ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 07, pp.53898-53904, July, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

STUDIES ON OCCURRENCE AND PATHOLOGY OF VIRAL DISEASES IN CHICKEN IN AND AROUND SHILLONG, MEGHALAYA

Amlyne G. Momin and *Damodar Singh, Y.

Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram-796014 (India)

ARTICLE INFO

Article History:
Received 08th April, 2017
Received in revised form
09th May, 2017
Accepted 18th June, 2017
Published online 26th July, 2017

Key words:

Occurrence,
Viral diseases,
Chicken,
Shillong, Meghalaya.

ABSTRACT

A study was conducted during the period from August, 2015 to April, 2016 to survey the occurrence of viral diseases in chicken in and around Shillong, Meghalaya, to study the pathology and finally to diagnose them by using common molecular techniques. A total of 370 dead and sick birds were collected from different organized and unorganized poultry farms in and around Shillong, Meghalaya. Of these, 109 cases (i.e. 29.46%) were diagnosed as viral diseases. The diseases were diagnosed based on clinical history, clinical signs/symptoms prior to death, gross lesions observed on post-mortem examination, histopathology and laboratory detection of viral genomes. Among the diseases, Newcastle disease (ND) was found in 15.14%, followed by infectious bursal disease (IBD) in 12.97% and fowl pox (FP) in 1.81%, respectively. Age-wise analysis showed that the maximum number of cases were recorded in the age group of 3-6 weeks (33.03%), followed by 6-9 weeks (28.44%), 9-12 weeks (17.43%), 1-3 weeks (14.68%) and above 12 weeks (6.42%) age groups of chicken. The present study suggests that some important viral diseases are occurring in chicken population in and around Shillong, Meghalaya with higher incidence in 3-6 weeks age groups.

Citation: Amlyne G. Momin and Damodar Singh, Y., 2017. "Studies on occurrence and pathology of viral diseases in chicken in and around Shillong, Meghalaya", *International Journal of Current Research*, 9, (07), 53898-53904.

INTRODUCTION

Poultry industry has made remarkable progress in Meghalaya during the last few decades, from a backyard venture to a considerable sophisticated commercial industry. Total poultry population of Meghalaya was estimated to be 35,65,059 as per 19th Livestock Census, 2012 (Anonymous, 2012). However, a negative trend in the growth was observed in last few years. Egg consumption in Meghalaya is about 38 numbers per head per year which is more than all India level of 30 eggs, but far below the minimum recommended levels. One of the most important reasons behind this is frequent incidence of diseases in poultry farm leading to huge economic losses to the poultry farmers. The poultry health care system in Meghalaya suffers due to difficult geographical terrains which lead to reduced accessibility, weaker linkages and a poor health delivery system. In rural areas, diagnosis of poultry diseases is mostly based on clinical and post-mortem examination. Often the etiology of outbreak of diseases, which cause huge loss to the poultry farmers, remains undiagnosed. The inadequate measures adopted by the stakeholders for the control of diseases in addition to inefficient management have rendered the poultry farming a risky business. Poor reporting system and lack of mass surveillance facilities are also among the major constraints for generating the data regarding exact disease status and the economic losses. However, no detailed studies have been done on poultry diseases in this area so far. So, the epidemiology, pathogenesis and pathology of the poultry diseases in this area are not fully known.

***Corresponding author:* Damodar Singh, Y.**
Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram-796014 (India).

MATERIALS AND METHODS

The epidemiological data pertaining to viral diseases in poultry from August, 2015 to April, 2016 were collected from both organized and unorganized poultry farms in and around Shillong, Mizoram. Detailed information such as total birds in a flock, number of birds affected, number of birds died, age of the affected birds, month of occurrence of the disease, history of previous outbreaks of viral diseases and vaccination status were obtained from the affected flocks. Dead/moribund birds were collected for proper necropsy. Representative tissue samples (heart, liver, spleen, lungs, kidneys, bursa of Fabricius, trachea, proventriculus, caecal tonsil, etc.) showing typical lesions were collected for histopathological examination and laboratory analysis. Both organized and unorganized poultry farms in and around Shillong, Meghalaya were visited

regularly and the morbidity, mortality, age of affection of various diseases were recorded. To assess the age-wise variations in the incidence of the diseases, the birds were grouped as 1-3, 3-6, 6-9, 9-12 and above 12 weeks old. In case of mortality/outbreak of diseases in the poultry population, the clinical signs exhibited by the individual bird during illness were recorded in detail in a prescribed according to the description of the respective poultry farm's owner or attendant. In addition, sometimes some sick/moribund birds were kept under careful observation with feed and water *ad libitum* till death to record the detailed clinical signs along with other abnormalities. Detailed post-mortem examination of all the dead birds was performed. At necropsy, gross tissue changes were observed and recorded carefully. Representative tissue samples (heart, liver, spleen, lungs, kidneys, bursa of Fabricius, trachea, proventriculus, caecal tonsil, brain, feather follicles, etc.) showing lesions were carefully collected in ice and in 10% formaldehyde solution. Viable tissue samples were collected aseptically in sterile polypropylene zipper bags and stored in -80ºC for further analysis.

