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SEROLOGICAL MONITORING
OF NEWCASTLE DISEASE IN RUSSIA 2017

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SUMMARY

Newcastle disease is an OIE-listed and highly contagious viral avian disease inflicting great economic losses and constituting a serious threat to poultry farms all over the world. The paper provides monitoring research results for Newcastle disease among poultry and wild birds in the Russian Federation for 2017. The tests were carried out with diagnostic kits for Newcastle disease virus antibody detection by immunosorbent assay and HI at the FGBI "ARRIAH" Reference Laboratory for Viral Avian Diseases (Vladimir). Biological material delivered from Rosselkhoznadzor Territorial Administrations was collected from 31,678 domestic and 433 wild and synanthropic birds from 22 and 4 regions of the Russian Federation, respectively. The paper shows different levels of seroprevalence in poultry from industrial poultry establishments of a closed type and backyards and in wild birds of various regions of the Russian Federation. Almost total Newcastle disease seroprevalence was found in adult poultry from industrial closed establishments due to a total vaccination against the disease. Broilers demonstrated a relatively low average Newcastle disease virus seroprevalence because of an insufficient antibody level by the moment of blood sampling (mostly during slaughter). On average, antibodies to Newcastle disease virus were detected in one third of samples from backyard poultry. With that, high seroprevalence was registered on farms of North Caucasian Republics and southern regions of the Russian Federation. Seroprevalence in wild birds was moderate. Thus, the monitoring research indicates an unstable epidemiological situation for Newcastle disease in the Russian Federation and the remaining risk of disease outbreak on industrial and backyard farms.

Key words: Newcastle disease, epidemiology, poultry, wild birds.

INTRODUCTION

Newcastle disease (NB) is a highly contagious viral avian disease affecting respiratory organs, the digestive tract and central nervous system. The disease is caused by a RNA paramyxovirus of serotype 1 (APMV-1) of the family *Paramyxoviridae* in the genus *Avulavirus* [4, 6]. Under natural conditions ND is more often found in order Galliformes (chickens, turkeys, pheasants, peafowls). Cases of infection of synanthropic birds were also described (pigeons, sparrows, magpies, parrots, hawks). The disease gravity depends on the virulence of the virus and the age, immune status and susceptibility of the host. Many wild and synanthropic avian species are natural reservoir hosts or carriers of the ND agent with the most significant role attributed to migratory birds which transmit the infection during seasonal migrations. Domestic ducks and geese can also constitute the agent's reservoir [1, 4, 6].

ND is registered all over the globe and included in the OIE list of notifiable diseases as it inflicts massive economic damage and hinders international trade [5, 8]. The disease spread is due to trade and economic relations between countries and seasonal migrations of wild and synanthropic birds. The disease was present on 6 out of 7 continents and registered in numerous countries [4, 6, 7]. Each year ND cases in pigeons are recorded in different regions of the Russian Federation with various intensity [1, 7].

In some countries vaccination against ND is prohibited and elimination strategy for poultry is based on destruction of an infected flock and quarantine measures. The prevention strategy for ND in the Russian Federation consists in mandatory preventive immunization of birds on poultry industry establishments of a closed type with live and inactivated vaccines [1, 3, 9]. Vaccination and animal health measures ensure quite effective prevention of the disease. However, ND still constitutes a potential threat to the Russian poultry farming as vaccination in small backyards is often disregarded which increases the risk of epizootic outbreaks. In 2016–2017 ND outbreaks in chickens on the territory of the Russian Federation were registered in the Republic of Crimea [2].

The need of ND monitoring research is stipulated by the risk of new virus variants introduction, the pathogen introduction to poultry industry establishments and epidemics that cause significant economic losses [1, 7, 8].

