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Retrospective Study on Epidemiology of Infectious Bursal Disease in Broiler Chickens in Haryana, India

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A B S T R A C T

A retrospective study was conducted to understand the epidemiology of infectious bursal disease (IBD) in broiler chicken flocks in Haryana state. The epidemiological data related to IBD outbreaks for the period from January 2008 to June 2016 was analyzed. A total of 1368 outbreaks of IBD occurred during this period with overall morbidity, mortality and case fatality rate of 4.19%, 2.61% and 62.34% respectively. The disease was recorded throughout the year with maximum outbreaks in August month and in quarter July to September. Out of 1368 IBD outbreaks, maximum number of 734 (53.7%) IBD outbreaks were reported in 21-30 days of age followed by 349 (25.5%) in 11-20 days of age, 259 (18.9%) in 31-40 days of age and 26 (1.9%) outbreaks in 41-50 days of age. This indicates an increase in number of IBD outbreaks in 11-20 days of age cases as compared to earlier reports. Out of total IBD outbreaks, 918 were recorded in vaccinated flocks while 450 were in unvaccinated flocks. The case fatality rate was higher in unvaccinated flocks. Concurrent diseases were recorded in 627 IBD affected flocks. Pneumonia, coccidiosis, respiratory disease complex (RDC), *E. coli* infection, mycotoxicosis, Ranikhet disease and heat stroke were the major concurrent diseases. Improper immunization schedule, unhygienic conditions on the farm, emergence of newer strains of IBD virus, interference or absence of maternal antibodies could be the reasons for disease in vaccinated flocks. Continuous study may help in better understanding of infectious bursal disease in broiler chickens in this region.

Introduction

Infectious bursal disease (IBD) or Gumboro disease is an acute (Van den berg *et al.*, 1991), highly contagious viral infection of poultry and causes heavy mortality and immunosuppression. It is caused by RNA virus of Avibirnavirus genus of Birnaviridae family (Dobos *et al.*, 1979). After its first outbreak in poultry in Gumboro town in Southern Delaware in the United States in 1957 (Cosgrove, 1962), the disease has been recorded from all over the world (Asrani *et al.*, 1993, Muller *et al.*, 2003). Between 1960 and 1964, the disease affected most regions of the USA (Lasher and Davis, 1997), and reached Europe in the years 1962 to 1971 (Faragher, 1972). From 1966 to 1974, the disease was identified in the Middle East, southern and western Africa, India, the Far East and

Australia (Faragher, 1972; Firth, 1974; Jones, 1986; Van den Berg, 2000). IBD was first reported by Mohanty *et al.,* (1971) from Uttar Pradesh in India.

The variant IBDV strains emerged in 1980's in IBDV-vaccinated farms in the Delmarva area and in the late 1980's, very virulent infectious bursal disease virus (vvIBDV) emerged in Europe (Chettle *et al.,* 1989) which rapidly spread across continental Europe and Asia (Lin *et al.,* 1993; Shcherbakova *et al.,* 1998), Middle East (Pitcovski *et al.,* 1998), South America (Difabio *et al.,* 1999), and Africa (Zierenberg *et al.,* 2000). However, there are significant differences between the African, European and Asian vvIBDV strains, suggesting independent evolution (Van den Berg, 2000). Based on a recent study, it is expected that, worldwide, about 60 to 76% of IBDV isolates are of vvIBDV genotype (Jackwood and Sommer, 2007; He *et al.,* 2012). The strain variation seems to be one of reason for outbreaks of IBD even in the vaccinated flocks.

