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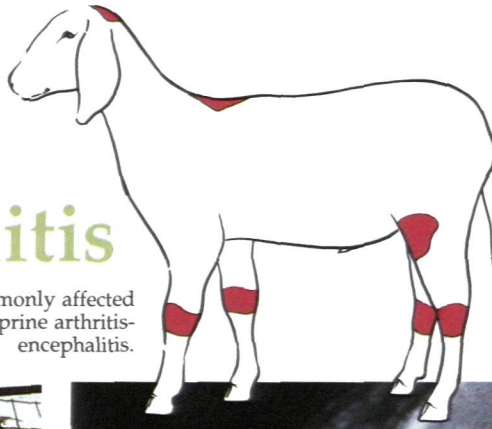
Control of caprine arthritis-encephalitis in goats



Joints commonly affected by caprine arthritis-encephalitis.

By Trevor Ellis, Senior Veterinary Virologist, Animal Health Laboratories

Caprine arthritis-encephalitis, CAE for short, is the name given to a disease complex in goats, one form of which, 'big knee', has been recognized in dairy goats in Australia since the late 1950s. There are many forms of this progressive disease, all of which result in premature culling in milking goats.

Studies conducted in the U.S.A. and in Western Australia have identified an infectious cause of CAE and its prevalence in Australia has been reduced considerably by comprehensive testing and management practices developed by the Western Australian Department of Agriculture, and described in this article.

To May 1988, of the 3,110 goats tested for CAE virus antibodies, only 127 goats have tested as positive, with over 90 per cent of these being dairy goats. The industry has taken major steps to control CAE in Western Australian goats in the past four years.

Australian goat herds must be free of CAE to participate in the lucrative export trade of top quality Angora goats to New Zealand.

There were also fears that similarities between the CAE virus and a viral disease of sheep not present in Australia, maedi visna, could lead to that disease establishing here, especially as many farmers are now running both sheep and goats.

Possible link with sheep

One form of the disease, progressive pneumonia, was identified in a middle-aged dairy goat in Western Australia in 1977 by Dr W. Robinson, a veterinary pathologist at Murdoch University. He was impressed by the similarity of this disease to maedi-visna, which is found in many sheep-raising areas of the world. Because of the apparent similarity of the diseases, Dr Robinson and V.W. Smith, J. Dickson and W. Coackley, of the Department of Agriculture's Animal Health Laboratories, started collaborative studies to determine if the progressive pneumonia in goats was caused by the same virus that caused maedi-visna and if it could be spread to sheep.

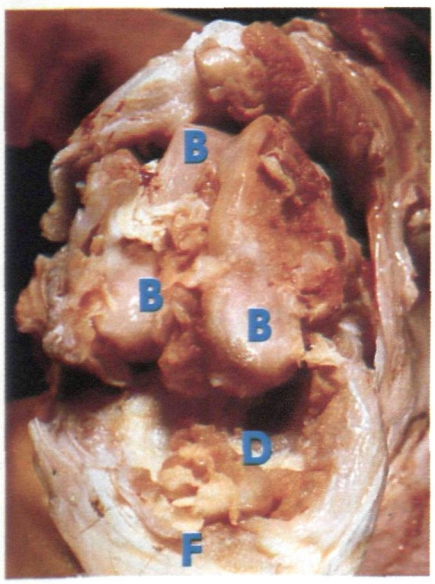
What is CAE?

As the name caprine arthritis-encephalitis implies, one common form of the disease in goats is an arthritis, commonly found in the carpal joint of the goat. Similar changes are present in several other joints in affected goats. The arthritis mostly affects tissues around the joints, with limited damage to the joint surfaces, and in this regard it is similar to rheumatoid arthritis in humans.

Left: An adult goat severely affected by CAE virus. Symptoms include swollen joints ("big knees"), loss of condition and a shaggy coat.

Above: X-ray of the carpal joint ("knee") of a goat with CAE and showing the marked calcification in the thickened fibrous tissue around the affected joint.

A virus-infected goat kid with leucoencephalomyelitis. The kid is paralysed in the hind quarters but the forelegs are sound and the kid is bright and alert.



Stifle joint of a goat with severe CAE. Fibrous tissue around the joint (F) has thickend markedly and there is fibrin discharge (D) within the joint. The bony surfaces of the joint (B) are not badly affected.

Another less common form of the disease is a chronic progressive pneumonia that eventually causes such thickening of the lungs that goats can only breathe with great difficulty. Both of these forms are seen in older goats and may be associated with a mild inapparent encephalitis.

