Seroprevalence Study of Newcastle Disease in Local Chickens in Central Ethiopia

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ABSTRACT

A study of Newcastle disease (NCD) seroprevalence rates in local scavenging chickens in central Ethiopia was conducted on 180 chickens raised under a traditional management system in three selected agricultural-climatic zones. The study revealed the occurrence of high rates of NCD virus antibodies in local chickens in all three agricultural-climatic zones. Hemagglutination inhibition test was used to analyze 180 chicken sera for NCD virus antibodies, yielding an overall seropositive rate of 32.22% (58 chickens). Seroprevalence rates for NCD were 28.57%, 29.69%, and 38.33% in the high, mid-range, and low altitudes, respectively. This study has shown that NCD is one of the major infectious diseases threatening the survival and productivity of traditionally managed local chickens in central Ethiopia. Further detailed study focusing on NCD virus strain identification, a survey of major poultry diseases, and institution of improved management packages are recommended.

INTRODUCTION

The total poultry population in Ethiopia is estimated to be 56.5 million.[1] Despite the fact that traditionally reared poultry account for approximately 99% of the chicken population in Ethiopia (only approximately 1% are raised commercially), little research has been carried out on traditionally reared poultry.[2] There is no generally accepted definition of rural poultry production, and various production systems have been described by a number of authors.[3–5] The traditional poultry system is characterized by minimal human involvement, with birds scavenging in the backyard for food, and no investments beyond the cost of the foundation stock, a few handfuls of local grain, and possibly simple night shades, but no veteri-

nary medical attention.[5] The system is also characterized by high mortality caused by factors such as disease, predators, and poor management and nutrition.[4–7]

In Ethiopia, poultry diseases are considered to be the most important factor responsible for reducing both the number and productivity of chickens.[3,6] Poultry diseases such as Newcastle disease (NCD), coccidiosis, salmonellosis, and nutritional deficiency are considered to be the most endemic and the ones to incur huge economic losses.[2,4 6–8] Poultry diseases have worsened since the initiation of an Ethiopian "villagization" program in which farmers from different areas were settled in certain localities (1984–1986).[2,5–7] Prior to the program disease outbreaks usually occurred at the beginning of the rainy season, but after villagization, outbreaks remain a problem throughout the year.[5] Summarizing data from 6 African countries, Sonaiya[8] concluded that mortality caused by Newcastle disease ranges from 50% to 100% per year, and that severity is higher in the dry season,[8] although Dessie and Ogle[5] have stated that the disease is more widespread in the rainy season in the central highlands of Ethiopia.

NCD, locally known as Fengel, is a highly contagious and destructive illness of chickens that occurs almost any time of the year, inflicting heavy losses. The first documented evidence of NCD in Ethiopia dates back to 1978, when an outbreak occurred in then-Eritrea in the northern part of the country. The disease is caused by Newcastle disease viruses belonging to the Paramyxoviridae family, which possess two surface proteins that are important to the identification and behavior of the virus. The first, hemagglutinin/neuraminidase (HN), is important in the attachment and release of the virus from the host cells, in addition to its serologic identification.[9,10] The other very important surface protein is the fusion (F) protein, which has a critical role in the pathogenesis of the disease.[9,10]

Newcastle disease viruses occurs in three pathotypes: lentogenic, mesogenic, and velogenic, reflecting increasing levels of virulence.[10,11] The most virulent (velogenic) isolates are further subdivided into neurotropic and viscerotropic.[11] The disease can be present in healthy-appearing but infected carriers such as exotic pet and exposition birds, which includes domestic poultry, and in a persistent carrier state, which has been demonstrated in the psittacine order.[12] Recent observations made by Nasser revealed that the velogenic strains of NCD virus are widely distributed throughout Ethiopia.[13] Velogenic NCD virus causes the most severe form of the disease and is likely the most serious disease of poultry throughout the world.[9] In chickens NCD is characterized by lesions in the brain or gastrointestinal tract, morbidity rates near 100%, and mortality rates as high as 90% in susceptible chickens. Neurological symptoms or severe depression are the most obvious clinical signs of NCD, and some unvaccinated birds may be found dead with no detected sign of prior illness.[14]

The epidemiology of NCD in village birds in Ethiopia is not clearly understood. Nonetheless it appears that NCD is the most important reoccurring epidemic every year.[5,7,13] Although NCD represents the most severe poultry disease responsible for marked economic losses, few studies of NCD have been done on chickens in central Ethiopia. Furthermore, the actual cause of the widespread epidemic of high mortality in local chickens in various parts of Ethiopia has yet to be identified. Such a wide knowledge gap on diseases of local chickens is a hindrance to the implementation of effective disease-control measures. The aim of the present study is, therefore, to determine the seroprevalence rate of NCD and assess its variation in different agricultural-ecological zones in central Ethiopia

MATERIALS AND METHODS

Description of Study Areas

The present preliminary cross-sectional study was conducted in three selected sites, representing different agricultural-climatic

Table 1. Description of Chickens Studied by Sex and Study Site

Study Areas	Agricultural-Climatic Zone	Male	Female	Total
Debre Berhan	High Altitude	26	30	56
Sebeta	Mid Altitude	30	34	64
Nazareth	Low Altitude	29	31	60
TOTAL		85	95	180

zones in central Ethiopia. The areas are Debre Berhan (highland, 130 km north of Addis Ababa; altitude, 2780 m; mean annual minimum and maximum temperature range, 6.3˚C and 18.8˚C), Sebeta (mid-altitude, 25 km southwest of Addis Ababa; altitude, 2240 m; mean annual minimum and maximum temperature range, 15˚C and 21˚C) and Nazareth (lowland, 98 km southeast of Addis Ababa; altitude, 1300 meters; mean annual minimum and maximum temperature range 15˚C and 28˚C).[9]

Study Protocols

Study design. The seroprevalence study was conducted on local chickens randomly sampled from three selected agricultural-climatic zones in central Ethiopia, which represent high, middle, and low altitudes.