IBD has been reported in Assam (Sami and Baruah, 1997), Himachal Pradesh (Kurade *et al.,* 2000), Tamil Nadu (Sivaseelan and Balachandran, 2003), Uttar Pradesh (Desingu *et al.,* 2013) and in different parts of Haryana (Jindal *et al.,* 2004; Mittal *et al.,* 2005; Mor *et al.,* 2010). Epidemiological study on the basis of data of poultry diseases from disease investigation laboratory Hisar, Haryana for the period July 1994 to June 2003 revealed that 8.89% flocks out of 795 poultry flocks were affected with vvIBDV (Jindal *et al.,* 2004). Similar study for the period July 2005 to June 2008 revealed 4.54% morbidity with IBD in 483 poultry flocks of Haryana (Mor *et al.,* 2010). Out of these 483 flocks, 334 flocks were vaccinated and 149 flocks were unvaccinated. We analyzed the epidemiological data of IBD outbreaks from January 2008 to June 2016 in broiler chickens in parts of Haryana.

Materials and Methods

The epidemiological data of IBD in broiler chickens from January 2008 to June 2016 was collected from disease investigation laboratory of department of Veterinary Public Health and Epidemiology, Hisar. Live or dead birds are brought by the poultry farmers to laboratory for disease investigation on routine basis. Detailed information such as total birds in a flock, number of birds affected, number of birds died, age of affected birds, month of occurrence of disease, vaccination status and type of vaccines used was obtained from affected flocks. The disease was diagnosed in broiler chickens on the basis of clinical signs and pathognomic lesions as detailed in results and whenever required the representative samples were subjected to histopathological and PCR studies. Year wise distribution, temporal distribution, month wise, age wise and vaccination status were the criteria's used to analyse the IBD outbreaks. Data so collected was analyzed using Pearson Chi square test. Alpha was set at 95%. Statistical software SPSSTM 20.0 (IBM, Corp. USA) was used.

Results and Discussion

Occurrence of the disease

Out of a total of 28044 disease outbreaks recorded during the period from January 2008 to June 2016, 1368 outbreaks (4.9%) were of IBD. On analyzing the eight and a half year data, 98 IBD outbreaks were reported during the year 2008, 92 in 2009, 198 in 2010, 289 in 2011, 128 each in 2012 and 2013, 158 in 2014, 171 in 2015 and 106 outbreaks in 2016 up to the month of June (Table 1). The number of IBD outbreaks were highest in the year 2011 as compared to other years, however, the

percent IBD outbreaks were highest in 2016 (7.1%) and lowest in 2012 (3.2%) (Fig. 1). During the period, the disease affected 3,93,257 birds (4.19%) out of 9383790 birds and caused mortality of 2,45,161 (2.61%) broiler chicks.

On an average the case fatality rate (CFR) due to the IBD was 62.34%. Pearson Chi square value was 16545.09 for morbidity, 10997.53 for mortality and 2389.36 for case fatality. Chi-square analysis showed that the prevalence of IBD significantly ($p < 0.05$) varied over the years.

High case fatality rate reflects acute form of the disease in majority of the IBD-affected flocks. High case fatality rate and mortality may lead to considerable economic losses to the poultry farmers. In a previous study, Jindal *et al.,* (2004) reported that IBD affected 8.89% flocks during the nine year period with morbidity, cumulative mortality and case fatality rate of 5.9%, 3.63% and 61.43% respectively in Haryana state. Mittal *et al.,* (2005) also recorded that IBD in broiler chicks accounted for 6.13% of outbreaks during the period from July, 2002 to June, 2003 in Haryana state. Mor *et al.,* (2010) reported morbidity, cumulative mortality and case fatality rate of 4.54%, 2.34% and 51.69% respectively.

The results of the present study are in agreement with these reports. It appeared that over the years the occurrence of disease was increasing from 2008 to 2011 and came down in 2012 and again showed increasing trend till 2016. This is probably due to continuous strain variation in field virus as well as vaccination strategies adopted by the vaccine industry and farmers. The area of Haryana where this study was conducted is primarily a broiler chicken raising area. Such a study would provide a better picture about the epidemiology of IBD.