Goats less than six months old can have a form of the disease called viral leucoencephalomyelitis. The white matter of the brain and the spinal cord are affected, resulting in a characteristic leg weakness or paralysis.

The control of CAE in dairy goat herds has had a positive spin-off with the disappearance of another worrying associated syndrome called 'hard udder', in which the gland becomes firm and doesn't start normal lactation after kidding.

Goats do not die suddenly from any form of CAE, but all forms of the disease are gradually progressive, eventually resulting in premature death of the animals, often at a time of peak productivity.

Symptoms of the disease develop mostly in all breeds of dairy goats. It develops readily in Angora and feral goats infected artificially, but has rarely been seen naturally in Angora goats, and then only in the eastern States.

Causes of CAE

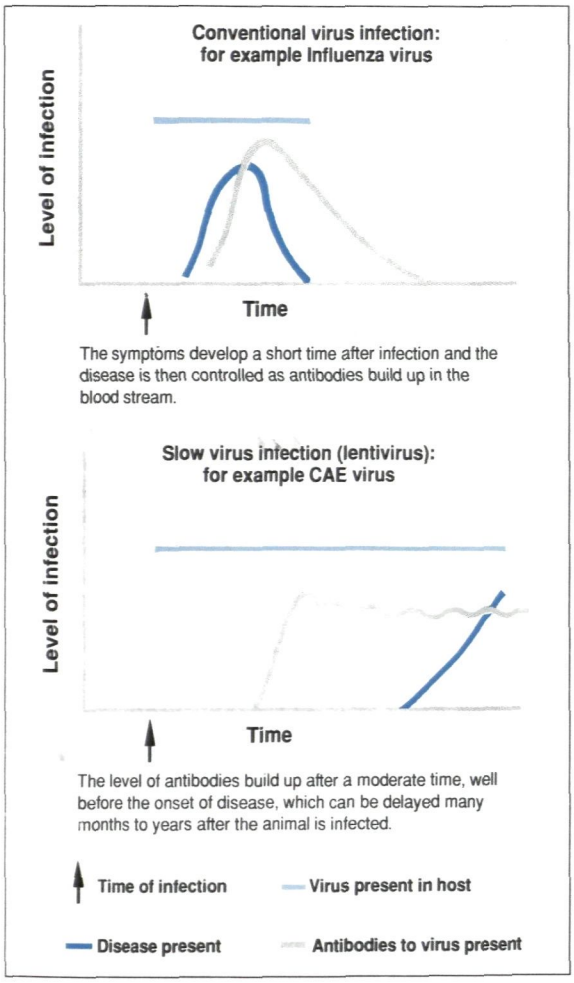
CAE is caused by a specific type of virus called a lentivirus which is in the same sub-family of viruses to those that cause maedi-visna, the horse disease equine infectious anaemia, and the human disease acquired immunodeficiency syndrome. However the only close similarity is that between the CAE virus and maedi-visna virus.

The viral cause of CAE was first reported in 1980 and the link between the various disease forms was confirmed soon after.

Lentiviruses have a characteristic disease pattern, being known as slow virus diseases (see the figure). Compared with a virus disease such as influenza, where the symptoms develop a short time after infection and the disease is then controlled as antibodies build up in the bloodstream, the level of antibodies against a slow virus disease builds up after a moderate time, well before the onset of disease which can be delayed many months to years after the animal is infected.

Once a goat is infected with CAE virus it remains infected for life. Certain white blood cells are persistently infected despite the relatively constant levels of antibodies which are usually present four to eight weeks after the initial infection.

Once the cause of the CAE infection was known research workers at Murdoch University and the Department of Agriculture studied how the virus was spread. It is primarily spread from the doe to the kid by colostrum or in the milk, although other close contact transmission between goats occurs at a lower rate.



Comparison of conventional and slow virus infection and the build up of antibodies.

Why control the disease?

There is no cure for a goat infected with the CAE virus and some goats will develop one or more forms of the disease. This was important in the dairy goat industry in Western Australia as the infection was present at particularly high levels and goats were generally affected at the time they would normally approach peak milk production (Tables 1 and 2). Therefore the dairy goat industry had to control CAE for commercial as well as for animal welfare reasons.

