NEWCASTLE DISEASE AND INFECTIOUS BURSAL DISEASE AMONG FREE-RANGE VILLAGE CHICKENS IN TANZANIA

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Abstract

NEWCASTLE DISEASE AND INFECTIOUS BURSAL DISEASE AMONG FREE-RANGE VILLAGE CHICKENS IN TANZANIA.

Newcastle disease in free-range village chickens was confirmed by retrospective data analysis and epidemiological cross-sectional studies. The combination of serological survey and virus isolation and characterisation established seasonal occurrence of Newcastle disease (ND) in free-range village chickens. The highest sero-prevalence (81.5) and virus isolation frequency (18/27) were found in the period between June and October. The field isolates of Newcastle virus (NDV) were confirmed to be PMV-1 serotype by polyclonal PMV-1 antiserum and monoclonal antibody (mAb) U85. All isolates were not inhibited by mAb 716/161 specific for pigeon panzootic NDV, showing that the current Tanzanian field isolates have antigenic variation and were not involved in the recent pigeon NDV panzootic. Mean death time determination characterised isolates into velogenic, mesogenic and lentogenic pathotypes. Isolation of NDV from apparently healthy ducks revealed the role of ducks in the epidemiology of ND in free-range village chickens in Tanzania. Studies are recommended to determine the similarities of the field isolates from different sources within Tanzania and to panzootic NDV from other countries. Strategic control of ND in free-range village chickens is recommended taking into consideration the presence of different age groups. Infectious bursal disease was histologically diagnosed in free-range village chickens. Therefore, there is a need of carrying out research on the role of other diseases and determine their prevalence and their contribution to the mortalities experienced in the free-range village chickens.

1. INTRODUCTION

Just like in other developing countries the poultry industry is dominated by the traditional sector in Tanzania. Free-range poultry keeping is most common in the country. Of the approximately 30 million chickens kept in Tanzania, 28 million are free-range village chickens [1]. They provide livelihood and supply 100% of eggs and chicken meat consumed in rural areas, where 83% of the population live. In addition, they cater for 20% of the chicken egg and meat demand of urban consumers [2]. Therefore, free-range chickens have an important role in economic and nutritional needs of the Tanzanian people especially in the rural areas.

The contribution of the chicken industry to the national economy and the per-capita meat and egg consumption is very low [2]. At the same time poverty and protein deficiency is manifested by wide spread malnutrition in children and women in village communities. Several factors have been suggested for the low production characteristics of free-range village chickens. The system is characterised by low input and low output, with minimal management interventions, feed supplementation, housing and disease control. This kind of production by itself is a limiting factor to sound economic and sustainable production. The low input is, however, a result of the high risk due to high mortalities experienced in village poultry. Diseases and especially the devastating Newcastle disease (ND) are perceived to be the main constraint [3], which frustrates any investment in this system. Thus, the potential of the free-range chicken population has not been exploited. Therefore, if any success is to be achieved in improvements for free-range village chickens it will inevitably depend on the successful control of ND.

Newcastle disease is a viral disease affecting mainly chickens. It is caused by avian paramyxovirus serotype 1 (APMV-1) (NDV) of the genus *Rubulavirus* belonging to the subfamily *Paramyxovirinae,* family *Paramyxoviridae,* order *Mononegavirales* [4]. The disease is mainly controlled by vaccination. ND has long been known to be endemic in Tanzania [2, 5, 6, 7]. The disease was first reported in Java in 1926. Its history, origin and spread to Tanzania have not been explained. However, it is wide spread in the country and it has numerous names depending on the locality. The common names are “Kideri, Mdonde, Mdondo” and “Sotoka ya kuku” in Swahili. While in Nyamwezi and Sukuma it is known as “Kifwa” or “Ikula”, respectively. The names literally mean fatality or plague.

There has been limited information available on the history, incidence and prevalence of ND in Tanzania. In neighbouring Kenya and Uganda it was first diagnosed in 1935 and 1955, respectively. In Tanzania the first isolation and pathotyping was reported by Loretu and Mkaria [7]. A formal and informal survey in Morogoro, Tanzania, reported that farmers recognised ND was the most important killer disease of village chickens [3].