Temporal distribution

The whole year was divided into 4 quarters viz. Jan-March (A); April-June (B); July-Sept. (C); and Oct.-Dec. (D). The disease was recorded in all the quarters with maximum percent (7.50) of IBD outbreaks observed in quarter July-September (C) corresponding to rainy season. This was followed by quarter D (4.96%), B (4.08%) and quarter A (3.81%) respectively in descending order. Percent morbidity varied from 3.74-5.02%. It was significantly higher in quarter B than that in quarter C. Mortality rate varied from 2.38-3.09%. The case fatality rate was higher in quarter C (63.75%) followed by quarter D (63.69%), B (61.57%) and A (60.36%) (Fig.2). Pearson Chi square value was 5339.29 for morbidity, 2789.14 for mortality and 333.70 for case fatality in birds. Chi-square analysis showed that the prevalence of IBD significantly ($p < 0.05$) varied over the different quarters (Table 2). These findings have the support of Choudhary *et al.,* (2012) who reported that the incidence of IBD was higher among chickens during monsoon season (36.73%) than the winter months (30.83%) in and around the Ranchi, India. Rashid *et al.,* (2013) also reported that higher mortality was observed in rainy season than other seasons.

Jindal *et al.,* (2004), Mittal *et al.,* (2005) and Mor *et al.,* (2010) reported comparatively more outbreaks in winter season than in summer and rainy seasons in Haryana state. Though the occurrence of IBD in this study was more in July to September quarter (rainy season), percent morbidity and cumulative mortality were comparatively higher in April to June quarter (summer months). High mortality in summer season is expected because of high temperature stress. Immediately after rains, there is high humidity in the environment which may also substantially increase the mortality rate.

Month wise distribution

Disease was present in all the months. Maximum number of IBD outbreaks were recorded in August month (175) followed by 136, 128, 125, 116, 111, 105, 104, 99, 98, 95, 76 in April, July, January, November, September, May, October, March, December, June and February respectively (Fig. 3). Percent morbidity varied from 3.28-7.81% while percent mortality varied between 1.77-3.2%. Case fatality rate ranged from 55.21 to 69.21%. Percent morbidity and mortality were highest in June month however the case fatality rate was highest in the month of July (Table 3).

Effect of age

The number of outbreaks in the age group of 21-30 days (53.7%) was higher than in the age groups of 11-20 (25.5%), 31-40 (18.9%) and 41-50 days (1.9%) (Fig.4). The morbidity rate due to the disease was 3.34% in chickens of age group 11-20 days, 4.63% in age group 21-30 days, 4.34% in age group 31-40 days and 3.15% in age group 41-50 days. Percent mortality varied from 1.91%-2.98% and was highest in chickens of age group 21-30 days and lowest in the age group 11-20 days. The CFR was maximum (75.05%) in birds of age group 41-50 days followed by 64.32%, 60.70% and 57.12% in birds of age groups 21-30, 31-40 and 11-20 days respectively (Table 4). It is interesting to note here that number of IBD outbreaks have increased in the age group of 11-20 days as compared to previous studies (10.2% as reported by Mor *et al.,* 2010) which is in contrast to general concept that birds are refractory to IBD for upto 3 weeks of age due to presence of maternal antibodies (MAbs). This could possibly be due to emergence of virulent strains of viruses (Sah *et al.,* 1995). This may also be due to early age of vaccination of chicks in our area leading to neutralization of MAbs in some flocks as reported by some other workers (Tsukamoto *et al.,* 1995; Alam *et al.,* 2002; Hair-Bejo *et al.,* 2004; Moraes *et al.,* 2005) and may be due to absence of MAbs in some flocks making them susceptible to field virus. From our study, it appeared that the chicks of age 21-30 days were more susceptible to the disease with higher percent morbidity and mortality. Studies conducted in Ghana also revealed that 80% of the cases due to IBD occurred in the birds of age group 3-5 weeks (Anku, 2003). Mittal *et al.,* (2005) reported that the disease was maximum in the age group of 21-30 days followed by 31-40 and 41-50 days in Haryana state. Zeleke *et al.,* (2005) in Ethiopia reported that disease was affecting 20-45 days old broiler and layer chickens in the month of March and April. Mor *et al.,* (2010) observed higher (52.80%) occurrence of IBD in broiler chickens of 21-30 days of age and 10.2% of cases in the age group of 11-20 day of age.

