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Content

Summary

None of the 3,123 investigated sheep flocks in the surveillance programme were diagnosed with maedi in 2021. Of 52 tested goat herds, two herds were diagnosed with caprine arthritis-encephalitis (CAE).

Introduction

Small ruminant lentivirus (SRLV) comprise the maedi-visna virus (MVV) and the caprine arthritis-encephalitis virus (CAEV), which are closely related. Maedi-visna virus mainly infects sheep, while CAEV mainly infects goats, although cross-infections between the two species do occur.

Maedi is a progressive viral pneumonia in sheep first described in Iceland in 1939 (1). The disease occurs in several European countries as well as in other continents. The disease visna is a neuropathogenic manifestation of the infection (1, 2).

Caprine arthritis-encephalitis (CAE) causes emaciation, arthritis, encephalitis and sometimes mastitis and pneumonia in goats. Sheep may be infected and produce antibodies against CAEV, but usually show no clinical signs of disease.

Maedi-visna and CAE are classified as list 2 diseases in Norway and are notifiable to the World Organisation for Animal Health (WOAH). In Norway, maedi was officially reported for the first time in 1972 (3).

In November 2002 and January 2003, post-mortem examinations of lungs from two diseased sheep from two different farms in the former Nord-Trøndelag county showed histopathological changes consistent with maedi. During the following investigations more than 15,000 sheep in 300 flocks were serologically examined for maedi-visna infection, and approximately 50 flocks were found to be seropositive (4, 5). The outbreak demonstrated the need for a nationwide surveillance programme, and up to 2018 no new cases of maedi were detected (4, 6)

The Norwegian Food Safety Authority (NFSA) is responsible for carrying out the programme. The samples are collected by inspectors from the NFSA, while the Norwegian Veterinary Institute (NVI) is in charge of planning the programme, performing the analyses and reporting the results.

In 2019, the surveillance programme detected a new case of maedi in a farm in Trøndelag county. Contacts to this farm were traced, and an outbreak zone was established in Northern Trøndelag, where all sheep farms were monitored by serology. A total of nine herds was diagnosed with maedi in the outbreak (7).

An overview of the number of new infected flocks registered with maedi each year up to and including 2021 is given in Figure 1.

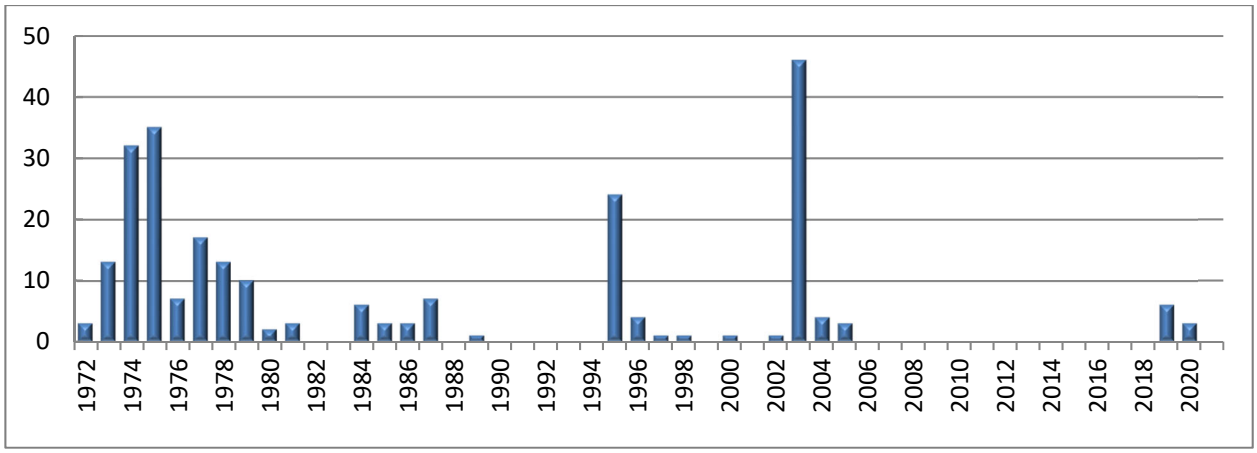

***Figure 1**: The number of new flocks infected with maedi from 1972 and onwards. The bars for 2003 – 2005 show both seropositive flocks detected through the investigations after the outbreak in the former Nord-Trøndelag county and seropositive flocks identified in the programme. The rise in 2019 represents a new maedi outbreak in Trøndelag.*

Before 2001, CAE was widespread in the Norwegian dairy goat population. The dairy organisation (TINE) and the Norwegian Goat Health Services have conducted an eradication programme named "Healthier goats", targeting caprine arthritis encephalitis, caseous lymphadenitis and paratuberculosis. The programme started in 2001, and in total 612 goat herds were included in the programme from 2001 to 2014 (8). In 2018, the goat population was included in the surveillance programme for SRLV.