The epidemiology and control of ND has been extensively studied and documented in commercial poultry systems, but has been poorly documented in village poultry [8]. The large differences in management between commercial and village poultry prohibit the transfer of epidemiological data and control programmes of ND from the commercial sector to the village environment. Thus, success in attempts to control ND in village poultry have been hardly successful [9, 10]. It is well known that knowledge of specific disease risk factors is a prerequisite for effective evaluation of disease control programmes [11]. Consequently, epidemiological cross-sectional studies on free-range village poultry have been carried out in Tanzania since 1994. The main objective was to generate data which could be used in the formulation of ND control programmes.

Results from these studies confirmed the occurrence of ND in village poultry in Tanzania. Confirmation was by serology, clinical and pathological signs, virus isolation and characterisation of the field virus strains. Isolates were prepared from chickens and ducks. The studies showed high seroprevalence figures, a seasonal pattern, and presence of velogenic, mesogenic and lentogenic field strains with antigenic variation. Different factors associated with disease occurrence were identified [5].

2. RESULTS

2.1. Management practices and flock dynamics

2.1.1. Management practice

A standardised questionnaire was used together with visual observation to collect demographic data on chicken farmers. Data on housing, management practices, chicken population dynamics and incidence of diseases were gathered. Two regions, Morogoro and Tabora, were selected. In each region one district and five villages were selected randomly. Ten farmers were randomly selected from each village. The management practices common in the two regions are shown in Table I to V.

TABLE I. PERCENTAGES OF POULTRY FARMERS PROVIDING DIFFERENT TYPES OF PROVISION OF HOUSING IN TWO REGIONS OF TANZANIA (MOROGORO AND TABORA)

Housing	Morogoro region	Tabora region	Average for the two regions
Separate or kitchen	25	100	53
In living house	71	0	45
Roosting on trees	4	0	2
Seasonal confinement	42	90	58

The results show that housing of some sort was provided to chickens and other poultry. The type, size and material of the shelters differ between regions and within the same village. The type and size of shelter did not take into consideration the flock size, ventilation and light. Some of the shelters had raised floors [5], while others had floors at ground level. Lack of consideration for flock size could lead to overcrowding, whereas lack of ventilation and humid floors could lead to ammonium accumulation. Consequently, the (respiratory) health of the chickens was influenced, especially during the rainy season when total confinement was practised to prevent crop damage by poultry near the homesteads. The type of housing also influenced the type of handling when vaccinating. When total confinement was practised, mass vaccination through drinking water was used. However, this way of vaccination was not possible when no housing or housing in human living quarters was provided. Housing in kitchens and human living quarters was a common practice (Table I). Consequently, the thermostable and feed carried V4 vaccines attracted a lot of attention in developing countries as a suitable alternative to control Newcastle disease [12].

TABLE II. PERCENTAGE OF POULTRY FARMERS PROVIDING DIFFERENT KINDS OF SUPPLEMENTATION IN MOROGORO AND TABORA REGIONS OF TANZANIA

Type of feed supplementation	Morogoro region	Tabora region	Average for the two regions
Maize grain	11	35	20
Maize bran	50	65	56
Human table leftover	93	88	91
Protein (insects, worms to larvae)	7	18	11
Provision of water	25	41	31
Provision of water and feeding facilities	18	59	33

The number of chicken keepers practising some form of supplementation in the two regions is shown in Table II. It was observed that the most common form of supplementation of village chickens was through accidental availability during the process of preparation of food for humans. Likewise leftovers after dinner and the cleaning of utensils used for cooking were available for scavenging. During the harvest and storage of crops, wastage was available to the village poultry. Actually these practices can not be considered proper supplementation, as the nutritional requirements of the chickens were not taken into account.

