should be made if blood cannot reach the laboratory within 24 hours of collection. Neutrophils and lymphocytes start to degenerate within 24 hours of collection yielding marked artificial elevations in eosinophil, basophil, and monocyte counts. Test tube size also plays a role in the number of samples which are clotted. Smaller tubes of whole blood have fewer blood clots than larger 7 and 9 milliliter tubes.

Serum Chemistry Panels

Serum chemistry panels can give a tremendous amount of diagnostic information if an appropriate history is available on individual cows at the time of sampling. Serum creatinine and blood urea nitrogen

(BUN) assays should always be performed together in order for diagnostic interpretation to be accurate. BUN is primarily influenced by glomerular filtration rate, which is influenced by the level of hydration of the animal. Serum creatinine values in beef and lactating dairy cattle should range from 0.9 to 1.2 mg/dL. Dry dairy cows will often have creatinine values of 1.2 to 1.5 mg/dL. Normal BUN values can range from 9 to 20 mg/dL. Values less than 9 mg/dL are often seen in cattle that have been completely off feed for six days or more, as the rumen wall associated bacteria are utilizing BUN as a source of nitrogen. These values often range from 2 to 6 mg/dL. Values greater than 20 mg/dL must be interpreted in light of glomerular filtration rate and hydration status. Serum creatinine values of greater than 1.2 mg/dL would indicate either decreased glomerular filtration rate which would increase BUN or increased creatine release from myocytes. BUN values can also become elevated when dietary nitrogen/starch levels are not optimal for microbial protein synthesis. Many times this is not a condition of over feeding protein but of actually feeding a starch limiting diet. This condition is seen after years of extremely poor corn digestibility and/or extremely dry corn silage production.

SGOT/AST is an enzyme from both liver and muscle tissue. Normal SGOT/AST values in cattle range from 23 to 165 U/L. The use of other enzymes can be helpful in interpretation. For instance if CPK (creatine phosphokinase) is elevated from muscle, the increased SGOT is also most likely from muscle. If LDH is increased, cholesterol decreased, and GGT increased, the elevated SGOT is most likely from liver.

CPK ranges from 14 to 170 U/L in cattle. CPK can be elevated following calving, surgery, transportation, and any other cause in which muscle cells would be damaged releasing the enzyme. These values will remain elevated for 5 to 7 days following the initial muscle damage. This enzyme is removed by renal filtration.

GGT (gamma glutamyl transferase) is associated with bile duct epithelium and colostrum formation. Normal GGT values should range from 0 to 30 U/L. GGT will become elevated anytime there is decreased duodenal contraction and/or decreased gall bladder contraction. Therefore, conditions which interfere with the hormone cholecystokinin will elevate the GGT level in cattle. It is not uncommon to see cattle with an LDA have GGT levels of 30-45 U/L. Elevated GGT levels do not indicate liver pathology. It may only indicate bile stasis. Once an LDA is repaired, this value will often return to normal within 24 hours of the animal returning to feed. GGT values are also elevated in newborn calves following colostrum ingestion. These values often exceed 1000 U/L and will remain elevated for as long as 10-14 days.

ALP (alkaline phosphatase) ranges from 16-150 U/L in normal cattle. Elevated ALP levels are noted in rapidly growing animals as well as from placental tissues in pregnant cattle. Therefore, it is often elevated above normal in both beef and dairy cattle. Once again, this elevated enzyme is not an indication of pathology.

Total protein values in cattle should range from 6.4 to 8.8 g/dL. Elevated values occur in cattle experiencing acute inflammation with elevated fibrinogen levels or cattle with chronic infections in which chronic antigenic stimulation has led to an increased immunoglobulin level. This chronic stimulation could include mastitis, peritonitis, etc.

Albumin levels in cattle should range from 3.0 to 3.5 g/dL. Elevated albumin levels are most often noted with dehydration. Hypoalbuminemia is associated with inflammation in which albumin moves to a site of infection/inflammation. This can occur with any acute inflammatory response including mastitis, metritis, peritonitis, "hardware", enteritis (Johne's, Salmonella), pyelonephritis (BUN/Creatinine would be elevated), and, on rare occasions, pneumonia.