A second reason for controlling CAE is the marked similarity between CAE virus and the virus that causes maedi-visna in sheep. Experimentally the CAE virus will infect sheep and produce antibodies. The antibodies produced react identically in tests to antibodies to the maedi-visna virus, so infected sheep would be positive for a maedi-visna test. The Australian sheep flock is free of maedi-visna, but if sheep became infected with CAE virus Australia could lose this disease-free status.

Supervised delivery of a goat kid to ensure the kid does not suckle and the doe does not lick the kid, all part of the colostrum deprivation and segregation programme to control CAE.

Table 1. Prevalence of CAE-virus-infected goats in Western Australia before accreditation scheme

Type	Year	Goats positive	Herds positive
Dairy	1982	45/87† (52.3%)	7/7† (100%)
	1983	46/121 (38%)	7/11 (63.6%)
	1984	75/167 (44.9%)	9/10 (90%)
Angora	1982	2/43 (.7%)	1/3 (33.3%)
	1984	17/2415 (0.7%)	6/11 (54.5%)
	1985	30/2897 (1.03%)	11/27 (40.7%)
Feral	1982	0/30	0/3*
	1985	0/509	0/3*

† Total number tested that year. The first figure is the number of goats or herds that tested positive.
* Abattoir lines of goats from pastoral area

Many sheep producers are also considering running goats for fibre and meat production, so we need to control the disease in goats. Fortunately, as Table 2 shows, there is a low prevalence of CAE virus infection in Australia in Angora and Cashmere goats, and none has been detected in feral goats.

The presence of CAE in Australian Angoras also jeopardized our export trade of top quality Angora goats to New Zealand. In an attempt to diversify its primary production base, the New Zealand Government provided large tax incentives for the purchase of top quality, CAE-virus-free Angora goats from Australia. Both the imported goats and the herd of origin had to be free of the virus.

The top prices offered for Angora goats stimulated the Angora goat industry to participate in the control programme for CAE.

Control programmes

Our research showed that if we could break the doe-to-kid cycle of virus transmission, it would be possible to build up a disease-free herd from an infected herd. The cycle was broken by supervising deliveries at birth and immediately removing kids from the doe so that they could not suck goat colostrum or milk. Segregated kids were then reared on cow's colostrum and cow's milk or cow's milk replacers. These goats were segregated from the infected herd, even at milking time, and a CAE-free herd was built up which gradually replaced the infected milking herd until all infected goats were culled. By avoiding contact with infected goats both on and off the property, the herd could be maintained free of CAE.

We monitored the CAE status of the herds by repeat blood testing for antibodies to the virus, as infected goats have persistent levels of antibodies. These studies indicated that it should also be possible, by repeat blood testing and culling of goats that tested positive to the virus, to develop a CAE-free herd without the need to remove kids from does at birth, to artificially rear them and to maintain strict segregation. The latter procedure was impractical for commercial Angora goat herds.

Dairy goats being machine-milked in a modern goat dairy.