In the village system chickens depend on the environmental feed resource base (FRB), which shows seasonal fluctuations. Protein might be plentiful during the rainy season when vegetation and insects are many. On the other hand, during the dry season insects, worms and even grains are scarce. This could lead to seasonal malnutrition and seasonal immuno-suppression, which in turn could contribute to seasonal disease occurrence in village poultry. This could possibly explain the low vaccine efficacy in some trials or the seasonal occurrence of ND. Therefore, it is necessary to determine the capacity of the feed resource base in free-range village chickens and correlate it with disease occurrence.

The same applies to the availability of water. There are various sources of water available for the chickens in the village. Like the FRB, water can be shared among different flocks enhancing the spread of disease. When a sick bird is introduced or if a carrier is present, disease could be easily spread to birds scavenging in the same area or sharing the same water source. Thus, all chickens in one village should be considered as a single flock when planning disease control strategies [13].

TABLE III. PERCENTAGE OF POULTRY FARMERS PROVIDING BASIC HYGIENE MEASURES.

Cleaning frequency	Morogoro region	Tabora region	Average for the two regions
Regular cleaning	18	35	24
Occasional cleaning	71	65	69
Cleaning rarely	11	0	7

Occasional cleaning is common practice in the village with 69% of farmers occasionally cleaning the chicken night shelter (Table III). During the dry season dust can be a problem due to accumulated dry faeces. Fine dust aerosols could easily transmit airborne respiratory diseases or cause stress to the respiratory mucosa of birds housed in such premises. Lack of cleaning and hygiene could predispose birds to external parasites, which cause harm, discomfort, stress and act as intermediate hosts for various diseases. On the other hand, accumulated faeces in uncleaned premises with a lack of ventilation could result in ammonium toxicity during the humid wet season, causing impairment of the respiratory system and predisposing birds to infectious respiratory diseases like ND, infectious laryngotracheitis, infectious bronchitis, infectious coryza and *Mycoplasma* infections. Furthermore, *E. coli* could gain entry through the damaged respiratory mucosa. Such lack of proper management could contribute to the fact that ND is endemic and persistent in village poultry.

TABLE IV. PERCENTAGE OF POULTRY FARMERS PROVIDING DISEASE TREATMENT AND PROPHYLAXIS

Type of practice	Morogoro region	Tabora region	Average for the two regions
Veterinary extension services	18	6	13
Indigenous knowledge/drugs	50	71	58
No effort at all	32	23	29

Treatment and control of diseases by the veterinary extension services was minimal in the two regions (Table IV). In general the selected farmers had not previously vaccinated their chickens against Newcastle disease. The importance of disease was reflected by the efforts of 50 to 71% of the farmers using indigenous knowledge and ailments against diseases in their flocks. However, most of the farmers conceded that the response to these local treatments was not successful. Consequently, a high mortality could be expected in free-range village chickens. However, any success with local treatments should be reported and documented, since it is easily adopted and uses locally available materials.

TABLE V. PERCENTAGE OF POULTRY FARMERS CULLING THE FLOCK

Type of culling	Morogoro region	Tabora region	Average for the two regions
Slaughter for home consumption	100	94	98
Sale of live birds	61	82	61
Sale of eggs (occasional)	46	41	44
Gifts	100	100	100
Other purposes (medicinal & bride's portion)	79	41	64

Exchange of live birds in the form of sale, gifts and slaughter are most common under village conditions (Table V). Movement of live birds has been implicated as the major factor in the spread of disease. ND epidemics are associated with the season when chickens are moved as gifts in Uganda and Ethiopia. This could also be the case in Tanzania. Moreover, it is common practice to slaughter sick birds for the home table and visceral organs are often not properly disposed of. Other chickens, wild birds, dogs, cats, rats and insects have access to such offal in the village. Although the survival of field ND virus in offall and faeces has not been studied under tropical conditions, it could be considered a source of ND spread to susceptible chickens.