Effect of vaccination

To study the impact of vaccination on disease occurrence, the data was analyzed with regard to disease and vaccination status in flocks. 918 (67.1%) of the disease outbreaks during the study period were in vaccinated flocks while the remaining 450 (32.9%) were in unvaccinated flocks. Case fatality rate was comparatively more in unvaccinated flocks (66.71%) than in vaccinated flocks (61.01%). Commonly used vaccines against IBD were of Intermediate (I), intermediate plus (I^+), Georgia (G), MB strains. The vaccination was generally carried out in broiler chicks of 12-15 days of age through drinking water. The IBD outbreaks in vaccinated flocks have been reported by many workers (Mor *et al.,* 2010; Choudhary *et al.,* 2012; Adamu *et al.,* 2013; Rashid *et al.,* 2013; Owolodun *et al.,* 2015, Morla *et al.,* 2016; Patel *et al.,* 2016). Mittal *et al.,* (2005) also reported that more number (80%) of outbreaks occurred in vaccinated flocks than the unvaccinated flocks.

Table.1 Year-wise distribution of IBD in broiler chickens from January 2008 to June 2016

Year	Total outbreaks	No IBD outbreaks (%)	Flock size	Morbidity (%)	Mortality (%)	CFR[1] (%)
2008	2646	98 (3.7)	536150	21316 (3.98)	15680 (2.92)	73.56
2009	2320	92 (4.0)	588300	21283 (3.62)	13295 (2.26)	62.47
2010	3933	198 (5.0)	1014130	37700 (3.72)	23450 (2.31)	62.20
2011	4796	289 (6.0)	1807820	71153 (3.94)	45091 (2.49)	63.37
2012*	4063	128 (3.15)	858160	22770 (2.65)	13276 (1.55)	58.30
2013*	3308	128 (3.87)	937630	43630 (4.65)	27121 (2.89)	62.16
2014*	2758	158 (5.73)	1241720	47680 (3.84)	27314 (2.20)	57.29
2015*	2729	171 (6.27)	1380980	79560 (5.76)	47853 (3.47)	60.15
2016	1491	106 (7.1)	1018900	48165 (4.73)	32081 (3.15)	66.61
Total	**28044**	**1368 (4.9)**	**9383790**	**393257 (4.19)**	**245161 (2.61)**	**62.34**

* - part of MVSc thesis of Dr. Preeti (2016), VPHE department

[1] Case fatality rate

Table.2 Temporal distribution of IBD in broiler chickens from January 2008 to June 2016

Quarters	Total outbreaks	No. of IBD outbreaks (%)	Flock size	Morbidity (%)	Mortality (%)	CFR* (%)
Jan.-March (A)	7873	300 (3.81)	2227300	90012 (4.04)	54334 (2.44)	60.36
April-June (B)	8236	336 (4.08)	2228530	111917 (5.02)	68909 (3.09)	61.57
July-Sept. (C)	5523	414 (7.50)	2627080	105243 (4.01)	67089 (2.55)	63.75
Oct.-Dec. (D)	6412	318 (4.96)	2300880	86085 (3.74)	54829 (2.38)	63.69
Total	**28044**	**1368 (4.88)**	**9383790**	**393257 (4.19)**	**245161(2.61)**	**62.34**

*Case fatality rate

Table.3 Month-wise distribution of IBD in broiler chickens from January 2008 to June 2016