Formalin fixed tissues (2-3 mm thick) were taken, washed overnight in running tap water and then dehydrated in ascending grades of alcohol starting from 50%, 70%, 90% and absolute alcohol I, alcohol II, alcohol III and finally cleared in xylene. These dehydrated tissue pieces were then embedded in molten paraffin. Sections were cut at 4-5 µm thick with semi-automatic rotary microtome (MRS 3500, Histoline Laboratories) and stained with Mayer's hematoxylin and eosin (Bancroft and Stevens, 1980). The stained slides were examined under a trinocular research microscope (Olympus) and the magnified images of the tissue structures were captured for further study. The diagnosis of the diseases was made mainly basing on the clinical history, signs, characteristic gross lesions and microscopic tissue alterations. However, PCR or RT-PCR assays were employed to confirm the diagnosis by detecting the viral antigens of diseases like infectious bursal disease (IBD), Newcastle disease (ND) and fowl pox.

RESULTS AND DISCUSSION

A total of 370 chicken carcasses were examined, of which 109 (29.46%) cases were diagnosed as viral diseases. This present percent proportionate incidence is found little higher than that of Rahman and Samad (2005) who recorded 22.73% as viral diseases. The incidence of Newcastle disease (15.14%) was found to be the highest followed by infectious bursal disease (12.97%), which is in accordance with the findings of Dey *et al.,* (2009). Fowl pox with a proportionate incidence of 1.81% was low in comparison with ND and IBD, which was similarly reported by Dolka *et al*., (2012), but lower than that of Ukashatu *et al.*, (2012). Age-wise analysis showed that the highest occurrence of viral diseases in the age group of 3-6 weeks (40.38%), which supports the earlier reports of Rahman and Samad (2005). Name of the viral disease, total number of cases examined, age of birds, number of confirmed cases and proportionate incidence% recorded during the present study period are shown in (Table 1).

Newcastle disease (ND)

During the present study period, the disease was found to affect all age groups of birds as similarly described by (Shankar, 2008). Maximum cases of the disease were recorded in 6-9 weeks old chickens (30.71%), which support the findings of Olabode *et al.,* (2012). The percent morbidity (35-50%) and percent mortality (25-35%) recorded during the present study indicates that there might be involvement of virulent NDV in these outbreaks. Common clinical signs recorded during the present study included emaciation, depression, laboured breathing with other respiratory signs such as coughing, sneezing, and nasal discharge. In most of the birds, the lower eyelids were congested and swollen leading to conjunctivitis. Greenish or whitish diarrhea was a frequent finding. Face, head including the wattles showed oedema in some chicken. Nervous signs like torticollis and paralysis were also observed. These findings are almost similar to those of many researchers (Beard and Hanson, 1992; Gowda and Eswaran, 1992; Bhaiyat *et al*., 1994; Capua *et al.*, 2002; Shankar, 2008; Khan *et al.,* 2011; Nidzworski *et al.,* 2013). Some layer birds were seen to lay soft shelled eggs with severe drop in egg production, which had been similarly described by Shankar (2008), Hadipour *et al*., (2011) and Nidzworski *et al.,* (2013). Many birds were found dead suddenly with few or no symptoms, which supports the description of Calnek (1991).

Table 1. Overall occurrence of viral diseases of chicken in and around Shillong, Meghalaya: age-wise distribution and proportionate incidence

Name of disease	Number of Carcasses Examined	Number of suspected cases	Age of birds (weeks)					Number of confirmed cases	Proportionate incidence%
			1-3	3-6	6-9	9-12	>12		
ND	370	87	7 (12.50%)	12 (21.43%)	20 (35.71%)	11 (19.64%)	6 (10.71%)	56	15.14
IBD		75	9 (18.75%)	23 (47.92%)	10 (20.83%)	6 (12.50%)	-	48	12.97
FOWL POX		21	-	1 (20.00%)	1 (20.00%)	2 (40.00%)	1 (20.00%)	5	1.81
TOTAL	370	183	16 (14.68%)	36 (33.03%)	31 (28.44%)	19 (17.43%)	7 (6.42%)	109	29.46

The most common gross changes recorded during the investigation were pin point hemorrhages at the tips of the proventricular glands, while in few cases there were congestion, petechiae and ecchymoses in the mucosa of the proventriculus. Haemorrhagic necrotic ulcers and enteritis with exudates were also observed in the intestines, while haemorrhages and necrotic lesions in caecal tonsils were also recorded in many cases. Similar lesions have been reported by several workers (Beard and Hanson, 1992; Verma, 1994;