Animals and management. A total of 180 apparently healthy chickens were purchased from local open-air markets in the respective study areas (Table 1). The poultry management pattern in the study areas were an entirely free-ranging traditional system. Chickens were then transported to the National Animal Health Research Center (NAHRC) in Sebeta for subsequent examination.

Examination, serum collection, and testing. Before undergoing any examination procedures, each chicken was given an identification number. A total of 1.5 mL–2 mL of blood was collected from the humeral region of the wing vein with a syringe and 3-mL needle. The syringe was laid nearly horizontally until the blood clotted. After clotting, the syringe was returned to a vertical inverted position to permit the serum to ooze out. The sample was then kept at 37˚C for several hours or left overnight before the serum was removed. The separated serum was transferred into test tubes, labeled with tag number and treatment group, and stored at -20˚C until the hemagglutination inhibition (HAI) test was performed to detect antibodies against the NCD virus.[10]

The HAI test was done following procedures outlined by the Office International des Epizooties (OIE)[10] and Beard.[15] The test was carried out by running twofold dilutions of equal volumes (0.025 mL) of phosphate buffered saline (PBS) and test serum (0.025 mL) in V-bottomed microtiter plates. Four hemagglutinating units (HAU) of virus/antigen were added to each well and the plates were left at room temperature for a minimum of 30 minutes. Finally, 0.025 mL of 1% (volume/volume) chicken red blood cells (RBCs) were added to each well and, after gentle mixing, allowed to settle for about 40 minutes at room temperature. The HAI titer was read from the highest dilution of serum causing complete inhibition of 4 HAU of antigen. Agglutination was assessed by tilting the plates. Only those wells in which the RBCs stream at the same rate as the control wells (containing 0.025 mL RBCs and 0.05 mL PBS only) were considered to show inhibition.

Data Analysis

Data analysis was performed using the Chi-square test for the two variables of sex and agricultural-climatic zone. Differences in prevalence rates between the variables and disease were considered statistically significant at $P < 0.05$.

RESULTS

The overall seroprevalence rate of NCD virus antibodies was 32.22% (58/180).

Table 2. Seroprevalence Rate of Newcastle Disease Virus Antibodies in Chickens in 3 Agricultural-Climatic Zones in Central Ethiopia

Study Areas	No. of chickens examined			Seroprevalence rate of >1:40		
	Male	*Female*	*Total*	*Male*	*Female*	*Total*
High altitude (Debre Berhan)	26	30	56	7 (26.92%)	9 (30%)	16 (28.57%)
Mid-altitude (Sebeta)	30	34	64	9 (30%)	10 (29.41%)	19 (29.69%)
Low altitude (Nazareth)	29	31	60	11 (37.93%)	12 (38.70%)	23 (38.33%)
TOTAL	85	95	180	27 (31.63%)	31 (32.63%)	58 (32.22%)

Seroprevalence rates of 28.57%, 29.69%, and 38.33% were found in Debre Berhan, Sebeta, and Nazareth, respectively (Table 2).

There was no statistically significant difference ($P > 0.05$) between both sexes and different agricultural-climatic zones in NCD virus seroprevalence rates. However, a relatively higher seroprevalence was observed in Nazareth, 38.33% (23/60), followed by Sebeta, 29.69% (19/64), than in Debre Berhan, 28.57% (16/56).

DISCUSSION

The present study showed the occurrence of a relatively higher seroprevalence rate of NCD virus antibodies in local chickens in all three agricultural-climatic zones in central Ethiopia. There was no statistically significant difference ($P > 0.05$) between NCD seroprevalence rates in different agricultural-climatic zones and both sexes.

The relatively higher overall seroprevalence rate of NCD virus antibodies in local chickens was attributed to a number of factors. The management system in traditional production may serve as a stress factor and favor infection. Poor sanitary conditions, continuous exposure of chickens to range conditions and wild birds, nutritional deficiencies, the absence of vaccination in traditionally managed chickens, and contact of chickens of one village with those in other villages may facilitate the spread of NCD. This is in concurrence with the reports by Dessie and Ogle.[5] The ease of contact of chickens from different areas at local open-air markets, which are then taken back to various localities, can undoubtedly facilitate the rapid spread and persistence of NCD among local chickens. Ashenafi[7] reported a 43.68% NCD seroprevalence rate in central Ethiopia among local scavenging chickens kept under a traditional management system. Similarly, Eskoli has reported a 72% seroprevalence rate of antibodies to NCD virus in traditionally managed, non-vaccinated village chickens in Nigeria.[14]

This study showed NCD to be one of the major infectious diseases that reduces the number and productivity of traditionally managed chickens in the study area. The data clearly indicate that local chickens kept under free-range traditional management systems—in which chickens literally scavenge their own feed and water— in the three agricultural-climatic zones were exposed to NCD virus. Poultry diseases such as NCD were shown to be the most important constraints on local chicken production in rural Ethiopia.[2,5,6] In Ethiopia, NCD is the most important cause of loss in village-dwelling as well as commercially raised chickens. The disease occurs almost any time of year and velogenic strains of NCD virus are widely distributed throughout the country.[8] It is therefore vitally important that further detailed studies focus on NCD virus strain identification so that preventive and control programs can be formulated.

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