Month	No. of IBD outbreaks	Flock size	Morbidity (%)	Mortality (%)	CFR* (%)
January	125	837250	31858 (3.81)	21724 (2.59)	68.19
February	76	581450	23785 (4.09)	13636 (2.35)	57.33
March	99	808600	34369 (4.25)	18974 (2.35)	55.21
April	136	938850	28297 (3.01)	16652 (1.77)	58.85
May	105	636930	32640 (5.12)	20362 (3.20)	62.38
June	95	652750	50980 (7.81)	31895 (4.89)	62.56
July	128	839740	34978 (4.17)	24208 (2.88)	69.21
August	175	1086840	39038 (3.59)	24754 (2.28)	63.41
September	111	700500	31227 (4.46)	18127 (2.59)	58.05
October	104	802620	26335 (3.28)	17128 (2.13)	65.04
November	116	756360	28765 (3.80)	17694 (2.34)	61.51
December	98	741900	30985 (4.18)	20007 (2.70)	64.57
Total	**1368**	**9383790**	**393257 (4.19)**	**245161 (2.61)**	**62.34**

*Case fatality rate

Table.4 Distribution of IBD outbreaks in different age groups of broiler chickens

Age group (days)	No of IBD outbreaks (%)	Flock size	Morbidity (%)	Mortality (%)	CFR (%)
11-20	349 (25.5)	2639730	88115 (3.34)	50329 (1.91)	57.12
21-30	734 (53.7)	5140370	238194 (4.63)	153201 (2.98)	64.32
31-40	259 (18.9)	1384250	60039 (4.34)	36446 (2.63)	60.70
41-50	26 (1.9)	219440	6909 (3.15)	5185 (2.36)	75.05
Total	**1368**	**9383790**	**393257 (4.19)**	**245161 (2.61)**	**62.34**

Table.5 Effect of vaccination on occurrence of IBD in different age groups of broiler chickens

Age group (days)	No of IBD outbreaks (%)	Flock Size	Morbidity (%)	Mortality (%)	CFR (%)
Vaccinated Group					
11-20	240 (26.14)	1847700	72060 (3.90)	39650 (2.15)	55.02
21-30	477 (51.96)	3954470	193480 (4.89)	121890 (3.08)	63.00
31-40	183 (19.94)	808400	32360 (4.00)	19740 (2.44)	61.00
41-50	18 (1.96)	146800	3335 (2.27)	2490 (1.70)	74.66
Total	**918**	**6757370**	**301235 (4.46)**	**183770 (2.72)**	**61.01**
Unvaccinated Group					
11-20	109 (24.22)	792030	16055 (2.03)	10679 (1.35)	66.52
21-30	257 (57.1)	1185900	44714 (3.77)	31311 (2.64)	70.03
31-40	76 (16.88)	575850	27679 (4.81)	16706 (2.90)	60.36
41-50	8 (1.88)	72640	3574 (4.92)	2695 (3.71)	75.41
Total	**450**	**2626420**	**92022 (3.50)**	**61391 (2.34)**	**66.71**