2.1.2. Flock structure and flock population dynamics

The average flock size per household in Morogoro was 27 and in Tabora it was 50 chickens. But the average flock sizes excluding chicks was 10 and 12 in Morogoro and Tabora, respectively. In Morogoro 60% of the flock owners did not keep breeding cocks, while in Tabora only 10% had no cocks. On average in Morogoro 3% of the chickens were cocks, 18% hens, 15.6% growers and 63.4%

chicks. In Tabora 2.1% were cocks, 11.2% hens, 7.5% pullets, 5.0% cockerels and 74.2% chicks. Sharing of cocks in the village showed the high rate of interaction among flocks in the same village, which in turn could influence disease spread.

The ratio of chicks to growers in Morogoro and Tabora were 4.1 and 6.1, respectively. The flock structure differed significantly from month to month (Fig. 1). The highest flock size in the two study areas was during the months of March to June. Following June a decline in the flock size occurred towards October. The decline coincided with the progressing dry season and ND outbreaks. Farmers observed losses due to disease in February and from June to October. Chick mortality before the age of 2 months ranged from 44 to 80% during the study period. Highest losses were recorded in March and June in Morogoro and in January and June in Tabora.

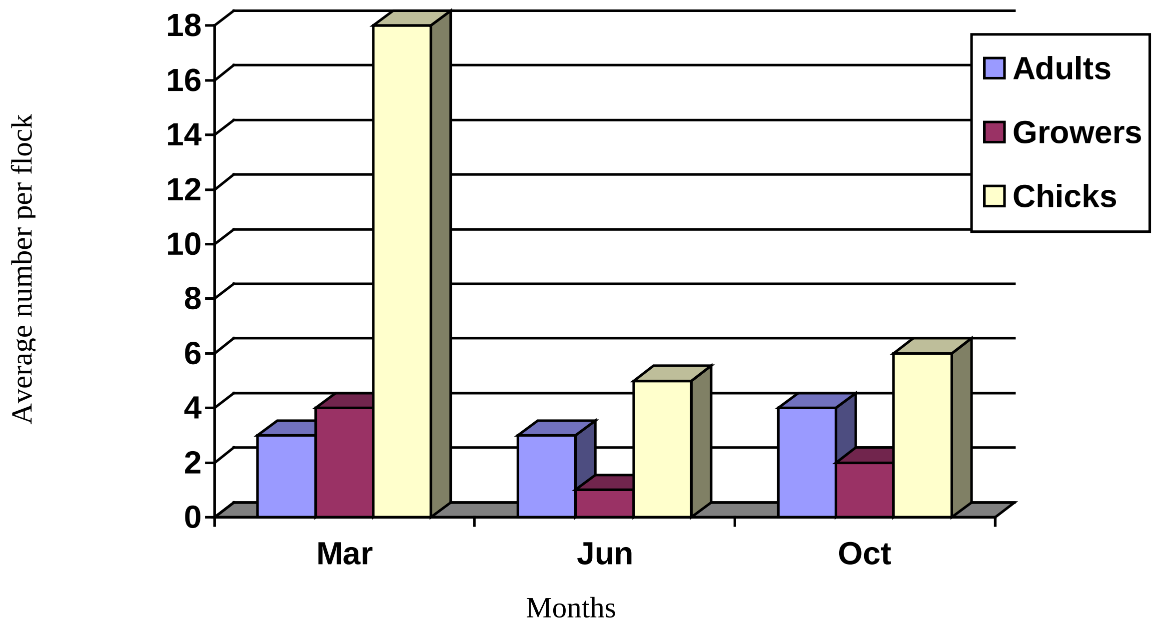

FIG. 1. Average number of chickens of different ages per household in various months in the Morogoro region.

A large chick population was present in the Morogoro flocks in January and March (Fig. 1). The chicks born in January were supposed to have reached two months of age in March. This should have increased the size of the grower group. However, no increase in the population of growers was recorded in March or in the following months. The population of chicks and growers remained low in June and October. This indicated high losses in the chick and grower age group. The adult population remained rather stable.

Different age groups of chickens are present at any given time in the flock. Since different age groups are not separated at night and no proper ventilation is available in the night shelters, a conducive condition is created for respiratory diseases, in particular those affecting all age groups like Newcastle disease. Such a management practice could play a role in the spread of ND as is the case in intensively managed chickens [8].

