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**Ovine Progressive Pneumonia
Control/Eradication Project in 4,000 Ewe Range Sheep Operation**

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Background:

Although pneumonia is one of the most visible clinical signs, the term Ovine Progressive Pneumonia (OPP) only addresses one aspect of this disease. In Europe the disease was first described and is known as Maedi-Visna (maedi meaning pneumonia, visna meaning nervous) and referred to as caused by the Maedi-Visna Virus (MVV; OPPV in the U.S.). The disease has 4 primary clinical forms: a chronic progressive pneumonia, a progressive mastitis, periarticular arthritis, and a nervous disorder (visna). In early literature the mammary involvement and arthritis were not linked to this virus. An article in: Vet. Res. 35 (2004) 257-274, reports on a conference of 16 European countries that collaborated in a review of the Small Ruminant Lentiviruses (SRLVs), which include Caprine Arthritis Encephalitis Virus (CAEV) in goats. (See page 3 for information on CAE.) Another article: "Transmission of small ruminant lentiviruses", Veterinary Microbiology 101 (2004) 199-208 states that "Cross-species infection of goats and sheep with MVV and CAEV respectively can be induced experimentally. Also, recent sequence comparisons of natural isolates of SRLV from sheep and goats have suggested that horizontal cross-species infection can occur naturally and is common. Therefore, to control SRLV infection in either species, SRLV positive animals must not be mixed with either sheep or goats."

In viewing a control or eradication program it is necessary to understand all aspects of the disease. This is difficult with OPPV and CAEV as there are many areas that are not fully understood. One of the most difficult aspects of controlling the disease is the delay of seroconversion, which may range from a few weeks to up to 2 years post-infection. This fact alone takes total dedication by the producer to a strict and rigorous long term plan. There are some grey areas in the modes of transmission that further complicate the picture. The most common and agreed upon modes of transmission are via the colostrum and milk to the newborn as well as horizontal transmission in adults. In adults, the secretions from the lungs of an infected sheep are carried out with droplets of moisture and either ingested or inhaled by a susceptible individual. Therefore, total separation of infected adults from susceptible adults is essential. This includes water source, feed source and equipment.

Other possible modes of transmission include semen and, though seen in only a small percentage of cases, intrauterine infection from an infected dam to the developing fetus. Properly washed embryos have been shown to be safe. Experimental infection of fetuses before day 60 gestation appears to cause resorption or abortion. However, in a current field study discussed later in this article, we have found little difference in the rate of conception between seropositive and seronegative ewes with approximately 98% of each group determined to be pregnant by ultrasound at 45-85 days of gestation. This may indicate that intrauterine infection with loss of fetuses may not be a major production loss.

... the brunt of the project is being funded by the ranch — they are convinced that OPP is an economically devastating disease.

The question each producer must explore is the cost benefit of control or eradication of the disease from the flock. The economic consequences are different with each production system. And studies of the effects of the disease on production are variable, perhaps because some of these studies have taken only one minor slice of the total and then concluded that the disease has little or no effect on production. Factors influencing economic losses are: slowly developing clinical disease caused by SRLV infection; and

NEW & RETURNING MEMBERS WELCOMED

James & Kim Baglien, Oregon (Suffolk)
 Edward Cabler, Washington (Icelandic)
 Elaine E. Clark, Maine (Icelandic)
 James R. Grajkowski, Wisconsin (Dorset, Crossbreds)
 Jane Killpack, Minnesota (Lincoln, Suffolk, Crossbreds)
 Randy & Jamie Loch, Pennsylvania (Teeswater x Clun Forest)
 Dan J. Lyons, DVM, Colorado (USDA Meat Inspector, retired)
 Janet W. McNally, Minnesota (Tamarack Prolific *BOORoola* GENE)
 Kerry Richardson, Illinois (Texel)
 Cheryl L. Schultz, Minnesota (Border Leicester)
 Dave & Cathie Shiff, Virginia (Border Leicester)
 Wendell Stine, Michigan (Crossbreds)
 Elayne Tingey, Idaho (Icelandic)
 Ann Tiplady, Vermont
 Mels van der Laan, Ontario (Texel)
 Diana Waibel, Oregon (Border Leicester)
 Robert Wallace, North Carolina (Cotswold)
 Mary Lou Williams, Pennsylvania (Border Leicester, Shetland, Leicester Longwool, Baby Doll Southdown, Romney)

Control/Eradication, continued from cover . . .

certain management practices which are conducive to transmission, such as crowding. Adding to the insidious nature of the disease, flocks with low prevalence of infection may appear to be free of symptoms. Further, only about 30% of infected animals go on to develop clinical disease.