Fig.1 Percent IBD outbreaks in broiler chickens from January 2008 to June 2016

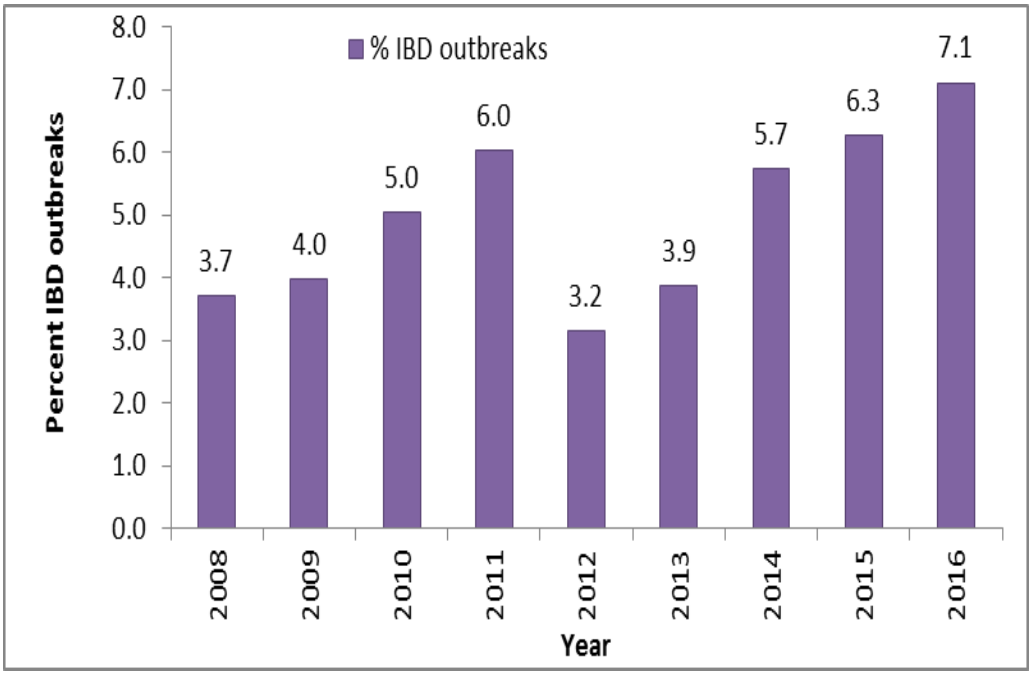


Fig.2 Case fatality rate due to IBD in broiler chicken in different quarters from January 2008 to June 2016

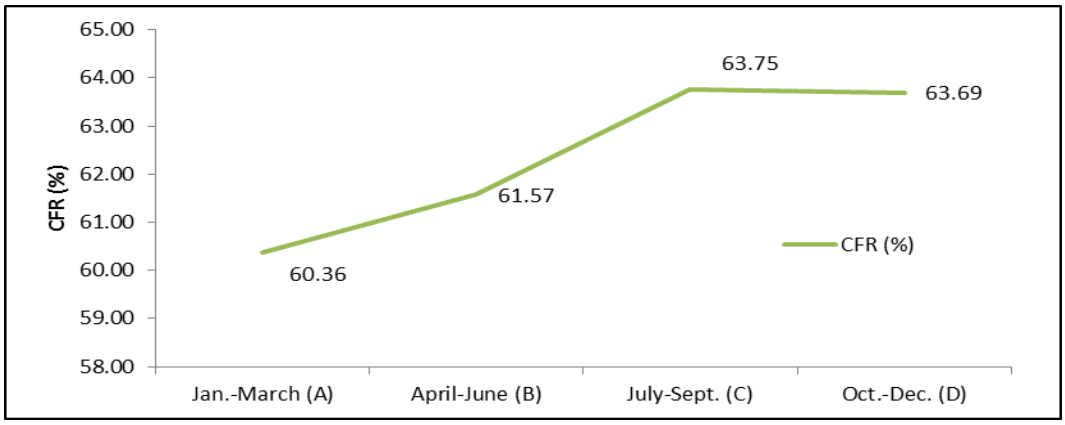


Fig.3 Month wise occurrence of IBD outbreaks in broiler chickens from January 2008 to June 2016