Aims

The aims of the surveillance programme for small ruminant lentivirus infections are to document the status for MVV and CAEV infections in sheep and goats in Norway and to identify infected flocks for disease control.

Materials and methods

The surveillance programme is based on serological examination for SRLV in both sheep and goats.

The plan for 2021, was to collect 9,000 blood samples from sheep at slaughter. Representative numbers of animals were sampled at 20 larger abattoirs, from various parts of Norway. A maximum of five animals (>2.5 years old) were to be sampled per herd any given day. The

preferred sampling period was from January to March, but a proportion of the animals were sampled from August to December. In addition, meat inspectors at the abattoirs were asked to monitor sheep and especially their lungs for detection of suspicious cases consistent with maedi.
In addition, 60 goat herds were randomly selected for sampling. In goat herds of less than 30 animals, all animals (>6 months old) were sampled. In herds of 30 to 100, 100 to 200, and more than 200 animals, samples from 30, 35, and 40 animals were sampled, respectively. The preferred sampling period was from January to March, but a proportion of the animals were sampled from September to December.

Serum samples were examined for antibodies against SRLV with ID Screen® MVV / CAEV Indirect ELISA (IDvet, Grabels, France) for initial screening. Samples with inconclusive or positive ELISA results were re-tested in duplicates with ID Screen® MVV / CAEV Indirect ELISA (IDvet). If samples were inconclusive or positive, samples were further tested in duplicates with ELISA IDEXX MVV/CAEV p28 Ab Verification Test (IDEXX Laboratories, Maine, USA).

In case of positive or inconclusive results in IDEXX ELISA on a sample taken from a sheep at slaughter, follow up sampling was done on selected animals in the flock of origin as described previously (9).

Samples with doubtful or positive status in confirmatory tests were reported, and new blood samples from the suspected animals or herd were requested and tested.

Results

Sheep

A total of 9,094 sheep samples were received in the programme in 2021. Five samples with unknown origin were excluded, leaving 9,089 samples from 3,123 sheep flocks for analysis (Table 1). This was approximately 23.3% of the total number of Norwegian sheep flocks.

In 2021 all sheep samples were concluded to be negative for antibodies against SRLV. A total of 50 samples (0.55%) from 49 flocks tested positive with the IDvet assay, whereas the IDEXX ELISA gave negative results for all these samples.

In order to increase the sensitivity of the testing regime, eight flocks in four counties with positive results in the screening assay and SP% ≥ 20% in the IDEXX Verification assay, were followed-up by sampling according to the sampling protocol given for goats in the Materials and Methods section. All 231 additionally sampled animals from these eight farms tested negative, thus maedi was not suspected in these farms.

No lungs from suspected cases of maedi were submitted from slaughterhouses for pathological examination and PCR for SRLV in 2021.

Table 1: *The results and total number of sheep flocks tested for maedi within the frame of the Norwegian surveillance programme for SRLV 2003-2021.*

Year	Total no. of flocks*	No. of flocks analysed	No. of animals analysed	Average no. of animals analysed per flock	No. of positive flocks
2003	18 400	456**	13 951	30.6	1
2004	17 439	1 230	36 911	30.0	1
2005	16 500	940	29 248	31.1	2
2006	15 800	911	27 846	30.6	0
2007	15 400	1 004	29 633	29.5	0
2008	15 059	783	23 235	29.7	0
2009	14 800	417	12 198	29.3	0
2010	14 800	188	5 697	60.6	0
2011	14 500	467	13 628	29.2	0
2012	14 300	479	14 043	29.3	0
2013	14 242	468	13 550	29.0	0
2014	14 218	3 506	9 771	2.8	0
2015	14 425	3 357	9 442	2.8	0
2016	14 561	3 504	9 858	2.8	0
2017	14 463	3 447	9 041	2.6	0
2018	14 337	3 282	8 685	2.6	0
2019	13 693	3 264	8 993	2.6	1
2020	13 506	2 927	8 701	3.0	0
2021	13 389	3 123	9 089	2.9	0

* Based on data from the register of production subsidies as of 31st of July the respective year until 2017. Thereafter, data from 1st of March was used.
** Sampling period: 20th of November to 31st of December.

Goats

A total of 1,540 samples from 52 goat herds were received and tested for antibodies against CAEV (Table 2). This was approximately 3.8% of Norwegian goat herds.

Of the samples, 1,519 samples tested negative, one animal tested inconclusive, and 20 individuals tested positive for SRLV with the IDvet assay. Of the latter 20 positive samples, 13 samples from eleven herds gave negative results with the IDEXX ELISA.

The goat with the inconclusive result was re-sampled two months later. The new sample also tested inconclusively in the IDEXX ELISA, but based on an assessment of the cross reactivity in the control well of the ELISA, it was concluded that no further follow up was needed in this herd.

The results of the other positive seven samples, originating from two herds, were confirmed positive with the IDEXX ELISA. Thus, in total, two goat herds, one milk goat herd and one meat goat herd, were concluded to be positive for CAEV in the surveillance programme.

