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MORTALITY AND DISEASE STATUS IN HY-LINE AND ISA-BROWN STRAINS OF LAYER CHICKENS REARED IN CAGE SYSTEM IN BANGLADESH

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ABSTRACT

Mortality and disease status in Hy-Line (n= 3450) and ISA-Brown (n = 250) strains of layer chickens were carried out in three commercial layer farms in the district of Mymensingh from day-old to 65 weeks age of birds from September 2003 to December 2004. The management including housing, hygienic measures, vaccination practices, diseases occurred and mortality were observed and recorded daily. Diseases and disorders were diagnosed based on the disease history, clinical signs, characteristics necropsy lesions, morbidity and mortality rates, and laboratory investigations including bacteriological and parasitological examinations. The morbidity and mortality of chickens caused by different diseases and disorders were statistically analyzed on the basis of farms, strains of birds, age and seasons. An overall 32.38% (n = 1198) morbidity and 21.30% (n = 788) mortality was recorded among 3700 chickens. Etiological analysis showed that the highest mortality caused by bacterial diseases (7.08%), followed by viral diseases (5.81%), fungal diseases (2.18%), mycoplasmosis (1.89%), parasitic diseases (1.83%) and nutritional and other disorders (2.48%). Specific diseases and disorders caused mortality in chickens included Salmonellosis (3.14%), Colibacillosis (2.51%), Fowl cholera (0.46%), Infectious coryza (0.41%), Necrotic enteritis (0.59%), Infectious bursal disease (2.19%), Newcastle disease (1.76%), Avian leukosis (0.73%), Fowl pox (0.51%), Marek's disease (0.62%), Aspergillosis (1.54%), Aflatoxicosis (0.65%), Mycoplasmosis (1.89%), Ascaridiasis (0.22%), Tapeworm infection (0.16%), Coccidiosis (1.32%), Ectoparasitosis (0.14%), Nutritional deficiency (0.68%), Ascites, Hydropericardium hepatitis syndrome (0.49%), Cannibalism (0.27%), Egg peritonitis (0.22%), Egg bound disorder (0.43%) and Heat stroke and cold (0.41%). Diseases caused highest mortality during laying period (8.43%), followed by growing (6.32%), pullet stage (4.65%) and brooding (3.78%) ages. Both the morbidity and mortality rates in ISA-Brown strain (62.60% and 37.20%) were found significantly ($p < 0.01$) higher in comparison to Hy-Line (30.17% and 20.14%) strain of chickens. Seasonal influences on mortality in layer type chickens showed significantly ($p < 0.01$) highest mortality during summer (8.57%), followed by winter (6.51%) and rainy (6.22%) months. It may be concluded that the infectious diseases even with vaccination associated with high morbidity and mortality in commercial egg type chickens in Bangladesh.

Key words: Morbidity, mortality, hy-line, ISA-Brown, layer chickens, necropsy, Bacteriological methods

INTRODUCTION

Poultry farming is emerging as a strong agro-based industry from the backyard poultry rearing system to commercial intensive rearing systems during the last two decades in Bangladesh. This rapid growth of poultry industry to supplement their income with the fast development of poultry industry, the occurrence of diseases has increased many folds which remain the major problem affecting its economy as a results disease play a vital role to better understand the status and pattern of diseases. The prevalence of chicken diseases diagnosed on dead birds have been reported from Bangladesh (Giasuddin *et al*., 2002; Sil *et al*., 2002; Islam *et al*., 2003; Saleque *et al*., 2003; Shil *et al*., 2003). The pattern of diseases with their etio-pathological findings of dead chickens based on diagnostic results of the Poultry Disease Diagnostic Center have been reported from Bangladesh as a single and concurrent infections (Rahman and Samad, 2003), systemic and miscellaneous diseases (Rahman and Samad, 2004), viral etiology (Rahman and Samad, 2005) and bacterio-pathological studies (Rahman *et al*., 2004). Mortality plays a major role in determining profit from egg type layers and is a function of dead and culled birds over the growth and production period. A negative association of mortality with net profit in chicken production has been reported by Zaheer-ud-Din *et al.* (2001), Asghar *et al.* (2000) and Farooq *et al*. (2002). Kitsopanidis and Manos (1991) also reported a reduction in net profit when mortality was more than 2 to 5%, whereas North and Bell (1990) reported poor economic performance of egg type layers at mortality level of more than 10%. Mortality in egg type chicken at any stage of life will affect performance of egg type layers, however,

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higher mortality during the laying period will badly affect productivity. This paper describes the current status of diseases and disorders with their causes associated with morbidity and mortality in Hy-Line and ISA-Brown strains of layer chickens at various stages of life reared in cage system in Bangladesh.

MATERIALS AND METHODS

This study was conducted on 3700 layer type chickens from day-old to 65 weeks of age at the three different commercial layer farms in the district of Mymensingh during the period from September 2003 to December 2004. These include Al-Arafa Poultry Complex, Suitiakhali; Master Poultry Farm, Sutiakhali and Noor Ali's Farm, Bhabkhali, and the layer birds of all the three farms reared in cage system. The main aims to investigate the morbidity and mortality associated with diseases and disorders with their causes in layer chickens reared in cage system

The management systems of the selected three layer farms were closely observed by regular visiting them intensively and by taking regular information from the owners of the farms. Data from the randomly selected three layer farms regarding shed capacity and cage size, flock size, sources of chicks, strains of chickens, cage management and hygiene, feed additives, vitamin-mineral supplements, treatment and egg production traits.

The signs of the disease if showed by the chickens of all the three farms were recorded properly. The morbidity, mortality, age of affection of various diseases and disorders were also recorded. The moribund and dead chickens were collected as soon as possible for necropsy. Diseases and disorders were diagnosed based on the history provided by the owners, clinical signs, characteristic post-mortem gross lesions, morbidity and mortality rates and laboratory investigations including bacteriological and parasitological examinations as described by Samad (2005).

The clinical signs exhibited by the individual bird during illness were recorded in detail by visiting and from the farm workers and the sick birds were also purchased from the selected farms with low price and maintained isolated in the Departmental experimental poultry shed to study the causative agents, clinical signs and post-mortem lesions, and microbiological examinations of the samples. Fecal samples were examined directly under the microscope for detection of parasitic infection.