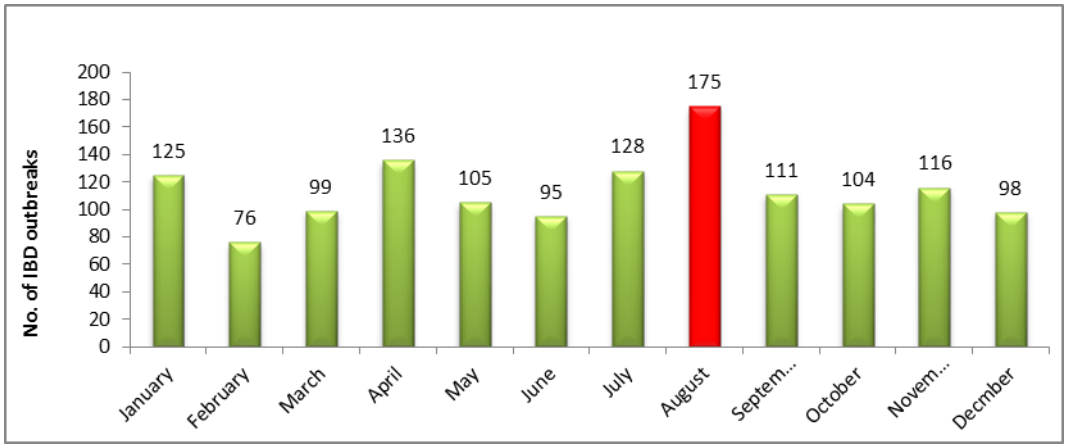


Fig.4 Bar diagram showing IBD outbreaks (%) in different age groups of broiler chickens

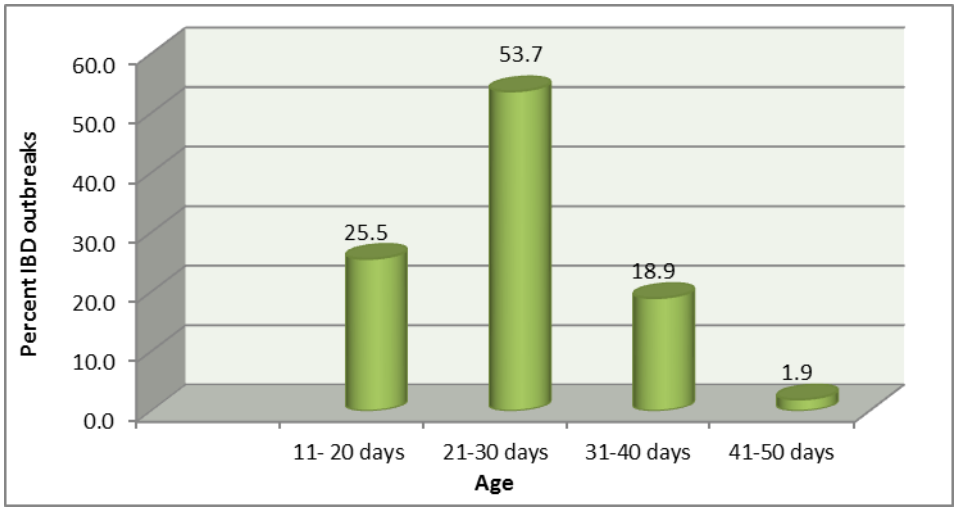
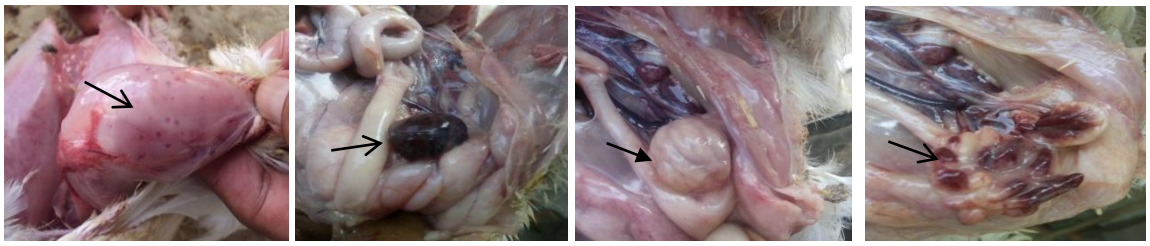


Fig.5 Photographs showing post-mortem lesions in infectious bursal disease affected broiler chickens



(a) (b) (c) (d)

a) Haemorrhages on thigh muscles
b) Swollen, edematous and haemorrhagic bursa of Fabricius
c) Swollen, edematous bursa of Fabricius
d) Gelatinous exudates around bursa with haemorrhages in bursa

The IBD outbreaks in vaccinated flocks have also been recorded by Anku (2003) in Southern Ghana. Mor *et al.*, (2010) observed that 69.15% of IBD affected flocks were vaccinated against this disease. Rashid *et al.*, (2013) found that mortality due to IBD was significantly higher in unvaccinated birds as compared to vaccinated birds. Vaccine efficacy highly depends on the dose and strains of the vaccine and challenge viruses, as well as, the route of administration, the appropriate vaccination time, and the levels of maternal antibodies (OIE, 2012).

