

Incidence of Ovine Progressive Pneumonia in the North Dakota State University Sheep Flocks, Determined by Agar-gel Immunodiffusion

T. W. Molitor, M. R. Light; I. A. Schipper

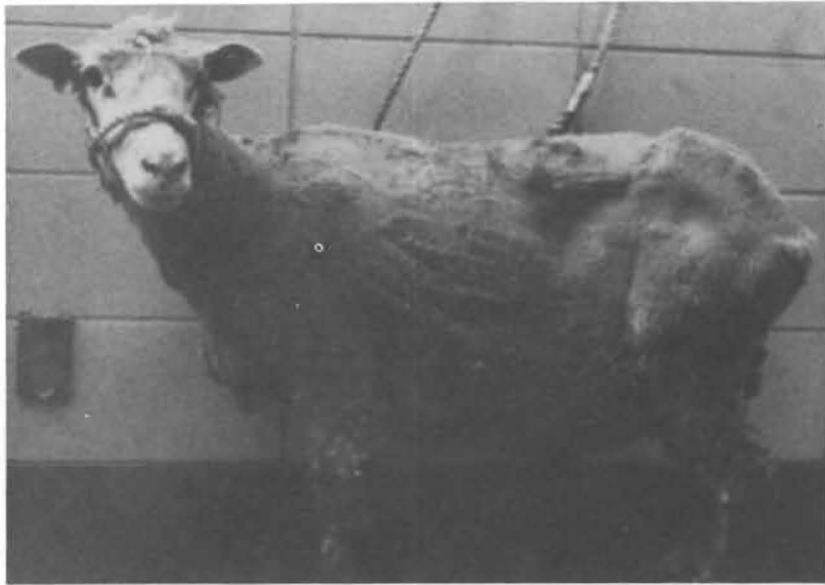


Figure 1

Introduction

Ovine progressive pneumonia (OPP) or Lunger's disease is a major disease of sheep flocks. Although the disease problem has been recognized for many years in all parts of the sheep-raising world, satisfactory approaches to diagnosis of infected sheep and disease prevention have not been available until recently.

In 1968, the causative agent of OPP, progressive pneumonia virus (PPV), was first isolated in the United States (1). Recently, (2, 3) a serological test, agar-gel immunodiffusion (AGID) was applied for the detection of precipitating antibodies against PPV in sheep sera. Detection of precipitating antibodies in sheep sera (or colostrum-whey) against PPV is indicative of infection but antibodies apparently play no role in fighting infection. By the time antibodies are produced, the virus is residing intracellularly and unattainable to antibodies. A virus similar to PPV, visna, has also been reported to undergo mutation once inside the host, resulting in an antigenically altered particle (4).

OPP initiates as a moderate dry cough and occasionally is accompanied by slight nasal discharge. The symptoms progress until the animal has a serious problem in breathing. Body temperature remains normal unless other infectious

agents accompany OPP. The appetite is unaffected but there is a slow progressive weight loss terminating in an emaciated animal. The wool, with advanced infection, lacks luster and grows poorly. The clinical signs appear 1-4 years after the animal is exposed to the causative virus and last over a 2-8 month period. Secondary bacterial infection often accompanies OPP and hastens the death of the sheep.

OPP primarily affects adult ewes but rams are occasionally involved. Sheep over two years appear to be more susceptible to OPP, but it has been reported in younger animals. The objective of this investigation was to characterize the extent of OPP in a naturally infected sheep flock by AGID, determine whether differences in age or breed of the sheep influences the susceptibility to OPP and to attempt to establish an OPP free flock from an infected source flock.

Molitor is laboratory technician and Dr. Schipper is professor, Department of Veterinary Science; Light is professor, Department of Animal Science.

Methods

PPV was initially isolated from the lungs of a Border Leicester ewe. PPV was propagated on ovine tracheal (windpipe) cell cultures. Other cell cultures including ovine lung, ovine choroid plexus and bovine choroid plexus cell strains were previously evaluated for the ability to support PPV infection in vitro. Ovine tracheal cells were superior to the other cell strains and therefore were used for the production of PPV antigen for AGID. The procedure for production of soluble antigen used in AGID is as follows; PPV-infected cell culture fluids were collected, pooled, inactivated at 56°C for 30 min., centrifuged at low speed to remove cellular debris and concentrated 100-fold.

In AGID, sera and a specific antigen diffuse through a solidified gel matrix. Antigen was placed in the center well with control and test sera placed in a hexagonal pattern around the periphery of the center wells. If any of the sera contained precipitating antibodies against PPV, a line of precipitation was visible (Figure 2).

University flocks consisting of six pure breeds were utilized in this experiment. Total flock numbers in the combined NDSU sheep barn flock (diseased) have varied between 250 and 300 adult ewes. OPP has been clinically diagnosed in the flock for at least 20 years. There were 30 sheep deaths in this flock attributed to OPP for the years 1976-1979. All breeds are similarly managed and intermingle except when in breeding groups. Another flock, the Animal Research Center flock (non-diseased), consists of four pure breeds totaling approximately 100 animals. Separation of sheep into two flocks was originally accomplished by removing lambs immediately after delivery and using formula feeding.

Blood samples were obtained from all sheep housed at the Animal Research Center (ARC) and the NDSU sheep barn. Sera was collected from all blood samples and tested for precipitating antibodies by AGID. All sheep were bled via the jugular vein.