Serum calcium values in lactating dairy cattle should range from 8.0 to 11.0 mg/dL. Serum calcium values should always be interpreted in light of serum albumin levels since approximately 50% of serum calcium is bound to albumin. Therefore, any process that decreases serum albumin will also lower serum calcium concentration. For example, if serum calcium is calculated to be 7.0 mg/dL and the serum albumin is 2.1 mg/dL, a corrected calcium could be calculated using the equation of: measured calcium (7.0) -measured albumin (2.1) + expected albumin (3.5) = corrected calcium of 7.0 - 2.1 + 3.5 = 8.4 mg/dL which is within normal limits for lactating dairy cattle.

Dairy cattle treated for milk fever can immediately have serum calcium levels of 12 to 20 mg/dL. This value falls very rapidly as loss in urine and redistribution of calcium occurs.

Beef cattle often have a serum calcium concentration that ranges from 7.0 to 9.5 mg/dL.

Serum phosphorus concentrations should range from 4.6 to 7.4 mg/dL. These values are greatly affected by hemolysis of the blood sample. Many of the newer and larger serum chemistry analyzers have the ability to quantitate hemolysis indexes, which then allow diagnosticians to determine if the hyperphosphatemia is real or artifact from sample collection (hemolysis). Other causes of hyperphosphatemia in cattle include decreased glomerular filtration rate from renal disease and, more commonly, dehydration. In these instances, calcium values are often 5.0 to 7.0 mg/dl while serum phosphorus will range from 8.0 to as high as 13 mg/dL. The primary cause of serum calcium:phosphorus inversions is dehydration.

Serum calcium and phosphorus levels are under

hormonal control. Serum calcium concentrations cannot be used to detect calcium deficiencies in rations. Just as in humans with osteoporosis, serum calcium values are often normal due to PTH (Parathyroid hormone) affecting bone osteoclasts and breaking bone down to maintain normal serum calcium levels. If calcium or phosphorus is thought to be deficient, a complete analysis of each individual ingredient and their intakes will be needed in order to calculate daily calcium and phosphorus intakes. These values will then need to be compared to NRC values.

Lactating beef cattle will often need 22 to 33 grams of phosphorus per day in the current ration. With most forages, it is difficult for animals to ingest more than 13 to 16 grams per day. These animals will maintain normal serum phosphorus levels at the expense of bone. Therefore, supplementation of lactating beef cattle with phosphorus is important in order to get dams to return to estrus quickly. In contrast, lactating dairy cattle seldom have less than 50 grams of phosphorus in their ration. Therefore, adding extra phosphorus to lactating dairy rations may not benefit dairy cattle with a positive response in estrous detection as it does in beef cattle.

Beta-hydroxybutyrate is one of the three ketone bodies that is easy to measure in serum. This ketone is stable and the assay is extremely repeatable. Normal Beta-hydroxybutyrate values range from 0-10 mg/dL, with values greater than 10 mg/dL being consistent with clinical ketosis. Ketosis following an LDA often ranges from 15 to 35 mg/dL and values as high as 70 mg/dL can be seen. This test is an excellent one to perform if serum glucose or non-esterified fatty acids are not available.

Values for serum chemistry panels can vary slightly due to reagents, type of equipment, and methods by which samples are acquired, handled, and analyzed. Quality control begins at the time samples are drawn and continues throughout the shipping and handling process. Contact your diagnostic laboratory for specific normal values. If results are different than you expect, contact the laboratory as soon as possible as laboratories want to know if results are deviating from normal or expected values.

Shipping and Packaging of Samples

All diagnostic samples should be shipped for next day air delivery. Serum should be separated from cells and only serum mailed if serology or serum chemistry panels are to be performed. Fresh tissues should be packaged in individual bags for each specific tissue in order to prevent cross contamination. This is very important if microbiologic identification is to be attempted from fresh tissue.

Samples should be shipped on ice in a styrofoam container or ice chest. Cargo holds of airplanes in summer months are often 160 to 180 degrees Fahrenheit with no air conditioning. Samples not on ice will have tremendous microbiologic overgrowth if not refrigerated. During winter months, cargo holds are freezing while the airplanes are in the air. This will cause significant hemolysis if samples become frozen and may render them useless for many of the tests you may have requested, including serology and/or serum chemistry panels.

Finally, 16% of samples received in our laboratory do not include a complete address in order to return results to the practitioner. Paperwork, including a history of the clinical disease condition, history of the cows, and tests requested should be placed in a Zip-loc bag in order to prevent leakage of fluid and condensation from the ice packs, making the ink illegible.

If you have questions regarding tests needed, samples, shipping, etc., please contact your laboratory in order that the best diagnostics can be provided to you and your client.