Table 1
Results of serum tests of chickens from Russian poultry establishments by HI and ELISA for Newcastle disease virus antibody detection

Federal subjects of Russian Federation	Broilers		Commercial and parent stock			
			young (up to 100 days)		adult (more than 100 days)	
	Number of tested samples	Positive results (%)	Number of tested samples	Positive results (%)	Number of tested samples	Positive results (%)
Vladimir oblast (5 poultry plants)*	340	134 (39%)	130	118 (91%)	990	990 (100%)
Ivanovo oblast (3 poultry plants)	1225	201 (16%)	120	112 (93%)	807	785 (97%)
Kostroma oblast (5 poultry plants)	310	41 (13%)	n/t	n/t	1659	1,588 (96%)
Nizhny Novgorod oblast and Republic of Mari El (8 poultry plants)	681	359 (53%)	n/t	n/t	2359	2,289 (97%)
Saratov oblast (6 poultry plants)	n/t	n/t	136	120 (88%)	498	483 (97%)
Kaliningrad oblast (2 poultry plants)	400	15 (4%)	n/t	n/t	200	185 (93%)
Krasnoyarsk Krai (7 poultry plants)	760	395 (52%)	125	51 (41%)	675	583 (86%)
Republic of Altai (4 poultry plants)	510	239 (47%)	n/t	n/t	980	912 (93%)
Khabarovsk Krai (2 poultry plants)	n/t	n/t	n/t	n/t	280	270 (96%)
Primorsky Krai (6 poultry plants)	n/t	n/t	25	0 (0%)	1000	973 (97%)
Amur oblast (4 poultry plants)	776	348 (45%)	n/t	n/t	150	124 (83%)
Stavropol Krai (6 poultry plants)	760	528 (69%)	170	115 (68%)	895	831 (93%)
Astrakhan oblast (2 poultry plants)	n/t	n/t	65	37 (57%)	796	740 (93%)
Krasnodar Krai (9 poultry plants)	572	346 (61%)	n/t	n/t	2711	2382 (88%)
Rostov oblast (2 poultry plants)	n/t	n/t	n/t	n/t	152	152 (100%)
Volgograd oblast (2 poultry plants)	n/t	n/t	n/t	n/t	503	397 (79%)
Total	**6,334**	**2,606 (41%)**	**771**	**553 (72%)**	**14,655**	**13,684 (93%)**

* number of poultry plants which provided the samples;
n/t – not tested.

The goal of this work was to carry out serological tests for ND on the territory of the Russian Federation in 2017 within the framework of state targets for epidemiological monitoring and diagnosis of highly dangerous animal diseases and to analyze the obtained data.

MATERIALS AND METHODS

Biological material (birds' blood serum) for the tests was provided by the Rosselkhoznadzor Territorial Administrations.

The tests were conducted with diagnostic kits produced by the FGBI "ARRIAH": kits for Newcastle disease virus antibody detection by immunosorbent assay (ELISA) for testing sera in a single dilution and kits for Newcastle disease virus antibody detection by hemagglutination inhibition test (HI). ELISA-kits were used for testing chicken blood sera, HI kits – for testing of poultry (chickens, turkeys, ducks, geese, and quails), wild and synanthropic birds sera.

The sera received for testing were inactivated by warming at 56 °C for 30 minutes.

RESULTS AND DISCUSSION

In 2017 tests for Newcastle disease virus antibody detection by HI and ELISA covered 31,678 samples of poultry blood serum from 22 Russian regions within the framework of the state targets for 2017.

21,760 chicken serum samples were delivered from 73 poultry establishments (poultry plants) from 17 Russian regions (Table 1).

Testing of adult poultry serum showed that up to 80% of samples were seropositive. From 80 to 90% of positive samples were found in Volgograd and Amur oblasts, Krasnoyarsk and Krasnodar Krais, in other 1 regions the number of positive results attained 93–100%.

The percentage of seropositive poultry among young birds of commercial and parent stocks (7 regions) varied considerably (from 0 to 93%).

Testing of broilers' sera from 10 regions demonstrated the fewest number of positive samples on farms of Kaliningrad oblast (4%) and the largest number – in Stavropol and Krasnodar Krais (69 and 61% respectively).