Bacteriological examination

Samples were collected by the sterilized cotton swabs from heart, liver, infected ova, infundibulum, peritoneal fluid, intestine and respiratory tract of the layer chickens (moribund and/or dead) suspected for salmonellosis and colibacillosis at necropsy and were kept into the test tube containing nutrient broth. These test tubes were then transported via thermo-flask containing ice to the bacteriological laboratory.

The swab containing test tubes with nutrient broth were incubated for growth of the causative organisms at 37 °C for overnight. For primary cultures the broth samples were inoculated separately in nutrient agar (NA) and incubated at 37 °C for overnight. The colonies on the primary cultures were repeatedly sub-cultured in enriched and selective media by streak plate method until the pure culture with homogenous colonies was obtained. Blood agar (BA), Eosin-Methylene blue (EMB) agar, MacConkey agar (MA) and Salmonella-Shigella (SS) agar (HiMedia Laboratories Ltd., Mumbai, India) were used in the repetitive sub-cultures for isolation and identification of the causative agents as described by Cheesbrough (1985).

The isolated colonies of bacteria were stained with Gram's stain to study the morphological and staining characteristics of bacteria as described by Parker and Collier (1990). For the cultural characteristics, discrete colonies on the agar surface were observed. Their shape, size, consistency and color were observed carefully.

Biochemical tests

Carbohydrate fermentation tests using five basic sugars namely dextrose, sucrose, maltose, lactose and mannitol were performed for further diagnostic confirmation of the isolated bacteria in pure culture as per method described by Cheesbrough (1985). After incubation for 24 hours at 37 °C of the test tubes containing different sugars and test organisms, the fermentation was indicated by the change of phenol red to yellow color with the production of acid and/ or gas.

The management systems and the vaccination schedule performed in the three different farms are presented in Table 1 and 2, respectively.

Table 1. Management practices of the randomly selected three layer chicken farms in Mymensingh district

S/N	Parameters	Farm No. 1	Farm No. 2	Farm No. 3
①	Name of layer farm	Al-Arafa Poultry Complex	Master Poultry Farm	Noor Ali's Farm
②	Source of chicks	Kazi Farms Ltd.	Kazi farm Ltd.	Paragoan Poultry Farm Ltd.
③	Total No. of chickens	3150	300	250
④	Strains of chickens	Hy-Line	Hy-Line	ISA-Brown
⑤	Housing and Feeding	Intensive, hand made feed	Intensive, market feed	Intensive, market feed
⑥	Antiseptic foot bath	Used	Used	Used

Table 2. Vaccination schedule used in the three different layer farms in Mymensingh district

S/N	Vaccines	Disease	Farm No. 1		Farm No. 2		Farm No. 3	
			Age (days)	Dose and route	Age (days)	Dose and route	Age (days)	Dose and route
①	IB + ND (Intervet)	IB and ND	5	1 drop in one eye	-	-	3	1 drop in one eye
②	Gumboro D78 (Intervet)	IBD	16 and 24	1 drop in one eye	25	1 drop in one eye	14 and 22	1 drop in one eye
③	Mv5 Clone-30 (Intervet)	ND	35	1 drop in one eye	14 and 40	1 drop in one eye	30	1 drop in one eye
④	Ovodipth erin (Intervet)	Fowl pox	45	Wing-web pricking	49	Wing-web pricking	-	-
⑤	Novivac coryza (Intervet)	Infectious coryza	-	-	-	-	42	SC (0.5 ml)
⑥	Fowl cholera (LRI)	Fowl cholera	-	-	60	SC (0.5ml)	-	-

IB = Infectious bronchitis, IBD = Infectious bursal disease, ND = Newcastle disease, SC = Sub-cutaneously

Statistical analysis

Results were analyzed statistically by using Chi-square (χ^2) test for significance in the mortality pattern of various diseases in layer birds in respect to age and seasons (Steel and Torrie, 1981).

RESULTS AND DISCUSSION

Characteristic clinical sign, necropsy and laboratory methods have been used to investigate the morbidity and mortality caused by diseases and disorders in 3700 layer egg type chickens of three different commercial poultry farms in the district of Mymensingh during the period from September 2003 to December 2004. Analysis of the results reveled that 1198 (32.38%) layer birds were affected with different diseases, of which 788 (21.30%) chickens died (Table 3). Of the 788 (21.30%) dead chickens, 262 (7.08%) died due to bacterial diseases, 215 (5.81%) due to viral diseases, 81 (2.19%) due to fungal diseases, 70 (1.89%) due to mycoplasmosis, 68 (1.84%) due to parasitic diseases and 92 (2.49%) due to nutritional disorders and other causes (Table 3 and 4).

Table 3. Susceptibility between Hy-Line and ISA-Brown strains of chickens to different diseases and disorders