2.2. Retrospective information on poultry diseases

2.2.1. Farmer's perception of poultry diseases

Diseases are regarded by 95.5% of flock owners as the major constraint to the village chicken population (Table VI), highlighting the importance of disease. Similar observations have been made in other developing countries with village poultry [12].

TABLE VI. MAJOR CONSTRAINTS TO VILLAGE POULTRY PRODUCTION AS PERCEIVED BY FARMERS IN MOROGORO AND TABORA REGIONS OF TANZANIA

Problem	Percent of respondents	Rank*
Diseases	95.5	+++++
Ectoparasites (utitiri)	88.8	++++
Predators	82.2	++++
Lack of veterinary services	73.3	+++
Bird theft	60.0	+++
Lack of marketing	55.5	++
Lack of price control	51.1	++
Lack of proper housing	40.0	+
Lack of feed and water	22.2	±

* Ranking was done by allocating 5+ for the problem which had ≥90% of all respondents indicating it as a problem, 4+ for ≥75 to <90%; 3+ for ≥60 to <75%; 2 + ≥50 to <60%; 1+ for < 50 but ≥30 and ± for <30%.

Information obtained from farmers showed that all flock owners had experienced every year an outbreak of ND either affecting their own flock or those of neighbours. Only 8% of respondents did not experience a ND outbreak during the study year. The outbreaks were associated with windy and chilly months of the year. Disease signs mentioned were diarrhoea (whitish, darkish, bloody, green), drooping of wings, reluctant to move, lack of appetite, sudden death, difficult breathing and sneezing, nervous signs and paralysis. All these signs were associated with ND. However, the signs are typical for any sick bird and other diseases could show similar signs. Farmers did not report post-mortem signs, since sick birds are prepared for the home table.

2.2.2. Poultry disease conditions reported at the veterinary investigation centre Tabora.

TABLE VII. FREQUENCY OF OCCURRENCE OF POULTRY DISEASES REPORTED AT THE VETERINARY INVESTIGATION CENTRE TABORA FROM 1976 TO 1994

Disease condition	Frequency	
	Incidence	Cases
Coccidiosis	134 (10.7)	395 (11.3)
Egg yolk peritonitis	130 (10.4)	292 (8.4)
Helminthoses	129 (10.3)	324 (9.3)
Egg bound peritonitis	119 (9.5)	387 (11.1)
Newcastle disease	114 (9.1)	633 (18.1)
Salmonellosis (Paratyphoid)	111 (8.9)	353 (10.1)
Visceral gouts	61 (4.9)	131 (3.8)
Poisoning	60 (4.8)	135 (3.9)
Leucosis	59 (4.7)	113 (3.3)
Trauma	49 (3.9)	51 (1.5)
Fowl typhoid	46 (3.7)	90 (2.6)
Cannibalism	46 (3.7)	85 (2.4)
Fowl pox	37 (3.0)	62 (1.8)
Infectious coryza	31 (2.5)	76 (2.2)
Colibacillosis	23 (1.8)	30 (0.9)
Avitaminosis A	23 (1.8)	64 (1.8)
Fatty liver syndrome	20 (1.6)	21 (0.6)
Non specific enteritis	19 (1.5)	194 (5.6)
Ectoparasites	17 (1.4)	25 (0.7)
Avitaminosis B	10 (0.8)	14 (0.4)
Intussusceptions	10 (0.8)	10 (0.3)
Traumatic proventriculitis	3 (0.2)	3 (0.1)
Total	1251	3488

between brackets is represented the percentage of the total.

At the veterinary investigation centres (VIC), sick and dead birds are brought for clinical and post-mortem examinations. Therefore, the data reflect diagnosis derived at post-mortem examinations.

Data were compiled from 1251 incidences of poultry disease reported at the VIC in Tabora region from 1976 to 1994. A total of 3488 cases were reported either from commercial backyard or from free-range village chickens originating from the surroundings of Tabora municipality. Newcastle disease (9.1%) had a lower incidence as compared to coccidiosis (10.7%), helminth infestations (10.4%), egg yolk peritonitis (10.4%) and egg bound peritonitis (Table VII). However, although the latter diseases had high incidences, ND had the highest case rate (18.1%). It showed that mortality due to ND was highest and most alarming to the poultry keepers.