Large Range-Flock Project:

In the late summer and fall of 2004 we started on a control/eradication program in a range sheep operation with 4,500 breeding ewes and 100 rams. All ewes and rams were blood tested for OPP using the agar gel immunodiffusion (AGID) test, and 68% of the ewes were found to be seropositive. With the exception of 1,100 yearlings that had not previously been bred (450 of which were eventually culled due to test result and/or poor breed characteristics), the ewes were in groups of approximately 650 with lambs at side. Blood samples were taken from the first two groups which were identified with numbered ear tags and numbered paint brands. The blood was drawn, the ewe's number recorded on the tube, and samples were sent to the laboratory. It took the lab 10 days to get the results back due to all the paper work. The test results were returned on a hard copy. Using this copy to identify and mark the seropositive ewes, we found that it required more time to decipher ear tag numbers and paint brands than it had taken us to collect the blood samples. Adding to this irritation was a greater than 10% human error in recording the numbers.

Following that disaster the balance of the ewes were identified with radio frequency identification (RFID) ear tags. We sampled over 2,400 ewes using the electronic tags. The process was fairly straight forward. We were using a set of corrals on the open plains with plenty of blue sky and breeze. A double-wide alleyway was divided by panels to keep the ewes in single file. One team first applied the RFID ear tags while three teams collected blood samples (one person to restrain the ewe and one person to bleed). A blood sample was collected; the electronic identification ear tag was scanned with a reader connected to a barcode printer, which produced a label; the label was then attached to the blood tube. No hieroglyphics were smudged onto a bloody label, and no verbal communication was required to

record the numbers. The laboratory scanned the samples into the computer and the results were automatically placed into a computer file. At the laboratory the data entry took one person only a couple of hours, and this time our results were back in 3 days. (Following reports were also returned in less than a week.)

We then returned to the same set of corrals with the electronic file downloaded into a laptop computer which was connected to the scanner. The ewes were placed in a double-wide alleyway without the divider (approximately 65 ewes per alley load). The EID was scanned; the test result appeared on the computer screen; the positives were identified by a paint brand and the ewes were immediately sorted into positive and negative groups. To read and identify 65 head took between 4-5 minutes, and with far less chance for human error. Does electronic identification pay?

Control and Eradication Plan

- Ewes are separated into positive and negative groups and are completely isolated (in this case by miles).
- The rams have been kept in separate groups following their testing in August 2004.
- Negative rams are used to breed negative ewes.
- Negative ewes will be tested again prior to lambing, with any that seroconvert being placed in the positive lambing group.
- Negative ewes will go through the shearing barn first.
- Lambing will be at separate facilities approximately 4 miles apart with no common use equipment or personnel.
- Replacement ewe lambs will be selected only from the negative group.
- The negative group will be tested again in the fall of 2005 prior to the breeding season.
- All replacement yearlings will be tested prior to entering the breeding program.

Continuing Observations and Data Collection

- Deaths in each group by age.
- Cause of death as determined by necropsy.
- Pounds of lamb produced per ewe in each group.
- Number of ewes in each group with insufficient milk requiring grafting.
- We will identify and record singles, twins and triplets to the ewe if possible.
(These observations were partially dependent on receiving adequate funding, which did not happen for this season. Perhaps the granting agency will look more favorably on next year's proposal.)

Hind Sight 20/20

- To determine the economic impact of OPP we realized that we should compare incidence of infection and production within each age group. Therefore we have been going back through the groups and placing the age of each ewe with her EID.
- In addition to number of lambs born to each ewe, we will attempt to record abortions and stillbirths.

Funding & Personnel:

We were originally doing an electronic ID study with this ranch as part of the scrapie study on identification, so some of the original EID was funded through that program. The necropsies are being conducted by the CSU necropsy department at no charge as they are using this for student training. *But the brunt of the project is being funded by the ranch — they are convinced that OPP is an economically devastating disease.* The team that is working on this includes: myself; Geri Parsons, a certified veterinary technician; Dr. Jay Parsons, an ag economist and our computer

guru; Dr. Anthony Knight, a former clinical science department chair; and Jeruesha Nichols, a certified veterinary technician.

March 10, 2005 Update:

Did we have a day yesterday! (*We are currently in the process of bleeding all of the negatives again before they go into their separate lambing quarters. The positives are down stream and down wind from the negatives by about 4 miles.*) The wind was a bit strong on the open plains so we worked inside of a couple of large barns. In the morning we had 299 to finish putting in RFID tags and drawing blood samples. Then we moved to another location and set up our double chutes. These ewes all had RFID tags from last fall and they were the last negative group we had to test. We recorded the ages (determined by original ear tag colors which are coded for the year of birth) on all of these at the same time we were drawing blood and did 816 in just under 4 hours. We had three teams of 2 taking blood and two herders pushing sheep. I was printing bar code labels which went on the tubes, while two others recorded ages on a second computer.