S/N	Diseases and disorders	Farm-1 Hy-Line (n = 3150)		Farm-2 Hy-Line (n = 300)		Total Hy-Line (n = 3450)		Farm-3 ISA-Brown (n = 250)		Overall Both strains (n = 3700)	
		No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)
A.	**Bacterial diseases**	**281** (8.92)	**205** (6.51)	**51** (17.00)	**32** (10.67)	**332** (09.62)	**237** (06.87)	**44** (17.60)	**25** (10.00)	**376** (10.16)	**262** (7.08)
1.	Salmonellosis	126 (4.00)	097 (3.08)	18 (6.00)	11 (3.67)	144 (4.17)	108 (3.13)	14 (5.60)	08 (3.20)	158 (4.27)	116 (3.14)
2.	Colibacillosis	095 (3.02)	074 (2.35)	17 (5.67)	11 (3.67)	112 (3.25)	085 (2.46)	13 (5.20)	08 (3.20)	125 (3.38)	093 (2.51)
3.	Fowl cholera	018 (0.57)	011 (0.35)	06 (2.00)	03 (1.00)	024 (0.70)	014 (0.41)	06 (2.40)	03 (1.20)	030 (0.81)	017 (0.46)
4.	Infectious coryza	018 (0.57)	009 (0.29)	05 (1.67)	03 (1.00)	023 (0.35)	012 (0.00)	06 (2.40)	03 (1.20)	029 (0.78)	015 (0.41)
5.	Necrotic enteritis	024 (0.76)	014 (0.44)	05 (1.67)	04 (1.33)	029 (0.84)	018 (0.52)	05 (2.00)	03 (1.20)	034 (0.92)	021 (0.57)
B.	**Viral diseases**	**231** (7.33)	**163** (5.17)	**51** (17.00)	**28** (9.33)	**282** (8.17)	**191** (5.54)	**40** (16.00)	**24** (9.60)	**322** (8.70)	**215** (5.81)
6.	Infectious bursal disease	094 (2.98)	064 (2.03)	17 (5.67)	10 (3.33)	111 (0.22)	074 (2.14)	12 (4.80)	07 (2.80)	123 (3.32)	081 (2.19)
7.	Newcastle disease	069 (2.19)	050 (1.59)	15 (5.00)	08 (2.67)	084 (2.43)	058 (1.68)	12 (4.80)	07 (2.80)	096 (2.59)	065 (1.76)
8.	Avian leukosis	029 (0.92)	020 (0.63)	06 (2.00)	03 (1.00)	035 (1.01)	023 (0.67)	05 (2.00)	04 (1.60)	040 (1.08)	027 (0.73)
9.	Fowl pox	018 (0.57)	012 (0.38)	07 (2.33)	04 (1.33)	025 (0.72)	016 (0.46)	05 (2.00)	03 (1.20)	030 (0.81)	019 (0.51)
10.	Marek's disease	021 (0.66)	017 (0.53)	06 (2.00)	03 (1.00)	027 (0.78)	020 (0.58)	06 (2.40)	03 (1.20)	033 (0.89)	023 (0.62)
C.	**Fungal diseases**	**088** (2.79)	**061** (1.94)	**17** (5.67)	**11** (3.67)	**105** (3.04)	**072** (2.09)	**15** (6.00)	**09** (3.60)	**120** (3.24)	**081** (2.19)
11.	Aspergillosis	059 (1.87)	045 (1.43)	11 (3.67)	07 (2.33)	070 (2.03)	052 (1.51)	09 (3.60)	05 (2.00)	079 (2.14)	057 (1.54)
12.	Aflatoxicosis	029 (0.92)	016 (0.51)	06 (2.00)	04 (1.33)	035 (1.01)	020 (0.58)	06 (2.40)	04 (1.60)	041 (1.11)	024 (0.65)
D.	**Mycoplasmosis**	**081** (2.57)	**054** (1.71)	**15** (5.00)	**08** (2.67)	**096** (2.78)	**062** (1.80)	**14** (5.60)	**08** (3.20)	**110** (2.97)	**070** (1.89)
E.	**Parasitic diseases**	**072** (2.29)	**042** (1.33)	**22** (7.33)	**14** (4.67)	**094** (2.72)	**056** (1.62)	**19** (7.60)	**12** (4.80)	**113** (3.05)	**068** (1.84)
13.	Ascaridiasis	012 (0.38)	004 (0.13)	04 (1.33)	02 (0.67)	016 (0.46)	006 (0.17)	03 (1.20)	02 (0.80)	019 (0.51)	008 (0.22)
14.	Tapeworm infestation	008 (0.25)	003 (0.10)	02 (0.67)	02 (0.67)	010 (0.29)	005 (0.14)	02 (0.80)	01 (0.40)	012 (0.32)	006 (0.16)
15.	Coccidiosis	044 (1.40)	032 (1.02)	13 (4.33)	09 (3.00)	057 (1.65)	041 (1.19)	11 (4.40)	08 (3.20)	068 (1.84)	049 (1.32)
16.	Ectoparasitosis	008 (0.25)	003 (0.10)	03 (1.00)	01 (0.33)	011 (0.32)	004 (0.12)	03 (1.20)	01 (0.40)	014 (0.38)	005 (0.14)

F.	**Nutritional disorders**	**112**	**065**	**20**	**12**	**132**	**077**	**25**	**15**	**157**	**092**
	and others	(3.56)	(2.06)	(6.67)	(4.00)	(3.83)	(2.23)	(10.00)	(6.00)	(4.24)	(2.49)
17.	Nutritional deficiency	037	020	04	03	041	024	06	03	047	025
		(1.17)	(0.63)	(1.33)	(1.00)	(1.19)	(0.70)	(2.40)	(1.20)	(1.27)	(0.68)
18.	Ascites and HHS	021	012	05	03	026	015	05	03	031	018
		(0.67)	(0.38)	(1.67)	(1.00)	(0.75)	(0.43)	(2.00)	(1.20)	(0.84)	(0.49)
19.	Cannibalism	013	007	02	02	015	009	03	02	026	010
		(0.41)	(0.22)	(0.67)	(0.80)	(0.43)	(0.26)	(1.20)	(0.80)	(0.70)	(0.27)
20.	Egg bound disorders	014	011	03	02	017	013	04	03	021	016
		(0.44)	(0.35)	(1.00)	(0.67)	(0.49)	(0.38)	(1.60)	(1.20)	(0.57)	(0.43)
21.	Egg peritonitis	011	006	03	02	014	008	-	-	014	008
		(0.35)	(0.19)	(1.00)	(0.67)	(0.41)	(0.23)			(0.38)	(0.22)
22.	Heat stroke and	016	009	03	02	019	011	07	04	026	015
	cold	(0.51)	(0.29)	(1.00)	(0.67)	(0.55)	(0.32)	(2.80)	(1.60)	(0.70)	(0.41)
	Total	865	590	176	105	1041	695	157	093	1198	788
		(27.46)	(18.73)	(58.67)	(35.00)	(30.17)	(20.14)	(62.80)*	(37.20)*	(32.38)	(21.30)

HHS = Hydropericardium hepatitis syndrome n = Number of birds **Significant at ($p < 0.01$) *Insignificant ($p > 0.05$)

The morbidity and mortality pattern in egg type chickens of different age groups caused by different diseases and disorders are presented in Table 3. Of the 3700 population of chickens of the three farms, 1198 (32.38%) birds of various ages were affected clinically of which 778 (21.30%) layer birds died. This high mortality (21.30%) in egg type chickens recorded in this study could be compared with the lower mortality reported by Farooq *et al.* (2002) who reported 6.67% mortality in egg type chickens. These losses were higher than that of the optimized level of mortality (8 to 10%) reported by North and Bell (1990) in egg type layers for better profitability. The high mortality in egg type chickens could be attributed to outbreak of diseases, sub-standard management and health practices, poor quality of chicks or feed and filthy environment.