Jadhav and Siddique, 1999; Singh, 2008; Hadipour *et al*., 2011; Khan *et al.,* 2011). The lungs were mostly congested, edematous and hemorrhagic which might be due to the degenerative and necrotic changes of the vascular endothelium caused by NDV. Haemorrhagic tracheitis with catarrhal exudates was also found present in many chickens are in support of earlier findings (Alexander and Allan, 1974; Verma, 1994; Jadhav and Siddique, 1999; Singh, 2008). The gross lesions of the spleen and kidneys recorded during this study are almost same as described by Pazhanivel *et al.,* (2002), Nakamura *et al*. (2008) and Hadipour *et al*., (2011) who recorded enlarged, congested and swollen kidneys with urate deposition. Pancreatic necrosis was also found in some birds, which is in agreement with Nakamura *et al*., (2008) who reported the presence of white spots in pancreas. Most of the cases showed haemorrhagic enteritis with infiltration of mononuclear cells in the mucosa and sub-mucosa, while in some cases, there were congestion and necrosis of enterocytes of the intestines. Hemorrhages and necrotic changes were observed in the mucosa and sub-mucosa of proventriculus in many cases. Similar microscopic changes have also been described by many workers (Kindark et *al*., 1996; Younus, 1996; Capua *et al*., 2002; Pazhanivel *et al*., 2002). The caecal tonsils showed hemorrhages, infiltration of heterophil in the lamina propria, lymphoid depletion and necrotic changes which support the previous reports (Stevens *et al*., 1976; Capua *et al*., 2002; Pazhanivel *et al*., 2002). The microscopic changes of lungs and trachea observed during the present study are almost similar to those of Pazhanivel *et al.,* (2002) who found para-bronchial lymphoid cell hyperplasia along with hypertrophy of bronchial epithelial cells, lymphocytic infiltration in lungs, loss of cilia in trachea, marked congestion and hemorrhage in alveoli. In most of the cases, the spleen sections showed depletion and necrosis of lymphocytes. Congestion, haemorrhages and interstitial nephritis observed in the kidney sections support the report of Nakamura *et al*., (2008). Non-suppurative encephalitis and perivascular cuffing observed in the brain sections are in accordance with the earlier reports (Gowda and Eswaran, 1992; Kindark *et al.,* 1996; Nakamura *et al*., 2008). In the present study, the clinical diagnosis was made on the basis of history, clinical signs, gross and microscopic lesions. Then, laboratory confirmation was done by RT-PCR for detection of the NDV viral genome (i.e. F gene). Out of 87 clinically ND suspected cases, 56 (64.37%) cases were found positive for NDV viral genome. Similarly, many workers had applied RT-PCR for detection of NDV (Schelling *et al*., 1999; Hasan *et al*., 2010; Gowthaman, 2011; Khan *et al*., 2012; Thomazelli *et al*., 2012, Madsen *et al*., 2013; Mohammed *et al*., 2013).

Infectious bursal disease (IBD)

In the present study, the maximum cases of IBD was recorded in 3-6 weeks old birds (47.92%), which is in support of Lukert and Saif (1997) as well as the report of Mor *et al.* (2010) who found maximum cases (52.80%) in 21-30 days old birds followed by (33.13%) in 31-40 days old birds in Haryana. Similarly, Khan *et al*. (2009) also found that 4 weeks old broiler were highly susceptible to IBD (38%) followed by 3rd week (28%) and 5th week (28%) and no clinical case was found in first weeks of age. The younger chicks of 1-3 weeks, 6-9 weeks and 9-12 weeks old chickens were also found affected during the investigation, which is in conformity with the earlier reports of Fadley and Nazerian (1983) and Okoye and Uzoukwu (1981) respectively. The disease was found to occur all around the year and the same was reported by Babiker *et al*. (2008). The percent morbidity varied from 3.5 - 5.4% while percent mortality varied between 38.5 - 52.6% during the period under study which is nearly similar to the previous reports (Kurade *et al*., 2000; Saif *et al*., 2000; Dey *et al.*, 2009). The low morbidity and mortality rates recorded during this present study might be due to regular vaccination of the chicks and proper managemental practices. The clinical signs like dullness, depression, anorexia, ruffled feathers and yellowish white or greenish yellow diarrhea recorded during the present investigation are in agreement with the findings of Islam and Samad (2004), Butcher and Miles (2012) and Rashid *et al.,* (2013). Most of the birds were disinclined to move and pecked at their vents and pericloacal feathers were stained with urates. Similar clinical signs had been reported by Cosgrove (1962) and Landgraf *et al*., (1967).

The post-mortem findings of the present study included haemorrhages and darkened discoloration of thigh and breast muscles in most cases, which supports the reports of many researchers (Das *et al.,* 1981; Verma *et al.,* 1981; Lukert and Saif, 1997; Prabhakaran *et al.,* 1997; Islam and Samad, 2004; Singh, 2008; Sultana *et al.,* 2008). In most of the cases, bursa was congested, enlarged and swollen with accumulation of thick creamy or cheesy exudates, while in some cases; there were presence of gelatinous exudates around bursa. These lesions of the bursa are in agreement with the previous reports (Helmboldt and Garner, 1964; Cheville, 1967; Landgraf *et al*., 1967; Skeeles *et al*., 1979; Ley *et al*., 1983; Younus, 1996; Zeleke *et al*., 2005; Dutta *et al.*, 2007; Sultana *et al.*, 2008). The gross lesions of other organs like liver, spleen and proventriculus recorded during this present study are found almost similar to those described by Saif (2008), Morales and Boclair (1993), Prabhakaran *et al.,* (1997), Islam and Samad (2004) and Dutta *et al.,* (2007). In most of the cases, the kidneys were congested, enlarged and swollen, which might be due to deposition of urates caused by the enlarged bursa. Similar observations have been reported by Baxendale (2002), Cosgrove (1962), Younus (1996), Islam and Samad (2004) and Dutta *et al.,* (2007). Thymus in most cases was found to be enlarged, congested and haemorrhagic, which might be due involvement of virulent form of IBDV and secondary infections.