March 24, 2005:

Earlier this month 2,193 head of previously (October/November) negative ewes were bled and tested for OPP using the AGID. There were 206 positives (9.4%), and 1,987 (90.6%) were negative. Today the positive ewes were identified and separated from the negative group.

I will be retiring July 31, 2005 but will probably follow this project. Hopefully, by saving replacements only from the negative group, we can work out of the problem early — even if we have animals that seroconvert, once they are out of lambing camp they are in minimal contact — but I have advised the owner that this project may take 3-5 years.

The OPP Society looks forward to further updates from Dr. K, who plans to celebrate his retirement, and 75th birthday, with another long ride on his recumbent bicycle (last year's trip was Portland, OR to Missoula, MT).

BLEEDING YOUR OWN SHEEP — A GOOD IDEA?

As with many flock management questions, the best answer may be, "it all depends." Several years ago, OPP Society founders Jim Schultz and Bob Leder, DVM, produced a sheep bleeding video — available to members for \$15 — that many have found helpful. (One producer, after viewing the video, was able to sample more than 200 ewes without assistance.) The following is excerpted from literature packaged with the video:

"We do not want this video to become a divisive issue between producers and their local practitioners. . . . The OPP Society does not seek to promote independence from veterinarians, but rather cooperation and understanding. We suggest that you discuss your interest in learning this technique with your veterinarian, and even solicit his/her assistance on your first try. Most vets can appreciate the expense you have in your eradication efforts and will understand your situation. . . . Your vet will also help you to submit your blood samples to the diagnostic lab."

The needs and priorities of each flock will vary. Those hiring their vets to draw blood, and who have additional help available, report being able to process as many as 60 head per hour. On the other hand, some who collect the samples themselves use the savings to cover the cost of more frequent testing.

TESTING YOUR DAIRY GOAT HERD FOR CAPRINE ARTHRITIS ENCEPHALITIS (CAE)

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Dr. James Evermann, Professor of Infectious Diseases,
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What is CAE?

Caprine arthritis encephalitis (CAE) is a group of diseases caused by caprine arthritis encephalitis virus (CAEV). Diseases include encephalitis (infection of the brain) in kids, and arthritis in adult goats. Encephalitis usually shows up as a progressive paralysis. Eventually, kids are unable to stand. Signs of arthritis begin with swollen joints and pain on movement. The arthritis develops slowly until the goat is unable to move the affected joints. Other diseases caused by CAEV include mastitis or "hard bag", pneumonia and wasting. A close relative of CAEV, ovine progressive pneumonia virus (OPPV), causes similar diseases in sheep. Sheep commonly develop wasting and pneumonia. Arthritis is less common in this species than in goats.

CAEV and OPPV belong to the lentivirus group within the retrovirus family. An important feature of retroviruses is that their genetic material becomes incorporated into the DNA of the infected cell. Once animals are infected with retroviruses, like CAEV, they are permanently infected.

How do goats become infected with CAEV?

The primary means by which goats are infected with CAEV is through the ingestion of virus in the colostrum of infected does. Intrauterine transmission (from the infected doe to her fetuses) of CAEV occurs rarely. There is evidence that CAEV may be transmitted by direct contact with infected goats. This mode of transmission is still being investigated but may occur through ingestion of virus in saliva and feces-contaminated feed and water, or by inhalation of aerosolized virus. Since CAEV is present in blood cells, the virus can be transferred through blood contaminated instruments such as tattooers, needles, dehorers, etc.

Do goats develop an immune response to CAEV?

Yes, infected goats develop antibodies that specifically bind to the CAEV. However, the immune response does not clear the virus infection and the goat remains persistently infected with CAEV for life. The importance of the immune response to CAEV is that it allows us to detect infection. Individual animals may be infected for several months before antibodies can be detected.

Antibodies to CAEV are transferred to kids that nurse infected does. These antibodies do not protect the kids from infection and are an indication that the kids have probably been exposed to CAEV via colostrum.

Why should I test my goats?

Since there is no cure or vaccine for CAE, controlling the infection relies on removing infected goats. If your herd is not infected with CAEV, testing new introductions will aid in keeping the infection out of the herd. In addition to the loss of animals due to encephalitis and arthritis, CAE infections lead to decreased longevity of goats and decreased milk production. For the dairy herd, elimination of CAEV will increase productivity.

If you are a purebred or seedstock producer, it is to your advantage to sell CAEV-free goats. Your stock will gain a reputation for longevity, productivity and will not serve as a source of infection for other dairy goat herds.