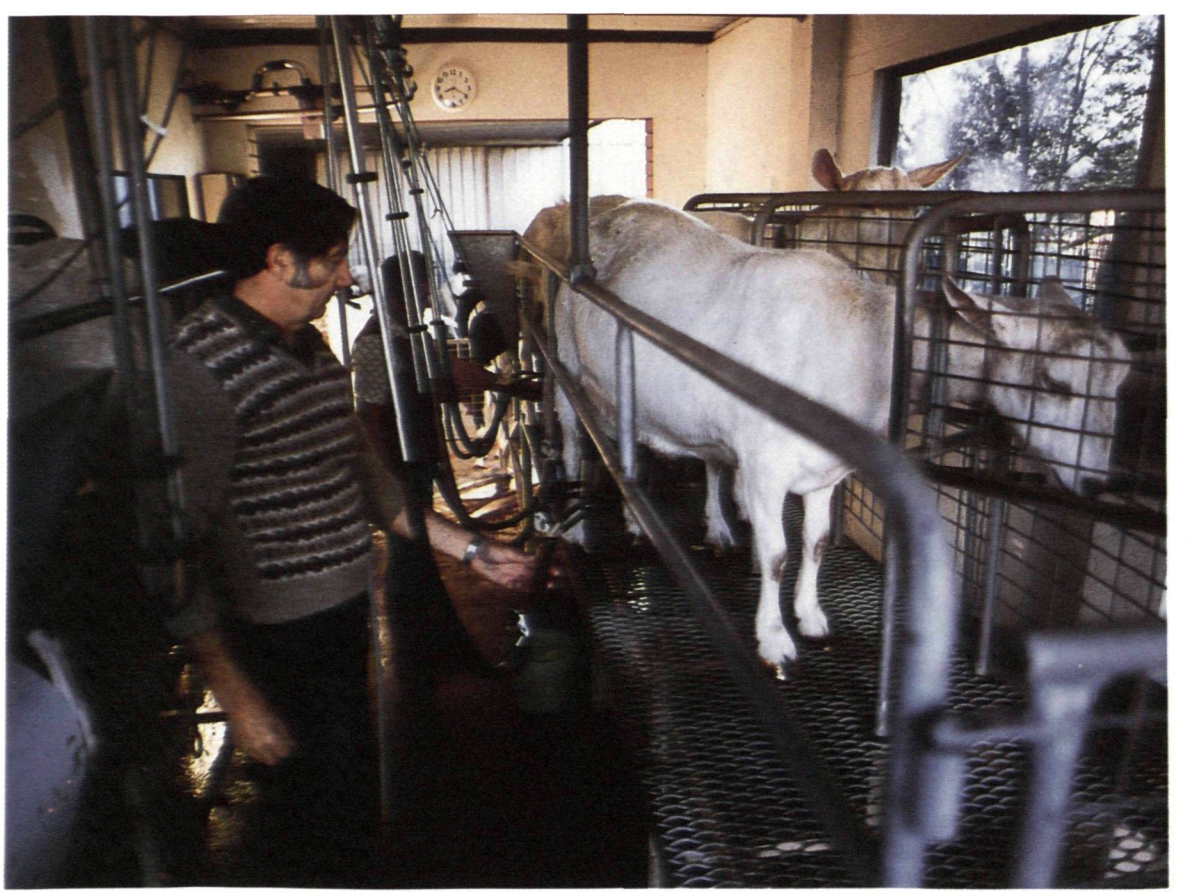


Table 2. Reported prevalence of CAE virus in other Australian States

State positive	Year	Type	Goats positive	% Herds
Tasmania	1983	Dairy	223/492# (45.3%)	
		Angora	9/217 (4.1%)	46
		Cashmere	1/302 (0.3%)	
Victoria/NSW	1984	N.S.	219*/775 (28.2%)	N.S.
New South Wales	1985	Dairy	773/2458 (31.4%)	
		Angora	11/230 (4.8%)	82
		Cashmere	1/4 (25%)	
South Australia	1986	Dairy	240/617 (38.9%)	71.9
		Angora	25/17000 (0.15%)	8.0
		Cashmere	0/1120	0
		Feral plus crossbreds	19†/3113 (0.6%)	N.S.

N.S. Not stated in the report
Total number of goats tested
* Of the 219 positive reactors, only 2 were Angora goats
† The 19 positives were all crossbred dairy goats

Although most infected goats take between four and eight weeks to develop antibodies to the virus, this time can be delayed for as long as 20 weeks. Testing the herds repeatedly at six-monthly intervals provided the best chance of detecting all infected goats. Herds giving negative results for all goats for two consecutive tests, and having had no contact with other goats of unknown status in that time, are considered free of the virus.

This criterion of herd freedom became the basis of New Zealand's quarantine testing requirements for herd of origin for imported Angora goats from Australia. The criteria also formed the basis for CAE-free Accreditation Schemes established in New Zealand in 1984, in Western Australia and Tasmania in 1985, in New South Wales in 1986 and in Queensland in 1987.

Western Australian scheme

In Western Australia, the Accreditation Scheme is a voluntary one administered by the Department of Agriculture's Division of Animal Health, with laboratory tests performed in our virology laboratory for a fee. The initial test was a gel diffusion test on submitted blood samples. In 1987 we introduced an ELISA test for routine testing of submitted blood samples. This newly developed test is slightly more sensitive than the gel diffusion test and costs less.

Since the CAE-testing of Angora goat herds to meet export requirements to New Zealand and the CAE-free Accreditation Scheme started in late 1984, the Department has tested 47,334 goats in Western Australia. Up to the end of May 1988, 188 herds have applied for entry into the Accreditation Scheme and 111 herds have been accredited. Seventeen herds have been tested negative once, 18 herds have not been tested, and 42 accredited herds did not renew accreditation.

Although the demand for Angora goats from New Zealand buyers has fallen markedly, many Angora herds that have attained CAE-free Accreditation status have continued to maintain it. Most dairy goat herds in this State are accredited or are in the process of becoming accredited.