Etiological analysis of the recorded diseases and disorders showed highest mortality rate with bacterial diseases (7.08%), followed by viral diseases (5.81%), fungal diseases (2.19%), mycoplasmosis (1.89%), parasitic diseases (1.84%) and nutritional disorders and others (2.49%). Comparatively higher mortality rate have been reported by Rahman and Samad (2003) who reported 39.81% bacterial diseases, 22.73% viral diseases, 13.65% mycoplasmosis, 10.11% parasitic diseases, 3.43% nutritional disorders and 1.54% fungal diseases. These differences might be due to differences of the experimental design. The present study was designed to detect the population mortality whereas Rahman and Samad (2003) who studied the case fatality rate in chickens in which dead birds were submitted for diagnosis in the laboratory.

The age-wise analysis on the overall mortality in chickens showed significantly ($p < 0.01$) highest mortality in adult layers (8.43%), followed by grower (6.32%), pullets (4.65%) and lowest in brooding chicks (3.78%). These results support the findings of Rahman and Samad (2003) who reported highest mortality adult layers (45.52%), followed by grower (24.04%) and pullets (18.16%) and lowest in brooding (12.28%) chickens. Ghodasara *et al*. (1992) also reported relatively higher mortality rate during laying (49%) than during the brooding (26%) and growing period (24%), resulting in poor performance. Farooq *et al*. (2002) reported higher mortality during brooding (50.4%) and laying (31.3%) than during growing (18.3%) period. However, these variations might be due to variation of geo-climatic conditions, management status, litter or cage system of rearing, biosecurity status, immunization status, social awareness and moreover techniques used for the diagnosis and analysis of the data.

Morbidity and mortality on strains of chickens

The susceptibility to diseases and disorders between Hy-Line and ISA-Brown strains of chickens are presented in Table 3. The morbidity and mortality recorded in ISA-Brown strains (62.80% and 37.20%) were found

significantly ($p < 0.01$) higher in comparison to Hy-Line strain (30.17% and 20.14%) chickens, respectively (Table 3). This study recorded 0.41% morbidity and 0.23% mortality caused by egg peritonitis in Hy-Line strain but not in ISA-Brown strain (Table 3). However, Farooq *et al.* (2002) reported higher mortality in Hy-Line and ISA-Brown strains than in Babcock and Nick-chickens. Petek (1999) and Tolimir and Masic (2000) also reported differences in mortality among various strains of egg type chickens.

Bacterial diseases

Salmonellosis

Salmonellae caused Pullorum disease, Fowl typhoid, Fowl paratyphoid and other related infections in chickens (Hossain and Islam, 2004 and Samad, 2005). This study was recorded overall 3.14% (n = 116) mortality caused by salmonellosis. Higher mortality rate was recorded in adult layer chickens (1.54%) in comparison to growing (0.67%), pullet (0.72%) and brooding (0.51%) stages of birds (Table 4). These results support the earlier reports of Giasuddin *et al.* (2002) who reported 5.56% and Islam *et al.* (2003) reported 6.73% mortality of chickens due to salmonellosis. Sasipreeyajan *et al.* (1996) isolated Salmonella from chicken litter (42%), drinking water (36%) and from feed troughs (28%), and in addition, it is also recognized vertically transmitted disease. However, the mortality due to salmonellosis recorded in this study were lower than those reported by Giasuddin *et al*. (2002) and Islam *et al.* (2003) in Bangladesh and elsewhere by North and Bell (1990) who reported 50% which might be due to indiscriminate use of antibiotics in flocks.

Significantly ($p < 0.01$) higher mortality in layer birds due to salmonellosis were recorded during summer (1.22) in comparison to rainy (1.0%) and winter (0.92%) seasons (Table 5). These findings support the report of Rahman and Samad (2003) who reported highest case fatality rate due to salmonellosis in summer (48.05%), followed by rainy (28.31%) and lowest in winter (23.66%) seasons. These findings indicate that salmonellosis is still an important disease problem in the poultry industry in Bangladesh.

Colibacillosis

Colibacillosis, caused by *Escherichia coli* is one of the most common bacterial diseases causing syndromes like air sacculitis, cellulitis, omphalitis, peritonitis, salpingitis, synovitis and coligranuloma. This study recorded an overall 2.51% mortality rate of colibacillosis in layer chickens which supports the earlier reports of Sarker (1976) reported 5.0% and Talha *et al*. (2001) reported 5.51% mortality rate due to colibacillosis in chickens in Bangladesh. Talha *et al.* (2001) and Rahman *et al.* (2004) reported higher proportinate prevalence rate of colibacillosis in growing chickens in comparison to adults whereas Bhattacharjee *et al.* (1996) reported widely prevalence of colibacillosis in both the brooding (12.82%) and pre-production (8.78%) and post-production (5.49%). It also appears that the *E. coli* infection is widely prevalent (0.45 to 1.0%) in all age groups of chickens with high mortality rate in adult layer birds (Table 4). Qu *et al.* (1997) reported 5.5% mortality and 10 to 20% drop in egg production with *E. coli* infections in egg type layers reared in cage. Zenella *et al*. (2000) reported 5 to 10% mortality due to *E. coli* infection with no pronounced signs, suggesting that the infection may be there but couldn't be easily detected until regular tests are performed for its proper diagnosis. The situation leading to mortality with no pronounced clinical signs will be more critical as it wound result in heavier losses of reduced egg production prior to the investigations. *E. coli* is not only associated with reduction of egg production and mortality, it could be a pre-disposing factor for other concurrent infections like Infectious bursal disease, coccidiosis, mycoplasmosis and others (Singh *et al*., 1994; Prabhakaran *et al*., 1997; Rahman and Samad, 2003). Therefore, it is important to control *E. coli* infections in chickens, thereby preventing losses due to this disease and other associated infections.