Tabell 2: *The results and total number of goat herds within the frame of the Norwegian surveillance programme for small ruminant lentivirus 2018-2021.*

Year	Total no. of herds*	No. of herds analysed	No. of animals analysed	Average no. of animals analysed per herd	No. of positive herds
2018	1 246	61	1 663	27.2	1
2019	1 209	58	1 751	30.2	1
2020	1 270	50	1 443	28.9	0
2021	1 359	52	1 540	29.6	2

* Based on data from the register of production subsidies as of 1st of March the respective year.

Suspicion of CAE was raised in one goat herd based on serum sample testing at the dairy organisation (TINE) laboratory in Molde, which is not part of the surveillance programme run by the NFSA. The suspicion was confirmed by testing new samples from the same animals at NVI.

Also, one male goat from a hobby herd with suspicion of CAE was submitted to NVI for autopsy, and diagnosed with CAE.

Finally, one more herd that had been sampled due to clinical suspicion of CAE, as well as two contact herds, were all concluded to be positive for CAE in 2021.

Thus, in addition to the two herds detected by the surveillance programme, six more goat herds were concluded to be infected with CAEV.

Discussion

During the years 2003-2008, ram circles and their flocks registered as members of The Norwegian Association of Sheep and Goat Farmers constituted the target population for the programme. Approximately 90% of the Norwegian sheep flocks participating in ram circles were screened for antibodies against MVV during 2003 to 2005. These herds were retested during 2006 to 2008. In 2009, breeding flocks of other sheep breeds than those represented by The Norwegian Sheep and Goat Breeders Association were selected for sampling. During 2010-2013, randomly selected sheep flocks were sampled.

From 2014, sheep have been sampled at slaughterhouses, giving a better surveillance of the total population with the use of less resources than needed when sampling on farms (9). However, less animals were tested per herd, giving less accurate results on the herd level.

In goats, the surveillance is still based on sampling live animals in the herds.

Results from the surveillance programme for maedi from November 2003 through 2006, showed a prevalence of less than 0.2% positive flocks. The distribution of the disease indicated that it was regionally clustered. A more extensive spread of MVV virus from the outbreak in 2003 was probably prevented by the restrictions on transfer of sheep across county borders. Maedi was not detected in the surveillance programme in the years 2005 to

2018. Even if maedi was detected in nine flocks in total during 2019 and 2020, the prevalence of infected flocks remains very low (less than 0.07%).

All dairy goat herds in Norway and many meat and fiber goat herds have joined the eradication programme Healthier goats. This has resulted in improved goat health and welfare in the Norwegian goat industry (8, 10). The finding of CAE in the years 2019 to 2021 in several hobby and meat goat herds, as well as in dairy goat herds where CAE previously had been eradicated, shows that attention and continued surveillance is needed in all types of goat herds.

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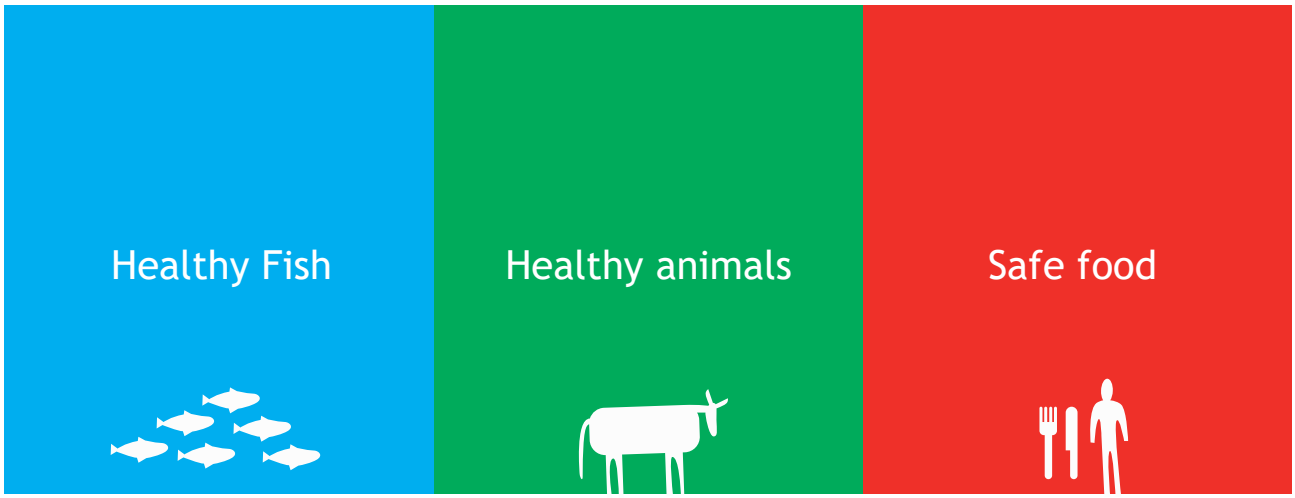

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