The analysis of total number of seropositive samples (in all regions) and of different poultry categories attested to the increasing number of seropositive samples from 41% in broiler chickens to 72% in young birds and 93% in adult birds. According to the information, the antibodies detected in the sera of commercial poultry were induced by vaccine strains of ND virus as part of live and inactivated vaccines. Some poultry plants showed unsatisfactory levels of post-vaccination immunity.

The given picture demonstrates data on detection of positive results for ND among chickens from commercial poultry industry establishments in 7 federal districts of the Russian Federation.

Judging by the data (see picture), 88–97% of adult birds in all regions were seropositive. A relatively low number of positive results obtained during testing of blood serum of young birds of commercial and parent stocks and broilers chickens attests to a low level of post-vaccination immunity and consequently their insufficient protection against ND.

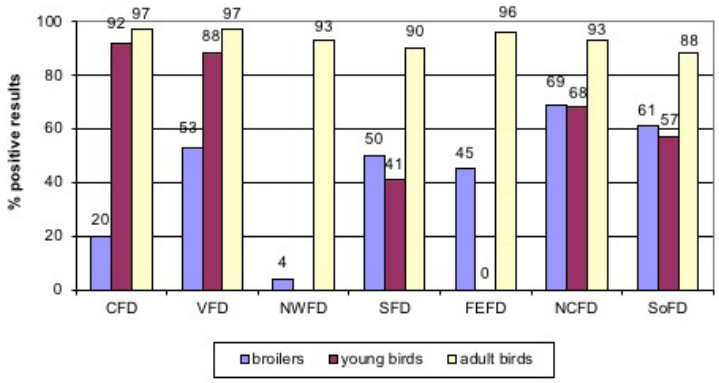

Fig. ND positive results of chicken serum testing. Chickens coming from different commercial establishments in 7 federal districts of the Russian Federation

CFD – Central Federal District;
VFD – Volga Federal District;
NWFD – Northwest Federal District;
SFD – Siberia Federal District;
FEFD – Far East Federal District;
NCFD – North Caucasus Federal District;
SoFD – South Federal District.

On average 31% of samples (Table 2) demonstrated a positive result during testing of 9,116 sera of chickens from backyards and collective farms in 12 Russian regions, in southern regions the positive detection rate was higher.

The analysis for detection of seropositive sera in Russian federal districts demonstrated the highest percentage of positive samples in North Caucasus (55% in the Republic of Ingushetia) and in South (62% in Krasnodar Krai) Federal District. According to the accompanying documents, chickens for backyards were mostly bought from poultry

Table 2
Results of serum tests of chickens from Russian backyards and collective farms by HI and ELISA for Newcastle disease virus antibodies

Federal District	Federal subject of Russian Federation	Number of tested samples	Number of positive samples	% positive samples
Central	Vladimir oblast	113	32	28
Northwest	Kaliningrad oblast	758	49	6
Siberian	Zabaikalsky Krai	738	63	9
Far East	Khabarovsk Krai	620	154	25
North Caucasus	Republic of Ingushetia	220	121	55
	Republic of Dagestan	291	140	48
	Chechen Republic	1412	682	48
South	Astrakhan oblast	1478	654	44
	Volgograd oblast	1000	139	14
	Krasnodar Krai	240	149	62
	Rostov oblast	1996	533	27
	Republic of Crimea	250	111	44
	Total	**9,116**	**2,827**	**31**

Table 3
Results of serum tests of poultry from Russian backyards and collective farms by HI for Newcastle disease virus antibodies

Federal District	Federal subject of Russian Federation	Bird species	Number of tested samples	Number of positive samples	% positive samples
Central	Vladimir oblast	ducks	23	2	9
		geese	22	0	0
Northwest	Kaliningrad oblast	turkeys	30	0	0
		geese	4	0	0
		quails	32	3	9
Siberian	Zabaikalsky Krai	turkeys	7	0	0
		geese	5	0	0
Far East	Khabarovsk Krai	quails	100	0	0
South	Astrakhan oblast	turkeys	20	0	0
		ducks	140	6	4
		geese	17	0	0
	Krasnodar Krai	ducks	60	46	77
	Rostov oblast	turkeys	40	1	3
		ducks	302	17	6

plants where they had been vaccinated against ND but were not vaccinated afterwards. Collective farms carried out revaccination against ND.