Fowl cholera

Fowl cholera (FC) is one of the common bacterial diseases of layer birds, caused by *Pasteurella multocida.* and it has been reported as outbreak form in Bangladesh (Choudhury *et al*., 1985). This study was recorded as 0.46% mortality in layer chickens which support the earlier report of Bhattacharjee *et al.* (1996) who reported 1.98% prevalence of Fowl cholera in layer chickens. In addition, Talha *et al.* (2001) reported 3.15% and Giasuddin *et al*. (2002) reported 3.08% prevalence of Fowl cholera in chickens.

Table 4. Overall morbidity and mortality caused by diseases and disorders in layer birds in three layer farms

S/N	Diseases and disorders	Brooding (Up to 3 wks) (n = 3700)		Growing (> 3 - 8 wks) (n = 3560)		Pullet (> 8 - 20 wks) (n = 3335)		Layers (> 20 wks) (n = 3180)		Total (n = 3700)	
		No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)	No. sick (%)	No. died (%)
A.	**Bacterial diseases**	**64 (1.73)**	**39 (1.05)**	**94 (2.64)**	**64 (1.80)**	**75 (2.25)**	**55 (1.65)**	**143 (4.50)**	**104 (3.27)**	**376 (10.16)**	**262 (7.08)**
1.	Salmonellosis	30 (0.81)	19 (0.51)	33 (0.93)	24 (0.67)	32 (0.96)	24 (0.72)	63** (1.98)	49* (1.54)	158 (4.27)	116 (3.11)
2.	Colibacillosis	28 (0.76)	17 (0.46)	37 (1.04)	27 (0.76)	19 (0.57)	17 (0.51)	41 (1.29)	32* (1.00)	125 (3.32)	93 (2.51)
3.	Fowl Cholera	-	-	4 (0.11)	2 (0.06)	8 (0.24)	5 (0.15)	18 (0.57)	10* (0.31)	30 (0.81)	17 (0.46)
4.	Infectious coryza	3 (0.08)	1 (0.03)	6 (0.16)	3 (0.08)	9 (0.26)	5 (0.15)	11 (0.35)	6* (0.19)	29 (0.78)	15 (0.40)
5.	Necrotic enteritis	3 (0.08)	2 (0.08)	14 (0.39)	8* (0.22)	7 (0.21)	4 (0.12)	10 (0.31)	7* (0.22)	34 (0.31)	21 (0.57)
B.	**Viral diseases**	**80 (2.16)**	**55 (1.49)**	**87 (2.44)**	**59 (1.66)**	**70 (2.10)**	**43 (1.29)**	**86 (2.70)**	**58 (1.82)**	**322 (8.70)**	**215 (5.81)**
6.	Infectious bursal disease	49 (1.32)	34** (0.92)	45 (1.26)	32 (0.89)	19 (0.57)	10 (0.30)	10 (0.31)	5 (0.16)	123 (3.32)	81 (2.19)
7.	Newcastle disease	21 (0.57)	12 (0.32)	23 (0.65)	15 (0.42)	25 (0.75)	17 (0.51)	27 (0.85)	21* (0.66)	96 (2.56)	65 (1.76)
8.	Avian leukosis	2 (0.05)	2 (0.05)	6 (0.17)	4 (0.11)	9 (0.27)	6 (0.18)	23 (0.72)	15* (0.47)	40 (1.08)	27 (0.79)
9.	Fowl pox	4 (0.11)	4 (0.11)	8 (0.22)	4 (0.11)	9 (0.27)	5 (0.15)	10 (0.31)	6* (0.19)	30 (0.81)	19 (0.51)
10.	Marek's disease	4 (0.11)	3 (0.08)	5 (0.14)	4 (0.11)	8 (0.24)	5 (0.15)	16 (0.50)	11** (0.35)	33 (0.89)	23 (0.62)
C.	**Fungal diseases**	**25 (0.68)**	**16 (0.42)**	**55 (1.54)**	**41** (1.15)**	**24 (0.72)**	**13 (0.39)**	**16 (0.50)**	**11 (0.35)**	**120 (3.24)**	**81 (2.19)**
11.	Aspergillosis	17 (0.46)	10 (0.27)	43 (1.21)	35** (0.98)	13 (0.39)	8 (0.24)	6 (0.19)	4 (0.13)	79 (2.13)	57 (1.54)
12.	Aflatoxicosis	8 (0.22)	6 (0.16)	12 (0.34)	6 (0.17)	11 (0.33)	5 (0.15)	10 (0.31)	7* (0.22)	41 (1.10)	24 (0.65)
D.	**Mycoplasmosis**	**19** (0.51)	**12** (0.32)	**30** (0.84)	**17** (0.48)	**25** (0.75)	**17** (0.51)	**36** (1.13)	**24*** (0.75)	**110** (2.97)	**70** (1.89)
E.	**Parasitic diseases**	**5 1 (0.14)**	**39 (0.03)**	**30 (1.10)**	**22 (0.84)**	**9 (0.66)**	**47* (0.27)**	**28* (1.48)**	**113 (0.88)**	**68 (3.05)**	**(1.84)**
13.	Ascaridiasis	5 (0.14)	1 (0.03)	4 (0.11)	3 (0.08)	4 (0.12)	1 (0.03)	6 (0.19)	3 (0.09)	19 (0.51)	8 (0.22)
14.	Tapeworm infestation	-	-	2 (0.06)	1 (0.03)	4 (0.12)	1 (0.03)	6 (0.19)	4 (0.13)	12 (0.32)	6 (0.16)
15.	Coccidiosis	-	-	31 (0.87)	25** (0.70)	10 (0.30)	6 (0.18)	27 (0.85)	18 (0.57)	68 (1.83)	49 (1.32)
16.	Ectoparasitic infestation	-	-	2 (0.06)	1 (0.03)	4 (0.12)	1 (0.03)	8 (0.25)	3 (0.09)	14 (0.37)	5 (0.14)
F.	**Nutritional deficiency & others**	**31 (0.84)**	**17 (0.46)**	**24 (0.67)**	**14 (0.39)**	**29 (0.87)**	**18 (0.54)**	**73** (2.30)**	**43 (1.35)**	**157 (4.24)**	**92 (2.49)**