In present study, the bursa of Fabricius showed congestion, complete lymphoid depletion in the follicles leading to formation of cysts filled with necrotic debris, heterophils and hemorrhages in the interfolliclar tissue. In few cases, areas of exudates, necrotic debris with severe heterophillic and lymphocytic infiltration in the bursal lumen were also recorded. These findings are in the line of earlier observations of several workers (Helmboldt and Garner, 1964; Cheville, 1967; Peters, 1967; Henry *et al*., 1980; Okoye and Uzoukwu, 1981; Calnek *et al.,* 1992; Homer *et al*., 1992; Yonus, 1996; Lukert and Saif, 1997; Zeleke *et al.,* 2005; Dutta *et al*., 2007; Samanta *et al.,* 2008). Haemorrhages and necrotic changes with lymphoid depletion in caecal tonsils recorded during the present study period supports the findings of Uddin *et al*., (2010) who observed significant reduction of lymphocytes in caecal tonsils, proventriculus, duodenum, jejunum, ileum and cecum. The spleen in most cases showed depletion of lymphocytes, congestion and focal or diffused areas of hemorrhage are in support of the previous reports (Helmboldt and Garner 1964; Dutta *et al.,* 2007). Congestion, degeneration of tubular epithelium degeneration and deposition of urates in tubular

lumen recorded during the present study are supported by the findings of Dutta *et al*., (2007). Severe congestion in parabronchial area of lungs and microscopic changes of liver which showed congestion, degeneration of hepatocytes and lymphoid aggregations in portal areas might be due to involvement of virulent form of IBDV and secondary infections. The disease was clinically diagnosed on the basis of clinical history from the responsible persons of the farms, recorded clinical signs and gross and microscopic lesions of affected chickens. RT-PCR, a nucleic acid based detection test, was used as confirmatory diagnosis for the detection of IBD viral genome. Tissue samples comprising of bursa, spleen, thymus and liver from a total of 75 clinically IBD suspected cases were tested for detection of the F gene. Out of 75 IBD suspected cases, 48 (64%) cases were found positive. Similar diagnostic techniques have also been performed by several workers (Tham *et al.,* 1995; Jackwood and Jackwood, 1997; Kataria *et al*., 1998; Muller *et al.*, 2003; Mittal *et al*., 2005; Mahmood and Siddique, 2006; Zahoor *et al*., 2010; Islam *et al.,* 2011; Barathidasa *et al.,* 2013). The present RT-PCR positive results (64%) is lower than that of Fatima *et al.,* (2013) who could detect 81 (95.29%) samples positive out of 85 bursal samples, which might be due inproper clinical diagnosis of IBD suspected cases.

Fowl pox (FP)

During the present study period, the disease was observed to affect almost all age groups except the young chickens of 1-3 weeks old, as similarly observed by Jarmin (2006). It was found to occur all around the year as described by Pattison *et al*., (2008). Mortality percentage recorded was very low as the cases were of all cutaneous forms of the disease which caused less severity. Not a single case of diphtheritic form was found during the period of study. The clinical signs recorded during the study period included emaciation, anorexia, weakness and reluctance to move. Wart-like growths on the eyelid leading impair vision were common findings. In some birds egg production was affected. Similar clinical signs have been described by Jordan *et al*., (1996).

The common gross lesions observed in the present study were the wart-like nodular growths which were rough, large after coalescing, brown to grey colour on the face, eyelids and beaks. Similar lesions have also been described by some researchers (Yoshikkawa *et al*., 2002; Riper *et al*., 2006). However, characteristic lesions for diphtheritic form of the disease were not observed in any of the affected birds. Similarly, Khan *et al.,* (2009) also showed dry pox lesions on the external body surfaces of peafowl with no internal lesions in necropsied birds. Some birds had prominent keel bones during post-mortem examination which might be due to starvation. Microscopic changes of the skin recorded during the present study included hydropic degeneration and hyperplastic epithelium of stratum spinosum which showed presence of eosinophillic inclusion bodies - Bollinger bodies. There was congestion & areas of necrosis in superficial layer of skin. These microscopic changes are in agreement with the findings of many workers (Reed and Schrader, 1989; Fallavena *et al.,* 1993; Gerlach *et al.,* 1998; Gortazar *et al.,* 2002; Smits *et al*., 2003; Gulbahar *et al.*, 2005; Beytut and Haligur, 2007). A presumptive diagnosis was made by the presence of wart-like nodules on the unfeathered parts of the body. Confirmation of the disease was accomplished by microscopic examination for characteristic Bollinger bodies. In addition, PCR was also used for confirming the disease by detecting the viral genome (i.e. 4b gene). Several researchers also used similar techniques (Oros *et al*., 1997; Raue and Hess, 1998; Xie *et al.*, 1999; Ganesh, 2002; Rocke *et al*., 2005; Kumar *et al*., 2010; Asthana *et al*., 2012; Thakor *et al*., 2012; Susan *et al*. 2014; Zheng *et al*., 2015). Out of 21 fowl pox suspected cases, 5 cases (23.81%) were found positive for the viral genome. The present study reveals that some viral diseases namely; ND, IBD and Fowl pox are prevalent in poultry population in around Shillong, Meghalaya and the birds aged between 3-6 weeks are most vulnerable to these diseases which need immediate attention for prevention and control.

REFERENCES

Alexander, D.J. and Allan, W.H. 1974. Newcastle disease virus pathotypes. *Avian Pathology* 3: 269-278.

Anonymous, 2012. Livestock census, 2012. Animal Husbandry & Veterinary Department, Government of Meghalaya, Shillong. www.megahvt.gov.in/livestockcensus.html.

Asthana. M., Chandra, R. and Kumar, R. 2012. Hydropericardium syndrome: current state and future Developments. *Archives of Virology* 158(5): 921-31.

Babiker, M.A.A., Yahia, I.E., Nora, K. and Tawfeeg, E.M. 2008. Investigations on nine flocks infected with infectious bursal disease Virus (IBDV) in Khartoum State (Sudan). *International Journal of Poultry Science* 7: 285-288.