The monthly ND incidence showed that the majority of cases occurred between July and November, with a peak from August to October (Fig. 2). The findings are in agreement with farmer's recollections and similar to what had been reported in other studies in the region [14]. However, sporadic incidences were reported almost every month, indicating the persistence of the disease in the area. Possibly the disease involved few flocks and the disease was contained in specific foci or villages during these months without spread through the entire region as was the case during the dry season.

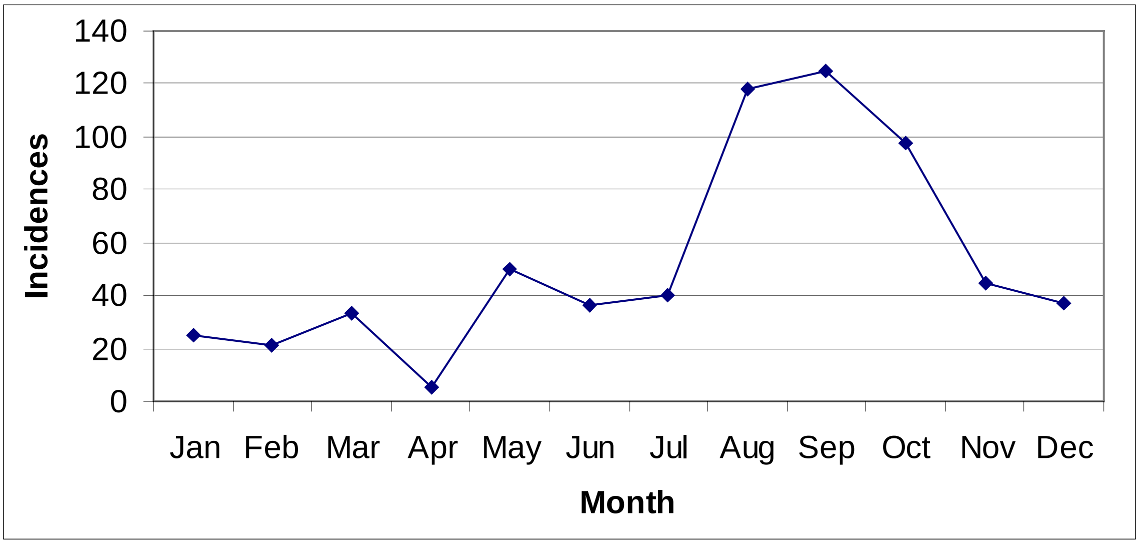

FIG. 2. Average monthly distribution of incidence of Newcastle disease as reported and diagnosed at the Veterinary Investigation Centre, Tabora from 1976 to 1994.

2.3. Seasonal occurrence of Newcastle disease in free-range village chickens

Seasonal occurrence of ND in free-range village chickens was determined by seroprevalence, clinical and pathological examination and NDV isolation. A total of 1,566 serum samples were collected from apparently healthy chickens with no history of ND vaccination. Two regions (Morogoro and Tabora) were involved. In each region five villages were selected randomly. In each village ten farmers were also randomly selected. Sampling was done once every two months from January to October, 1995. Cloacal and tracheal swabs were collected from the same birds. Sick or dead birds were examined during the visits. Samples from the brain, trachea, lung, intestine and liver were collected for NDV isolation. All samples were transported on ice.

The haemagglutination inhibition (HI) test as described by Allan and Gough [15] was used to determine exposure to NDV by detecting antibodies in the serum. NDV isolation was done by inoculation into the allantoic cavity of 9 to 11 day-old embryonated chicken eggs (ECE) [5]. To characterise the NDV isolates monoclonal antibodies and the mean death time of ECE were used [5].

2.3.1. Seroprevalence

The overall seroprevalence of antibodies against ND was 46.8%, ranging from 25% to 81.52%. There was a significant difference in seroprevalence between different months (Fig. 3). The highest prevalence was recorded in October (81.5%).