17. Nutritional deficiency	18 (0.49)	9 (0.24)	10 (0.28)	7 (0.20)	7 (0.21)	4 (0.12)	12 (0.38)	5 (0.16)	47 (1.27)	25 (0.68)
18. Ascites and HHS	8 (0.22)	5 (0.14)	5 (0.14)	3 (0.08)	6 (0.18)	4 (0.12)	12 (0.38)	6 (0.19)	31 (0.83)	18 (0.49)
19. Cannibalism	-	-	2 (0.06)	1 (0.03)	5 (0.15)	3 (0.09)	11 (0.35)	6 (0.19)	26 (0.70)	10 (0.27)
20. Egg peritonitis	-	-	-	-			14 (0.44)	8 (0.25)	16 (0.44)	8 (0.22)
21. Egg bound disorder	-	-	-	-			21 (0.66)	16 (0.50)	21 (0.56)	16 (0.43)
22. Heat stroke and cold	5 (0.14)	3 (0.08)	7 (0.20)	3 (0.08)	5 (0.15)	3 (0.09)	9 (0.28)	6 (0.19)	26 (0.70)	15 (0.40)
Total	223 (6.03)	140 (3.78)	329 (9.24)	225 (6.32)	245 (7.35)	155 (4.65)	401 (12.61)	268** (8.43)	1198 (32.38)	788 (21.30)

HHS = Hydropericardium hepatitis syndrome n = No. of birds **= Significant at (p <.01) *Insignificant (p > 0.05)

This disease was recorded in chickens of more than 3 weeks of age in all the three layer farms with significantly ($p < 0.01$) highest mortality (0.31%) in adult layer chickens (Table 4). This observation is in conformity with the earlier report of Choudhury *et al.* (1985) who reported FC in chickens aged between 6 to 12 months old, Talha *et al.* (2001) reported FC in chickens from more than 2 weeks of old with highest incidence in adult (> 20 weeks birds) and Rahman *et al.* (2004) who reported FC in chickens more than two weeks of age with significantly ($p <0.01$) highest occurrence in adult layer chickens.

Seasonal influence on mortality of FC in chickens showed significantly ($p < 0.01$) highest mortality during summer (0.24%) in comparison to rainy (0.14%) and winter (0.08%) seasons (Table 5). These results support the reports of Bhattacharjee *et al.* (1996) who reported higher infection rate during March to July, and Rahman *et al.* (2004) reported higher infection during summer (49.12%) in comparison to rainy (26.32%) and winter (24.56%) seasons.

Infectious coryza

Infectious coryza (IC), caused by *Haemophilus paragallinarum* characterized by conjunctivitis, oculo-nasal discharge, swelling of the infra-orbital sinuses and edema of the face, and severe drop in egg production which was recorded only in 15 (0.41%) chickens (Table 4). Significantly ($p < 0.01$) highest mortality was recorded in adult layers (0.19%), followed by pullets (0.15%), growing (0.08%) and brooding (0.03%) chickens (Table 4). The highest mortality due to IC was during summer (0.19%), followed by winter (0.14%) and rainy (0.08%) season. These observations are in conformity with the report of Talha *et al.* (2001) who reported 0.52% proportionate incidence rate, of which one case aged between more than 2 to 8 weeks and other case aged > 20 weeks old. Similarly, Ghodasara *et al*. (1992) and Anjaneyulu (1998) reported 0.41% and 9.6% incidence of this disease respectively.

Necrotic enteritis

Necrotic enteritis (NE) is an acute bacterial disease of chickens caused by *Clostridium perfringens* characterized by sudden death, friable and distended intestines and severe necrosis of the intestinal mucosa. This study recorded 0.57% mortality due to NE in chickens, of which 0.22% in growing, 0.22% in adult layer, 0.12% in pullet and 0.08% in brooding chickens. The significantly ($p < 0.01$) highest mortality due to NE was recorded during summer (0.24%) in comparison to winter (0.19%) and rainy 90.14%) season (Table 5). These results support the reports of Bhattacharjee *et al*. (1996) who reported 1.38% and Rahman *et al.* (2004) reported 1.37% NE in chickens.