Bancroft, J.D. and Stevens, A. 1980. Theory and practice of histological technique. Churchill Livingstone, New York, pp 89.

Barathidasa, R., Singh, S.D., Kumar, M.A., Desingu, P.A., Palanivelu, M., Singh, M. and Dhama, K. 2013. Recurrent outbreaks of infectious bursal disease (IBD) in a layer farm caused by very virulent IBD virus (vvIBDV) in India: Pathology and molecular analysis. *South Asian Journal Experimental Biology* 3: 200-206.

Baxendale, W. 2002. Birnaviridae. Edited Jordan F, Pattison M, Alexander D, Faragher T (eds) 5th edition, W.B. Saunders, *Poultry Disease* 319-323.

Beard, C.W. and Hanson, R.P. 1992. Newcastle disease In: Disease of Poultry 9 th edition pp 452-467. Edited by Calnek BW, Barnes HJ, Beard CW, Reid WM, Yoder HW Jr. Iowa State University Press Maes, Iwa-50010.

Beytut, E. and Haligur, M. 2007. Pathological, Immunohistochemical, and Electron Microscopic Findings in the Respiratory Tract and Skin of Chickens Naturally Infected with Avipoxvirus. *Turkish Journal Veterinary Animal Science* 31:311-317.

Bhaiyat, M.I., Ochiai, K., Itakura, C., Islam, M.A. and Kida, H. 1994. Brain lesions in young broiler chickens naturally infected with a mesogenic strain of Newcastle disease virus. *Journal of Avian Pathology* 23: 693-708.

Butcher, G.D. and Miles, R.D. 2012. Infectious Bursal Disease (Gumboro) in Commercial Broilers. Institute of Food and Agricultural Sciences, University of Florida http://edis.ifas.ufl.edu.

Calnek, B.W. 1991. Newcastle disease. Barnes HJ, Beard CW, Reid WM, Yoder HW (9th ed.). Iowa State University Press, Ames, Iowa-50010, *Diseases of Poultry* 504-505.

Capua, I., Pozza, M.D., Mulinelli, F., Marangon, S. and Terregino, C. 2002. Newcastle disease outbreaks in Italy during 2000. *Veterinary Record* 150: 565-568.

Cheville, N.F. 1967. Studies on the pathogenesis of Gumboro disease in the bursa of Fabricius, spleen and thymus of the chicken. *American Journal of Pathology* 51: 527-551.

Cosgrove, S.D. 1962. An apparently new disease of chickens—avian nephrosis. *Avian Disease* 6: 385–389.

Das, S.B., Verma, K.C. Panisup and Kataria, J.M. 1981. Pathogeneicity of a field isolate of infectious bursal disease virus in chicken. *Indian Journal of Veterinary Pathology* 15: 21-25.

Dey, P.P., Niyogi, D., Sarkar, S., Singh, Y.D., Patra, N.C. and Mukhopadhayay, S.K. 2009. Study on incidence of diseases in meat type birds in and around Kolkata. *Journal of Interacademicia* 13 :477-48.

Dolka, I., Sapierzynski, R., Bielecki, W., Malicka, E., Zbikowski, A. and Szeleszczuk, P. 2012. Histopathology in diagnosis of broiler chicken and layer diseases – review of cases 1999-2010. *Polish Journal of Veterinary Science* 15: 773-779.

Dutta, B., Santosh, H. and Saxena, S.C. 2007. Natural outbreaks of infectious bursal disease (IBD) in Vanaraja birds of Meghalaya. *Indian Journal of Veterinary Pathology* 31:78.

Fadley, A.M. and Nazerian, K. 1983. Pathogenesis of infectious bursal disease in chickens infected with virus at various ages. *Avian Diseases* 27: 714-723.

Fallavena, L.C.B., Rodrigues, N.C., Scheufler, W., Martins, N.R.S., Braga, A.C., Salle, C.T.P. and Moraes, H.L.S. 1993. A typical fowlpox in broiler chickens in southern Brazil. *Veterinary Record* 132: 635.

Fatima, T., Attrassi, B., Yahia, K.I.S. and Belghyti, D. 2013. Detection of Infectious Bursal Disease Virus from clinical samples in Morocco by Agar Gel Immunodiffusion Test and Reverse Transcription-Polymerase Chain Reaction. *International Journal of Pharmaceutical and Biological Sciences Research and Development* 1: 2347-4785.

Ganesh, K., Suryanarayana, V.V.S. and Raghawa, R. 2002. Detection of fowl adenovirus associated with hydropericardium hepatitis syndrome by polymerase chain reaction. *Veterinary Research Communication* 26: 73-80.

Gerlach, H., Ramis, A.J., Enders, F., Casares, M. and Truyen, U. 1998. Avian pox in Lories (Neopsittacus sp.): A case report. *Proceedings of International Virtual Conferences in Veterinary Medicine: Diseases of Psittacine Birds* May 15-June 30.

Gortazar, C., Millan, J., Hofle, U., Buenestado, F.J., Villafuerte, R. and Kaleta, E.F. 2002. Pathology of avian pox in wild red-legged partridges (Alectoris rufa) in Spain. *Annals of the New York Academy of Sciences* 969: 354-357.

Gowda, R.N.S. and Eswaran, R. 1992. Ranikhet disease in pigeons: Clinicopathological studies. *Indian Journal of Veterinary Patients* 16: 95-97.