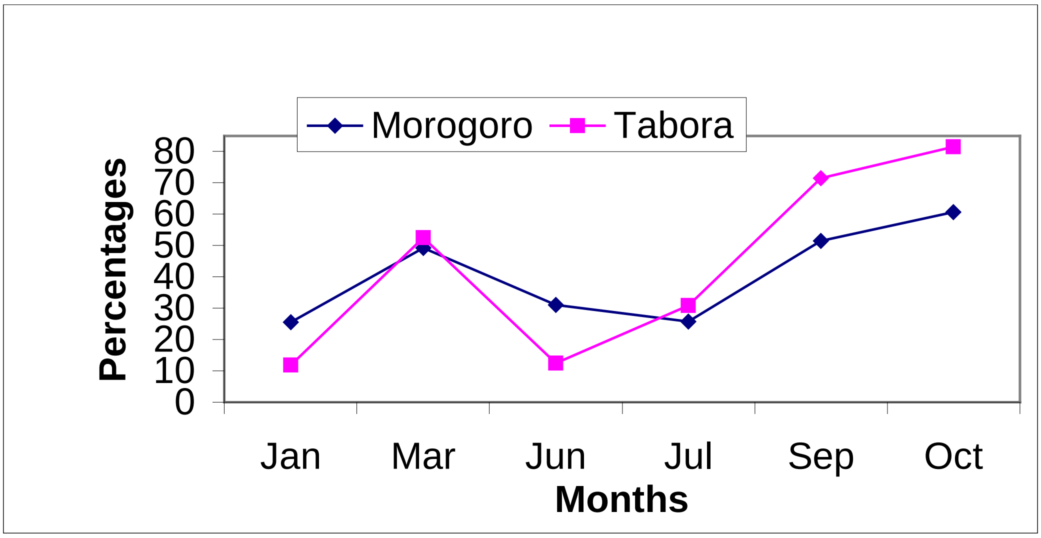

FIG. 3. Seroprevalence of Newcastle disease antibodies in two regions of Tanzania in 1995.

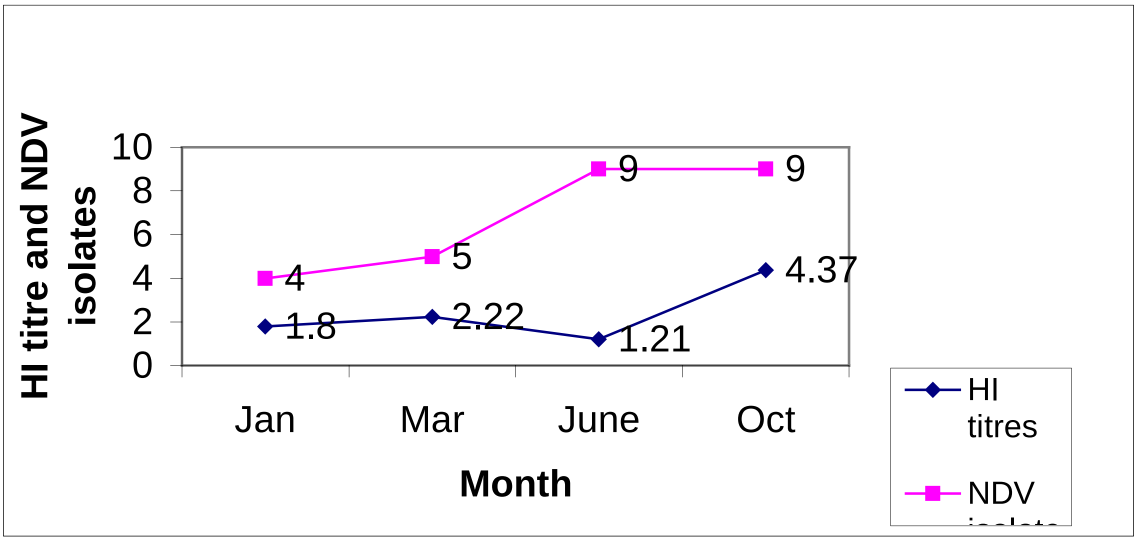

FIG. 4. Monthly average haemagglutination inhibition (HI) titres in logbase 2 and number of Newcastle disease virus isolates.