Table 5. Season-wise mortality of egg type layer chickens

S/N	Diseases and disorders	Summer (March to June) (n = 3700) No. died (%)	Rainy (July to Oct.) (n = 3700) No. died (%)	Winter (Nov. to Feb.) (n = 3700) No. died (%)	Total (March to Feb.) (n = 3700) No. died (%)
A. Bacterial diseases		**107 (2.89)**	**71 (1.92)**	**84 (2.27)**	**262 (7.08)**
1.	Salmonellosis	045 (1.22)**	37 (1.00)	34 (0.92)	116 (3.14)
2.	Colibacillosis	037 (1.00)**	21 (0.57)	35 (0.95)	093 (2.51)
3.	Fowl cholera	009 (0.24)**	05 (0.14)	03 (0.08)	017 (0.46)
4.	Infectious coryza	007 (0.19)**	03 (0.08)	05 (0.14)	015 (0.41)
5.	Necrotic enteritis	009 (0.24)**	05 (0.14)	07 (0.19)	021 (0.57)
B.	**Viral diseases**	**091 (2.46)**	**60 (1.62)**	**63 (1.70)**	**215 (5.81)**
6.	Infectious bursal disease	040 (1.08)**	22 (0.59)	19 (0.51)	081 (2.19)
7.	Newcastle disease	026 (0.70)**	20 (0.54)	19 (0.51)	065 (1.76)
8.	Avian leukosis	008 (0.22)	07 (0.19)	12 (0.32)**	027 (0.73)
9.	Fowl pox	008 (0.22)**	05 (0.14)	06 (0.16)	019 (0.51)
10.	Marek's disease	009 (0.24)**	06 (0.16)	07 (0.19)	023 (0.62)
C.	**Fungal diseases**	**016 (0.43)**	**42 (1.14)**	**23 (0.62)**	**081 (2.19)**
11.	Aspergillosis	009 (0.24)	30 (0.81)	18 (0.49)	057 (1.54)
12.	Aflatoxicosis	007 (0.19)	12 (0.32)**	05 (0.14)	024 (0.65)
D.	**Mycoplasmosis**	**041 (1.11)****	**14 (0.38)**	**15 (0.41)**	**070 (1.89)**
E.	**Parasitic diseases**	**021 (0.57)**	**16 (0.43)**	**31 (0.84)**	**068 (1.84)**
13.	Ascaridiais	003 (0.08)*	02 (0.05)	03 (0.08)	008 (0.22)
14.	Tapeworm infestation	001 (0.03)	03 (0.08)**	02 (0.05)	006 (0.16)
15.	Coccidiosis	016 (0.43)	10 (0.27)	23 (0.62)**	049 (1.32)
16.	Ectoparasitosis	001 (0.03)	01 (0.03)	03 (0.08)**	005 (0.14)
F.	**Nutritional disorders**	**040 (1.08)**	**27 (0.73)**	**25 (0.68)**	**092 (2.49)**
17.	Nutritional deficiency	009 (0.24)	10 (0.27)	06 (0.16)	025 (0.68)
18.	Ascites and HHS	009 (0.24)	05 (0.14)	04 (0.11)	018 (0.49)
19.	Cannibalism	004 (0.11)	03 (0.08)	03 (0.08)	010 (0.27)
20.	Egg bound disorder	009 (0.24)**	03 (0.08)	04 (0.11)	016 (0.43)
21.	Egg peritonitis	003 (0.08)*	02 (0.05)	03 (0.08)*	008 (0.22)
22.	Heat stroke and cold	006 (0.16)**	04 (0.11)	05 (0.14)	015 (0.41)
	Total	317 (8.57)	230 (6.22)	241 (6.51)	788 (21.30)

n = No. of birds died **Significant ($p < 0.01$) *Significant ($p < 0.05$)

The occurrence of NE in chickens more than 3 weeks old with highest mortality rate in growing chickens (>3 to 8 weeks) also is in conformity with the report of Das *et al.* (2001) who reported its highest incidence in 4 weeks old birds. Dewan and Das (1989) reported NE in pullets of 4 months (16 weeks) old birds. The highest mortality due to NE during summer (0.24%) and lowest during rainy (0.14%) seasons are in partly support with the report of Kim *et al.* (1996) who reported higher prevalence of NE during summer (52.40%) in comparison to winter (4.5%) season.

Viral diseases

Infectious bursal disease

Infectious bursal disease (IBD), also known as Gumboro disease is an acute contagious viral disease of young chickens characterized by diarrhea, vent picking, trembling, incoordination, swelling followed by atrophy of bursa of Fabricius and a variable degrees of immuno-suppression (Sah et al., 1995; Samad, 2005). This study recorded 3.32% morbidity and 2.19% mortality rates in chickens due to IBD (Table 4), and this result supports the report of Farooq *et al.* (2002) who reported 1.08% mortality rate due to IBD. However, this result contradict the earlier inland reports of Bhattacharjee *et al.* (1996), Talha *et al.* (2001) and Giasuddin *et al.* (2002) who reported 10.99%, 19.16% and 12.0% mortality in chickens caused by IBD, respectively. This difference could be due to case fatality rate reported by these authors. It indicates that the decreased mortality in chickens due to IBD recorded in this study might be due to use of vaccines in these selected flocks (Table 4). But the outbreak of this disease has been reported in both the vaccinated and non-vaccinated birds (Islam and Samad, 2003). However, Gumbooro disease had also been reported to cause heavier losses in chickens elsewhere (10-75%, 36.65% Singh *et al*., 1994; 20%, Rao *et al*., 1990). Although the IBD recorded in all the four age groups of chickens but significantly ($p < 0.01$) highest mortality rate was recorded in brooding aged up to 3 weeks (0.92%), followed by growing (0.89%) chickens which are in conformity with the earlier reports of Talha *et al.* (2001) who reported highest infection rate in birds aged between > 2 to 8 weeks. These results also support the global reports (32-76%, Philip and Moitra, 1993; 20%, Rao *et al*., 1990; 25%, Prabhakaran *et al*., 1997) who reported higher mortality rates in between the age of 2 to 12 weeks than at any other stage of life. However, Philip and Moitra (1993) reported unexpectedly higher losses due to IBD in chickens at the age of 17 weeks.

Although the IBD was recorded in all the four age groups of chickens but significantly ($p <0.01$) highest mortality rate was recorded in brooding aged up to 3 weeks (0.92%), followed by growing (0.89%) chickens which are in conformity with the earlier report of Talha *et al.* (2001) who reported highest infection rate in birds aged between > 2 to 8 weeks. Although the IBD was recorded all the seasons of the year but significantly ($p < 0.01$) highest mortality rate was recorded during summer (1.08%) in comparison to rainy (0.59%) and winter (0.51%) seasons.

Newcastle disease

Newcastle disease (ND) is an acute viral disease of chickens associated with high morbidity and mortality in Bangladesh (Chowdhury *et al*., 198; Samad, 2000). This study recorded an overall 2.56% morbidity and 1.76% mortality in egg type chickens caused by ND. Mortality (1.76%) due to ND recorded in this study is found lower than rates reported from Bangladesh by Talha *et al.* (2001), Giasuddin *et al*. (2002), Rahman and Samad (2003) who reported 10.24%, 8.0% and 10.34% mortality due to ND, respectively. The comparatively lower losses recorded in this study could probably be attributed to the implementation of effective measures for the prevention of diseases by vaccination and maintenance of improved hygienic condition in cage system. However, ND infection occurred despite that these infected flocks were vaccinated 3 to 4 times against the disease (Siddique *et al*., 1986; Babiker *et al*., 2009).