Gowthaman, V. Singh, S.D. Dharma, K., Barathidasan R. Anjaneya and Ramakrishan, M.A. 2011. Pathology and molecular diagnosis of Newcastle disease virus infection in broiler breeders. *Indian Journal of Veterinary Pathology* 35:168-170.

Gulbahar, M.Y., Çabalar, M. and Boynukara, B. 2005. Avipoxvirus infection in Quails. *Turkish Journal of Veterinary and Animal Sciences* 29: 449-454.

Hadipour, M.M., Habibi, G.H., Golchin, P., Hadipourfard, M.R. and Shayanpour, N. 2011. The Role of Avian Influenza, Newcastle Disease and Infectious Bronchitis Viruses during the Respiratory Disease Outbreak in Commercial Broiler Farms of Iran. *International Journal of Animal and Veterinary Advances* 3:69-72.

Hasan, A.K.M.R., Ali, M.H., Siddique, M.P., Rahman, M.M. and Islam, M.A. 2010. Clinical and Laboratory Diagnoses of Newcastle and Infectious Bursal Disease of chickens. *Bangladesh Journal of Veterinary Medicine* 8: 131 – 140.

Helmboldt, C.F. and Garner, E. 1964. Experimentally induced Gumboro disease (IBA). *Avian Diseases* 8: 561-575.

Henry, C.W., Brewer, R.N., Edgar, S.A. and Gray, B.W. 1980. Studies on infectious bursal disease in chickens. Scoring of microscopical lesion in bursa of Fabricius, thymus of Leghorns experimentally infected with infectious bursal disease virus. *Poultry Sciince* 59: 1006-1007.

Homer, B.L., Butcher, G.D., Miles, R.D. and Rossi, A.F. 1992. Subclinical infectious bursal disease in an integrated broiler production operation. *Journal of Veterinary Diagnostic Investigation* 4: 406-411.

Islam, M.T. and Samad, M.A. 2004. Clinico-pathological Studies on Natural and Experimental Infectious Bursal Disease in Broiler Chickens. *Bangladesh Journal of Veterinary Medicine* 2: 31-35.

Islam, M.T., Islam, M.N., Khan, N.Z.I. and Islam, M.A. 2011. Comparision of Agar Gel Immunodiffusion Test, Immunohistochemistry and RT- Polymerase Chain Reaction for detection of Infectious Bursal Disease Virus. *Bangladesh Journal of Veterinary Medicine* 9: 121-125.

Jackwood, D.J. and Jackwood, R.J. 1997. Molecular identification of infectious bursal disease virus strains. *Avian Diseases* 41: 97-104.

Jadhav, N.V. and Siddique, M.F. 1999. Handbook of Poultry production and management. Printed edn. Jaypee Brothers, Medical Publishers, New Delhi, pp 1990.

Jarmin, S., Ruth, M., Richard, E.G., Stephen, M.L. and Michael, A.S. 2006. Avian poxvirus Phylogenetics: Identification of a PCR length polymorphism that discriminates between the two major clades, Central Vet Lab: Weybridge, UK *Journal of General Virology* 87: 2191-2201.

Jordan, F.P., Alexander, M. and Faraghe, D.T. 1996. 5th ed. Elsevier, China. *Poultry Diseases* pp: 356-358.

Kataria, R.S., Tiwari, A.K., Bandyopadhyay, S.K., Kataria, J.M. and Batchaiah, G. 1998. Detection of Infectious Bursal Disease Virus in clinical samples by RT-PCR. *Biochemistry and Molecular Biology International* 45: 315-322.

Khan, A., Yousaf, A., Khan, M.Z., Siddique, M., Gul, S.T. and Mahmood, F. 2009. Cutaneous form of pox infection among captive peafowl (*Parvo cristatus*) chicks. *Avian Pathology* 38: 65-70.

Khan, M.Y., Arshad, M., Mahmood, M.S. and Hussain, I. 2011. Epidemiology of Newcastle disease in rural poultry in Faisalabad, Pakistan. *International Journal of Agricultural Biology* 13: 491–497.

Kindark, D.D., Verma, K.C., Kataria, J.M. and Sah, R.L. 1996. Pathologenicity of New castle disease virus isolated from Guinea focal, in chicken and guinea fowl. In: *Proceeding abstracts and student papers contributed in international youth programme*. XX World poultry congress.

Kumar, R., Kumar, V., Asthana, M., Shukla, S.K. and Chandra, R. 2010. Isolation and identification of a fowl adenovirus from wild black kites (Milvus migrans). *Journal of Wild Diseases* 46: 272–276.

Kurade, N.P., Bhat, T.K. and Jithendran, K.P. 2000. Occurrence of infectious bursal disease and its pathology in the birds of Himachal Pradesh. *Indian Journal of Veterinary Pathology* 24: 133-134.

Landgraf, H., Vielitz, E. and Kirsch, R. 1967. Occurrence of an infectious disease affecting the bursa of Fabricius (Gumboro disease). *Deutsche* Tierarztliche Wochenschrift 74: 6-10.

Lukert, P.D. and Saif, Y.M. 1997. Infectious bursal disease. Calnek BW, Barnes HJ, Beard, McDougald, LR, Saif YM (ed) 10th ed. Iowa State University Press, Ames, Iowa, *Diseases of Poultry* 721-738.

Madsen, J.M., Zimmermann, N.G., Timmons, J. and Tablante, N.L. 2013. Prevalence and Differentiation of Diseases in Maryland Backyard Flocks. *Avian Diseases* 57: 587-594.