Results and Discussion

The entire sheep population at NDSU was surveyed for precipitating antibodies against PPV by AGID. All 100 sera from sheep at the ARC were negative. Since separation

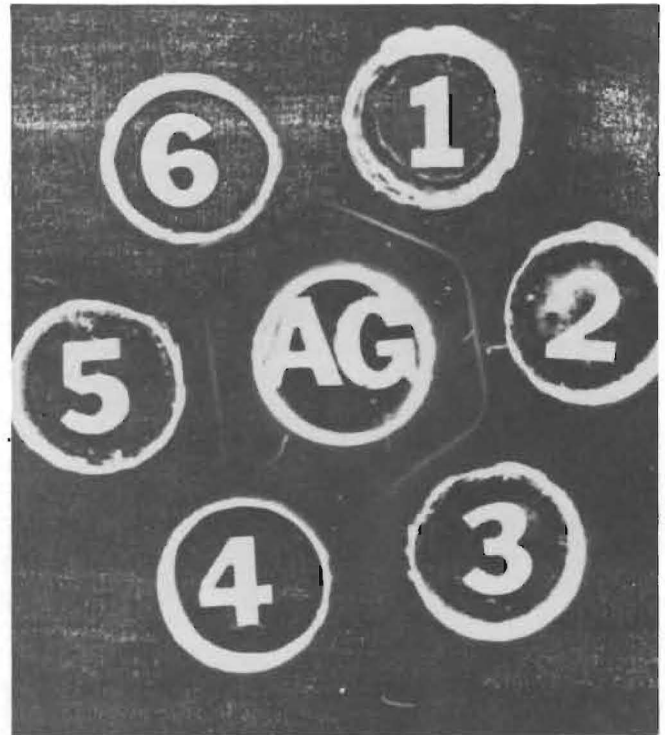


Figure 2

of lambs five years ago, no evidence of OPP has appeared in the ARC flock either by clinical signs or presence of precipitating antibodies in the sheep sera.

Of the 265 sera collected from sheep housed at the NDSU sheep barn, 88 were positive and 177 were negative by AGID. These results included animals from five pure breeds which ranged from 1 to 7 years in age (Table 1). Newborn lambs were not tested.

Some breeds had higher proportions of positive sera than others; positive sera were most frequent in North Country Cheviots (57%) and least frequent in Hampshires (21%). Considering the entire flock, irrespective of breed, 33% of the animals had positive sera. In general, the proportion of sheep with positive sera also increased with the age of the sheep. Only 20% of the yearlings had positive sera, whereas 67% of the 7-year-olds were positive.

The high incidence of OPP has been recently documented in range flocks by researchers in Idaho (5). They

Table 1. Agar-gel Immunodiffusion Analysis of Serum Samples. Foundation Flock

Breed	Total No. tested	Age (years)							Total
		1	2	3	4	5	6	7	
Suffolk	90	10/37*	3/13	3/15	3/8	2/5	4/11	1/1	26/90
Hampshire	62	1/19	1/10	3/14	1/3	6/12	1/4	—	13/62
Rambouillet	43	3/11	3/12	4/9	3/4	2/3	0/2	1/2	16/43
North Country									
Cheviot	30	2/7	2/8	5/6	3/3	3/4	2/2	—	17/30
Columbia	40	1/11	2/9	4/6	1/3	3/5	5/6	—	16/40
	265	17/85	11/52	19/50	11/21	16/29	12/25	2/3	88/265

* Number positive/number tested.

reported an incidence of 58% in all ages and 90% in cull ewes with similar breed and age susceptibilities as found in this study.

In some breeds of sheep precipitating antibodies may be present for years without the animal succumbing to the disease. Although 21% of the Hampshire sheep in the flock had precipitating antibodies against PPV, only two died from OPP during the past two and one-half years. In contrast, few Border Leicester sheep, which were not included in this survey because OPP has depleted Border Leicester numbers down to three in the entire flock, escape OPP for any appreciable time. Genetic predisposition must be an important factor in the susceptibility of a certain breed of sheep to OPP infection. Age must also play an important role in the incidence of OPP. The older the animal and the longer it remains in the flock, the greater the chance for exposure. The high incidence of OPP in sheep flock presents a major problem to the sheep

producers. Additional knowledge into breed and age susceptibilities to OPP may lead to a better understanding of this disease and possible means of control.

Summary

The incidence of ovine progressive pneumonia by breed and age in a naturally infected flock was determined. Breeds varied in susceptibility to ovine progressive pneumonia from the least susceptible - Hampshire, to the most susceptible - North Country Cheviot. Susceptibility also varied with the age of the sheep. As the animal increased in age so did the susceptibility to ovine progressive pneumonia.

An ovine progressive pneumonia free flock was established five years ago. This flock has remained free of infection throughout the five years.

LITERATURE CITED

1. Kennedy, R. C., E. M. Eklund, C. Lopez, and W. J. Hadlow. 1969. Isolation of a virus from the lungs of Montana sheep affected with progressive pneumonia. *Virology* 35:483-484.
2. Cutlip, R. C., T. A. Jackson, and G. A. Laird. 1977. Immunodiffusion test for ovine progressive pneumonia. *Am. J. Vet. Res.* 38:1081-1084.
3. Molitor, T. W., M. R. Light, D. L. Berryhill, and I. A. Schipper. 1979. Evaluation of the agar-gel immunodiffusion test for the detection of precipitating antibodies against progressive pneumonia of sheep. *Can. J. Comp. Med.* Accepted for publication.
4. Narayan, O., D. E. Griffen, and J. Chase. 1977. Antigenic shift of visna in persistently infected sheep. *Science* 197:276-278.
5. Gates, N. L., L. D. Winward, J. R. Gorham, and D. T. Shen. Serological survey of prevalence of ovine progressive pneumonia in Idaho range sheep. 1978. *JAVMA* 173:1580-1585.