Taking into consideration that the flocks had no history of ND vaccination, the increase in seropositivity (Fig. 3) and the rise in the mean HI titres indicated sero-conversion from June to October (Fig. 4). This is also supported by the increase in the number of NDV isolates recorded from the same birds. Eighteen NDV isolates were isolated from June to October as opposed to nine from January to March (Fig. 4). The results confirm the seasonal occurrence of ND in village poultry in Tanzania.

2.3.2. Clinical and pathological findings of ND in field cases

During the study 23 field cases were closely observed. Ten were dead, but 13 were obtained as sick birds. The predominant clinical signs observed were nervous signs, greenish to yellowish diarrhoea, peri-orbital oedema, sneezing, gasping and coughing. Cloacal hyperaemia and haemorrhages were seen following closer inspection. Post-mortem examination revealed similar signs as reported by Alexander [9]. However, the most striking signs were the hyperaemic, petechial and ecchymotic haemorrhages on the cloacal mucosa. This sign was pathognomonic for ND and has rarely been reported previously [9]. Mortality observed in 5 flocks in July ranged from 80 to 89.5%. The diagnosis of ND was confirmed by virus isolation from sick and dead chickens with subsequent characterisation.

Two flocks in one village in Morogoro reported ND outbreaks in February. Farmers reported sudden deaths and severely sick birds involving only chicks under two months of age. At post-mortem examination paint brush haemorrhages on thigh, breast and keel muscles were observed. The bursa of Fabricius was hyperaemic and enlarged with oedematous plica. Infectious bursal disease was diagnosed after histology of the bursa of Fabricius and death of ECE after CAM inoculation [16]. This was the first report of IBD in free-range chickens in Tanzania. Disease prevalence in the village poultry could not be determined due to a lack of serological kits for IBD.

2.3.3. Isolation and characterisation of Newcastle disease virus

A total of 37 isolates were made during the study. Twenty seven of the 37 were obtained from apparently healthy chickens (25) and ducks (2). Ten were obtained from sick and dead chickens during a ND outbreak. Virulence was determined by mean death time (MDT) and grouped according to Hanson and Brandy [17]. According to MDT, 24 NDV isolates were velogenic, seven mesogenic and 6 lentogenic. Thirty three isolates were confirmed to be PMV-1 at the Central Veterinary Laboratory, Weybridge, United Kingdom. All isolates were inhibited by monoclonal antibody (mAb) U85. This mAb is specific for classical strains of NDV. However, they were not inhibited by mAb 617/161, which is specific for the NDV responsible for the pigeon panzootic. Preliminary characterisation using a panel of nine mAbs showed antigenic variation of the field isolates.

4. DISCUSSION

There is minimal input in the management of free-range village chickens. The low input is possibly due to the uncertainty created by the high mortality due to Newcastle disease. If mortality could be minimised, farmers could be encouraged to invest in village poultry. Therefore, the control of ND in free-range village chickens is a prerequisite for any programme aiming to improve village poultry production in Tanzania.

Flock data showed high losses in chicks. These could be caused by a combination of disease and poor management. Further studies are needed to determine the contribution of the various risk factors involved in the high mortality rates.

Retrospective data obtained from a VIC, serological results and isolation and pathotyping of field viruses confirmed the seasonal occurrence of ND. The highest prevalence of ND was from June to October. It is recommended that vaccination programmes should be initiated strategically to protect chickens before the active period of NDV infections in June.

Different pathotypes were isolated from apparently healthy chickens and ducks, and from sick chickens. Isolation of virulent NDV from ducks confirmed the presence of NDV in other species of birds in Tanzania. Velogenic and mesogenic NDV could be responsible for epidemics, while lentogenic strains could be responsible for the immunity of survivors of natural infection in some of the ND outbreaks in village poultry.

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