Mittal, D., Jindal, N., Gupta, S.L., Katarina, R.S. and Tiwari, A.K. 2005. Detection of Infectious Bursal Disease Virus in Field Outbreaks in Broiler Chickens by Reverse Transcription-Polymerase Chain Reaction. *International Journal of Poultry Sciences* 4: 239-243.

Mohammed, M.H., Zahid, A.A.H., Kadhim, L.I. and Hasoon, M.F. 2013. Conventional and Molecular Detection of Newcastle Disease and Infectious Bursal Disease in Chickens. *Journal of World's Poultry Research* 3:05-12.

Mor, S.K., Narang G., Jindal, N., Mahajan, N.K., Sharma, P.C. and Rakha, N.K. 2010. Epidemiological studies on infectious bursal disease in broiler chickens in Haryana, India. *International Journal of Poultry Sciences* 9: 395-400.

Morales, O.E. and Boclair, W. 1993. Morphometric relations bursa/ spleen in infectious bursal disease. *Proceedings of the 42nd Western Poultry Disease Conference, Sacramento, California* pp 91-92.

Muller, H., Islam, M.R. and Raue, R. 2003. Research on infectious bursal disease--the past, the present and the future. *Veterinary Microbiology* 97: 153-165.

Nakamura, K., Ohtsu, N., Nakamura, T., Yamamoto, Y., Yamada, M., Mase, M. and Imai, K. 2008. Pathologic and immunohistochemical studies of Newcastle disease *(*ND*)* in broiler chickens vaccinated with ND: severe non-purulent encephalitis and necrotizing pancreatitis*.* *Veterinary Pathology* 45: 928-933.

Nidzworski, D., Wasilewska, E., Smietanka, K., Szewczyk, B. and Minta, Z. 2013. Detection and differentiation of Newcastle disease virus and influenza virus by using duplex real-time PCR. *Acta* Biochimica Polonica 60: 475–480.

Okoye, J.O.A. and Uzoukwu, M. 1981. An outbreak of infectious bursal disease among chickens between 16 and 20 weeks old. *Avian Diseases* 25: 1034-1038.

Olabode, H.O.K., Damina, M.S., Ahmed, A.S., H.M.E.D, Moses, G.D. and Wungak, Y.S. 2012. Retrospective Study of Newcastle disease in commercial Poultry Farms in Ilorin, Kwara State-Nigeria. *Vom Journal of Veterinary Sciences* 9: 66 -70.

Oros, J., Rodriguez, F., Rodriguez, J.L., Bravo, C. and Fernandez, A. 1997. Debilitating cutaneous pox virus infection in Hodgson's Grandala (Grandalacoelicolor). *Avian Diseases* 41: 481-483.

Pattison, M., McMullin, B. and Alexander, D. 2008. 6th ed. Elsevier, India. *Poultry Diseases* pp: 333-339.

Pazhanivel, N., Balasubramaniam, G.A. and Manohar, M.B. 2002. Pathology of New castle disease virus infection in immense and non-immense chicken. *Indian Veterinary Journal* 79: 29-32.

Peters, G. 1967. Histology of Gumboro disease. *Berl Munch Tierarztl Wochensch* 80: 394-396.

Prabhakaran, V., Chithravel, V., Kokilaprabhakaran, S. and Saravanan, C.S. 1997. Infectious bursal disease with concurrent infection of E.coli and coccidiosis Haemogram and Serum chemistry. *Indian Journal of Animal Health* 36: 7-9.

Rahman, M.A. and Samad, M.A. 2005. Important viral diseases associated with mortality of layer chickens in commercial poultry farms in Bangladesh. *Bangladesh Journal of Veterinary Medicine* 3(1): 1-5.

Rashid, M.H., Xue, C., Islam, M.T., Islam, M.R., She, Z. and Cao, Y. 2013. Comparative epidemiological study of infectious bursal disease of commercial broiler birds in Bangladesh and China. *Pakistan Veterinary Journal* 33: 160-164.

Raue, R. and Hess, M. 1998. Hexon based PCR combined with restriction enzyme analysis for rapid detection and differentiation of fowl adenoviruses and egg drop syndrome virus. *Journal of Virological Methods* 73: 211–217.

Reed, W.M. and Schrader, D.L. 1989. Pathogenicity and immunogenicity of Mynah pox virus in chickens and Bobwhite quail. *Poultry Science* 68: 631-638.

Riper, V.C. III and Forrester, D. 2006). Avian Pox. *Infectious Diseases of Wild Birds* 06: 131-176.

Rocke, T., Converse, K., Meteyer, C. and Mclean, B. 2005. The impacts of disease in the American White Pelican in North America. *Water birds* 28: 87-94.

Saif, E.M., Aly, M., El-Aziz, A.M.A. and Mohamed, F.M. 2000. Epidemiological studies on Gumboro disease in Upper Egypt. *Assiut Veterinary Medical Journal* 42: 223-241.

Samanta, A., Niyogi, D., Ghoosh, H.K, Ghosh, C.K. and Mukhopadhayay, S.K. 2008. Histopathological changes in bursa of broiler birds inoculated with IBD intermediate plus vaccine virus and virulent field IBD virus. *Indian Journal of Veterinary Pathology* 32: 70-72.

Schelling, E., Thur, B., Griot, C. and Audige, L. 1999. Epidemiological study of Newcastle disease in backyard poultry and wild bird populations in Switzerland. *Avian Pathology* 28: 263-272.