Specific antibodies were found in the blood of ducks, turkeys and quails (Table 3) during analysis of sera of other poultry species. No antibodies to NDV were detected in geese. Only one positive result was produced out of 97 tested turkey blood serum samples. Antibodies to NDV were found in 71samples (14%) of duck sera out of 525 tested samples. The largest number of positive samples (77%) was revealed in Krasnodar Krai. Data for vaccination of ducks were not available.

433 serum samples of wild and synanthropic birds from four Russian regions were tested for NDV antibodies by HI (Table 4).

Post-infectious antibodies to NDV were found in sera of synanthropic birds from Krasnoyarsk Krai and Nizhny Novgorod oblast: in 4 samples from a common pigeon (Order Columbiformes, Family Columbidae) and 5 samples from a rook (Order Passeriformes, Family Corvidae). Antibodies to NDV were found in 11 samples taken from wild birds of Order Anseriformes, Family Anatidae - wild ducks and geese – from Zabaikalsky Krai and Nizhny Novgorod oblast, and in 1 sample – from a yellow wagtail (Order Passeriformes, Family Motacillidae) from Krasnoyarsk Krai. No signs of the disease or massive deaths were registered during sampling that is why it is most probable that the formation of antibodies was induced by low-virulent ND viruses which are regularly isolated in wild bird populations.

Detection of antibodies to ND virus in sera of wild and synanthropic birds attests to the pertaining danger of the infection spread to poultry flocks if the latter do not have sufficient post-vaccination immunity level.

Serological tests for ND within the framework of state epidemiological monitoring are an integral part of the disease control, prevention and forecasting system. According to the results of the serological monitoring in 2017, almost absolute seroprevalence of ND for adult poultry was established on higher biocontainment indoor keeping industrial farms which is due to a universal vaccination against the disease. A relatively low average ND seroprevalence in broiler chickens can be explained by different vaccination schemes used on farms which from time to time failed to ensure a sufficiently high level of post-vaccination antibodies by the moment of blood sampling (generally, sera are sampled at slaughter). Detection of high antibody titers in backyard poultry can attest to the circulation of lentogenic and mesogenic strains of ND agent among backyard birds. A higher ND prevalence detected during blood sampling of backyard poultry from the North Caucasus republics and southern regions of the Russian Federation is indicative. Thus, a suggested real threat of primary outbreaks in backyard poultry is confirmed. ND seroprevalence in wild birds which most likely constitute natural reservoirs of Newcastle disease viruses of different pathogenicity was moderate.

CONCLUSION

Thus, the obtained data show that Newcastle disease epidemiological situation in the Russian Federation is unstable and there is a pertaining risk of the disease outbreak

Table 4
Results of serum tests of wild and synanthropic birds by HI for Newcastle disease virus antibodies

Federal subject of Russian Federation	Bird species	Number of tested samples	Positive result
Zabaikalsky Krai	wild duck	3	3
Krasnoyarsk Krai	synathropic bird (common pigeon)	130	3
	waterfowl (mallard duck, wigeon, teal)	20	0
	wild birds of meadows, fields and swamps (snipe, booted warbler, marsh snipe, stonechat, yellow wagtail, tree sparrow)	90	1
	wild birds of forests (tree pipit, tit, woodcock, wryneck, nuthatch, mistle thrush, willow tit)	60	0
Nizhny Novgorod oblast	synanthropic birds (common pigeon, rook, crow, jackdaw)	40	6
	waterfowl (wild ducks and geese)	53	8
	birds of fields and forests (blackcock, woodcock)	6	0
Republic of Tuva	waterfowl and semiaquatic birds (great crested grebe, gadwall, red-crested pochard, cormorant, terrick, herring gull, black-headed gull)	31	0
	Total	**433**	**21**

on industrial farms and in backyards, particularly, in case of ineffective vaccination of flocks and absence of planned vaccination.

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