. . . CAE, continued on next page

Testing for CAE, continued

What kinds of diagnostic tests are available?

CAEV infections can be detected in two ways. The first is by demonstrating the presence of antibodies to CAEV in goat serum. There are two diagnostic tests that are commonly used to tell if a goat has antibodies to CAEV, the enzyme linked immunosorbent assay (ELISA) and the agar gel immunodiffusion (AGID) test, and both are relatively inexpensive. The AGID takes 48 hours to complete and usually costs \$3.50 to \$7.50 per sample. There are several different ELISA techniques, the newest being a competitive assay (cELISA). This new cELISA test usually takes 48 to 72 hours and costs \$3.50 to \$7.00 per sample. Laboratory accession fees and/or out-of-state surcharges may also apply to both AGID and cELISA tests. These assays have been validated and licensed by USDA.

The second way to detect CAEV is by using a polymerase chain reaction (PCR) test. The PCR for CAEV detects the virus's genetic material (genome) in the white blood cells present in a sample of blood. The PCR test for CAEV is relatively more expensive at \$25 per sample.

What kind of samples will my veterinarian need to send to the diagnostic lab?

The AGID and ELISA tests are performed using serum separated from clotted blood. Your veterinarian will collect 5 cc of blood in red-topped blood collection tubes.

The PCR test requires whole, unclotted blood. Your veterinarian will collect 10 cc of blood in EDTA (purple-topped) blood collection tubes. This test is set up once a week and takes 3 to 5 days to complete.

Blood and serum should be refrigerated but not frozen, packed well to prevent breakage and sent to the lab by overnight mail.

Additional tips for diagnostic tests: If you are planning to test the goats prior to sale, show or export, call your diagnostic lab in advance to obtain their test schedule. Many labs only set up CAE tests once a week. Clear identification of each goat's sample by name or ID number is important.

What do test results mean?

The majority of CAEV infected goats will be positive by the AGID and ELISA tests and positive on the PCR test. Since CAEV infection is lifelong, goats that are positive should be removed from the herd or segregated as they are a potential source of CAEV infection for other animals.

Some infected goats are antibody negative and PCR positive. These animals are infected with CAEV, but have not yet developed antibodies. Some individuals may intermittently become antibody negative.

Some infected goats will be antibody positive and PCR negative. These goats probably have CAEV infected cells in lymph nodes, bone marrow or nervous tissue like the brain. The CAEV in these organs stimulates the immune system to make antibodies. At the time of sampling, however, there may not be any CAEV present in the blood sample and therefore, the PCR test will be negative.

If antibody or PCR positive goats are found, the herd should be considered CAEV infected. Further testing and control measures are needed to eliminate the infection from the herd.

Uninfected goats will be antibody negative and PCR negative. If negative animals are found in an infected herd, however, they will need to be retested over several months (60-90 days) after separation from CAEV positive goats. Re-testing is needed because of the sometimes lengthy interval between infection and the appearance of antibodies or virus in blood samples.

How can CAEV be controlled?

Since the main source of CAEV is the colostrum of infected does, positive does should be removed from the herd. If positive does are retained, then their kids should be removed from their dam at birth and fed colostrum from uninfected does or colostrum that has been pasteurized to inactivate any virus present.

Since the CAEV infection can also be transmitted from CAEV positive goats by other means, goats that have been tested and found positive for CAEV should be well separated from negative goats. Wire fences are not adequate barriers to virus spread; usual rule of thumb is to separate animals by a walkway. Milking utensils, waterers, feed tubs, tattooing equipment, or needles used in positive goats should not be used in negative groups.

Some of my goats are positive for CAEV but are completely healthy. Why?

Most CAE-infected goats will appear healthy. Observable disease only develops in approximately 10-15% of infected goats, and some symptoms like arthritis may take years to develop.

Can my goats become infected with CAE from contact with sheep?

Sheep become infected with a retrovirus similar to CAEV. The sheep retrovirus most commonly causes ovine progressive pneumonia (OPP) or maedi, and visna (encephalitis). OPPV and CAEV are about 70% similar in some of their genes. Experimentally, and naturally, OPPV infects kids causing arthritis and pneumonia, and CAEV infects and causes pneumonia in lambs.

The diagnostic tests described may not differentiate between CAEV and OPPV. Contact the laboratory that you are sending samples to for further information.

Can humans become infected with CAEV?

No, humans cannot become infected with CAEV.

The OPP Society expresses our appreciation to the authors for allowing us to print this updated article.

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A new resource exclusively for OPP Society members. The more the merrier! It's easy to join and all previous postings are archived. To learn more contact OPP Society director Mary Gloster.