In Haryana, intermediate or intermediate plus vaccines (both live vaccines) of different manufacturers are generally used in broiler chicks and are administered through the drinking water. These vaccines though accord protection against IBD but are also immunosuppressive. A number of predisposing factors like overcrowding, poorly constructed brooder house and poor ventilation may be responsible for disease to occur in vaccinated flocks. Other factor could be the use of various strains of IBD vaccines that have failed to develop the desired immune response due to antigen variations within the causative agent. Poor vaccination practices, non-maintenance of cold chains during transport and at farm, use of chlorinated water for vaccine, exposing vaccine virus to outside environment for a longer duration, improper handling of vaccine, health status of flock, concurrent disease and low maternal antibody levels in day old chicks may also contribute to the occurrence of IBD even in vaccinated flocks. Most of the poultry farmers in this part of Haryana are not fully aware about proper handling of vaccines. If the vaccines is not properly handled and exposed to sunlight for a longer duration, the vaccination may not produce desired level of antibodies and such flocks though vaccinated will behave as unvaccinated flocks and would be prone to disease.

Concurrent infections were recorded in 627 flocks out of 1368 in the present study; pneumonia, coccidiosis, respiratory disease complex (RDC), *E. coli* infection, mycotoxicosis, Ranikhet disease and heat stroke were the major concurrent diseases observed. Khurshid *et al.*, (1993) also reported secondary infections like coryza, colibacillosis and coccidiosis in broiler flocks affected with IBD. Anku (2003) reported that coccidiosis often accompanied the IBD outbreaks in Ghana. Mor *et al.*, (2010) also reported concurrent infections with IBD. It is difficult to pin point whether IBD was a primary or secondary disease in flocks where there was concurrent infection. The diseases

observed along with IBD are also capable to induce immunosuppression and predispose birds to IBD. Rashid *et al.*, (2013) also observed mixed infection of New castle disease, Marek's disease, infectious bronchitis, salmonellosis, colibacillosis, aspergillosis along with IBD. Conversely, IBD may also induce immunosuppression and predispose birds in a flock to secondary complications. Further studies are required to determine whether these diseases are primary or secondary to IBD.

Clinical findings

The IBD affected birds brought to disease investigation laboratory, Hisar showed varied symptoms like dullness, depression, anorexia, ruffled feathers, diarrhoea, dehydration and inability to move. Feed intake of the affected birds was drastically reduced. Similarly, water intake was also affected. There was yellowish white or greenish yellow diarrhoea in most of the affected birds.

Post-mortem findings

In almost all IBD-affected birds, the post-mortem lesions were observed in bursa of Fabricius. Haemorrhages on thigh and pectoral muscles (Fig. 5a), haemorrhages in bursal follicles (Fig. 5b), oedematous and swollen bursa (Fig. 5c), and presence of gelatinous exudates around bursa were recorded (Fig. 5d).

These changes were observed in acute form of the disease. However, in chronic form of the disease, the bursal changes comprised of atrophy and presence of cheesy core inside the bursa. The haemorrhages on thigh and pectoral muscles were of milder degree in sub-acute form of disease. In some of the flocks, haemorrhages at the junction of proventriculus and gizzard were also recorded.

From the present study, it can be concluded that outbreaks of IBD occur throughout the year in broiler chicken flocks in Haryana state even after vaccination. IBD showed increasing trend from 2012 to 2016. More IBD outbreaks were recorded in 11-20 and 21-30 days age groups. More IBD outbreaks were recorded in July- September quarter (rainy season).

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