Shankar, B.P. 2008. Common Respiratory Diseases of Poultry: review. *Veterinary World* 1: 217-219.

Singh, K.S. 2008. Studies on some common diseases of birds with special reference to Infectious bursal disease, Ranikhet disease, Colibacillosis and Gangrenous dermatitis. Phd. Thesis submitted to West Bengal University of Animal and Fishery Science, 37, 38, KB Sarani, Kolkata 700037.

Smits, J.E., Tella, J.L., Carrete, M., Serrano, V. and Lopez, G. 2003. An Epizootic of Avian pox in Endemic Short-toed Larks (Calndrellarufescens) and Berthelot's Pipits (Anthusberthelotti) in the Canary Islands*.* *Journal of Veterinary Pathology* 42: 1-59.

Stevens, J.G., Nakamura, R.M., Cook, M.L. and Wilczynski, S.P. 1976. Newcastle disease as a model for paramyxovirus- induced neurological syndromes: pathogenesis of respiratory disease and preliminary characterization of the ensuing encephalitis. *Infections and Immunity* 13: 590-599.

Sultana, R., Hussain, S.Y., Ilyas, Ch. S, Maqbool, A., Anjum, R. and Zaidi, F.H. 2008. Epidemiology of Infectious Bursal Disease in Broiler and Layer Flocks in Lahore, Pakistan. *Punjab University Journal of Zoology* 23: 067-072.

Susan, S., El-Mahdy, M.H., Awaad, H. and Soliman, Y.A. 2014. Molecular identification of local field isolated fowl pox virus strain from Giza governorate of Egypt. *Veterinary World* (7): 2231-0916.

Thakor, K.B., Dave, C.J., Fefar, D.T., Jivani, B.M. and Prajapati, K.S. 2012. Pathological and molecular diagnosis of naturally occurring inclusion body hepatitis-hydropericardium syndrome in broiler chickens. *Indian Journal of Veterinary Pathology* 36(2): 212-216.

Tham, K.M., Young, L.M. and Moon, C.D. 1995. Detection of infectious bursal disease virus by reverse transcription-polymerase chain reaction amplification of the virus segment A gene. *Journal of Virological Methods* 53: 201-212.

Thomazelli, L.M., Araujo, J. de, Ferreira, C., de S., Hurtado, R., Oliveira, D.B., Ometto, T., Golono, M., Sanfilippo, L., Demetrio, C., Figueiredo, M.L. and Durigon, E.L. 2012. Molecular Surveillance of the Newcastle Disease Virus in Domestic and Wild Birds on the North Eastern Coast and Amazon Biome of Brazil. *Brazilian Journal of Poultry Science* 14:01-07.

Uddin, M.M., Khan, M.Z.I., Islam, K.N., Kibria, A.S.M.G., Adhikary, G.N., Parvez, M.N.H., Basu, J., Uddin, M.B. and Rahman, M.M. 2010. Distribution of lymphocytes in the mucosa associated lymphoid tissues (MALT) of naturally occurring infectious bursal disease (IBD) in chicken. *Pakistan Veterinary Journal* 30: 67-71.

Ukashatu, S., Magaji, A.S., Najamuddeen, G. and Saulawa, M.A. 2012. Survey of poultry diseases among exotic breeds of poultry in Katsina metropolis, Katsina state, Nigeria. *Scientific Journal of Zoology* 1:69-73.

Verma, D. 1994. Studies on characterization, Pathogenicity and immunogenicity of a field isolate of Newcastle disease virus from fowl. M.V.Sc Thesis submitted to Deemed University, Indian Veterinary Research Institute, Izatnagar. *Indian Journal of Veterinary Pathology* 19: 64-65.

Verma, K.C., Panisup, A.S., Mohanty, G.C. and Reddy, B.D. 1981. Infectious bursal disease (Gumboro disease) and associate condition in poultry flock of Andra Pradesh. *Indian Journal of Poultry Science* 16: 385-392.

Xie, Z., Fadl, A.A., Girshick, T. and Khan, M.I. 1999. Detection of avian adenovirus by polymerase chain reaction. *Avian Diseases* 43: 98–105.

Yoshikkawa, G.T. and Alam, J. 2002. Histopathological Studies of Fowl Pox in Bantams. *International Journal of Poultry Science* 1:197-199.

Younus, M. 1996. A practical approach to poultry disease diagnosis first print, Dr Younus Laboratory, Hyderabad, Andra Pradesh, pp 20-25, 75-80, 86-91, 112-1213.

Zahoor, M.A., Abubakarb, M., Naimc, S., Khand, Q.M. and Arshedb, M.J. 2010. Incidence and Molecular Characterization of Infectious Bursal Disease Virus in Commercial Broilers in Pakistan. *International Journal of Agro Veterinary and Medical Sciences* 4: 75-80.

Zeleke, A., Gelaye, E., Sori, T. and Ayelet, G. 2005. Investigation on Infectious Bursal Disease Outbreak in Debre Zeit, Ethiopia. *International Journal of Poultry Science* 4(7): 504-506.

Zheng, M., Cao, H., Wei, X., Qin, Y., Ou, S, Huang, X., He, M., Xia, Z., Zheng, L., Li, J. and Liu, Q. 2015. Outbreak-Associated Novel Avipoxvirus in Domestic Mallard Ducks, China. *Emerging Infectious Diseases* 21: 372–373.

****