Although the ND was recorded in all the age groups of chickens but this study recorded highest mortality rate in chickens aged more than 20 weeks (0.66%). This observation is somewhat contradict with the report of Talha *et al.* (2001) who reported highest prevalence rate in chickens aged between > 2 to 8 weeks. But this finding supports the report of Parimal and Balasubramanian (1992) and Rahman and Samad (2003) who reported highest incidence of ND in 2 to 6 months and above 6 months old chickens, with highest mortality in 24 weeks age and < 7 weeks of old chickens, respectively.

ND was recorded in all seasons of the years with significantly ($p < 0.01$) higher during summer (0.70%) in comparison to rainy (0.54%) and winter (0.51%) seasons.

Avian leukosis

It is a neoplastic disease caused by retrovirus, which is characterized by a gradual onset in a flock, persistent low mortality and neoplasm of the internal organ especially in a flock, persistent low mortality and neoplasm of the internal organs especially the liver, spleen and kidney as reported by Mosleuddin *et al.* (1972). Only 0.73% mortality was recorded of which 0.47% recognized in layers (> 20 weeks old) and 0.18% in both pullet and in growing 0.11% chickens. These observations support the earlier reports of Kamal and Hossain (1992),

Bhattacharjee *et al.* (1996) and Talha *et al.* (2001) who reported 1.93%, 6.92% and 1.57% proportionate incidence of AL in chickens, respectively. Rahman and Samad (2003) reported 0.34% AL in Gazipur district. Age-wise mortality due to AI in chickens recorded in this study supports the earlier report of Talha *et al*. (2001) who reported highest mortality in > 8 to 20 weeks and in > 20 weeks old chickens. Although the AL was recorded in all the three seasons of the year but significantly ($p < 0.01$) highest mortality rate was recorded during winter (0.32%) in comparison to summer (0.22%) and rainy (0.19%) seasons.

Fowl pox

Fowl pox (FP) is an important viral disease in chickens, characterized by cutaneous and diphtheritic lesions in the upper digestive and respiratory tracts. This study recorded 0.81% (n = 30) morbidity and 0.51% (n = 23) mortality in chickens (Table 4). Significantly ($p <0.01$) highest mortality was recorded during summer (0.22%) in comparison to winter (00.16%) and rainy (0.14%) seasons (Table 5). Some research works on FP vaccine and vaccination have been reported from Bangladesh (Samad, 2000) but the reports on other aspects are limited in inland literature.

Marek's disease

The overall mortality due to Marek's disease was recorded in 0.62% (n = 23) chickens. Highest mortality rate of 0.35% (n=11) was found in laying hens. The occurrence of Marek's disease has been reported from Bangladesh (Mosleuddin and Dewan, 1974) but detail studies on MD are not available in inland literature (Samad, 2000). However, Al-Sadi *et al*. (2000) reported 5.70% incidence of MD in laying chickens in Iraq. Highest mortality of 0.24% was recorded in summer, followed by 0.19% in winter and 0.16% in rainy seasons.

Avian mycoplasmosis

Mycoplasma gallisepticum is considered the primary cause of chronic respiratory disease (CRD) and other organisms frequently caused complications, transmitted with horizontally and vertically and characterized by respiratory signs and lesions and a prolonged course in the flock Biswas *et al*., 1993; Samad, 2005). This study recorded 1.89% (n=70) mortality due to mycoplasmosis in chickens (Table 4). The mortality rate of 1.89% in layer chickens due to CRD recorded in this study supports the report of Babiker *et al.* (2009) who reported 1.11 to 1.45% mortality of layer chickens due to CRD. However, these reports contradicts with inland reports of Talha *et al.* (2001) and Giasuddin *et al.* (2002) who reported 11.55% and 9.0% case fatality rates of mycoplasmosis in chickens from Bangladesh. Rahman and Samad (2003) reported 13.65% case fatality rate due to mycoplasmosis in Gazipur districts. Age-wise mortality of mycoplasmosis showed higher mortality in adult layer (0.75%) in comparison to >3 to 8 (0.48%) weeks and >8 to 20 weeks (0.51%) and up to 3 weeks (0.32%) aged chickens (Table 4). These findings support the earlier reports of Rahman and Samad (2003) who reported higher case fatality rate incidence in adult layer whereas Talha *et al*. (2001) reported higher case fatality rate in grower (>2 to 8 weeks) chickens.

The mortality due to mycoplasmosis was highest during summer (1.11%), followed by winter (0.41%) and rainy (0.38%) seasons (Table 5). These findings correlate with the results of Rahman and Samad (2003) who reported higher case fatality rate of mycoplasmosis during summer months.

Fungal diseases

Aspergillus fumigatus is the main causal agent of aspergillosis in avian species which has been reported from Bangladesh (Samad and Chakraborty, 1993a). An overall 1.54% (n = 57) mortality due to aspergillosis was recorded in chickens which supports with the reports of Talha *et al.* (2001), Rahman and Samad (2003) who reported 4.20% and 1.09% mortality in chickens due to aspergillosis, respectively.

Mortality in chickens caused by aspergillosis was recorded highest in growing (>3 to 8 weeks old) chickens (0.98%) in comparison to other age groups of chickens (Table 4). Seasonal mortality due to aspergillosis was recorded highest during rainy (0.81%) in comparison to winter (0.49%) and summer (0.24%) seasons (Table 5). These findings support the results of Rahman and Samad (2003) and Mahajan *et al*. (1994) who reported highest incidence of brooder pneumonia during hot and humid weather.

Aflatoxicosis

Aflatoxicosis is one of the major issues in chicken production, which occurs due to contaminated feed, resulting in higher mortality and severe drop in egg production. This study recorded an overall 0.65% (n = 24) mortality in chickens which support the earlier reports of Rahman and Samad (2003) who reported 0.46%, Talha *et al.* (2001) reported 0.52%, and Bhattacharjee *et al.* (1996) reported 1.76% aflatoxicosis in chickens. The highest mortality rate was recorded in layer birds (0.22%), followed by brooding (0.16%), growing (0.17%) and pullet (0.15%) birds. Aflatoxicosis caused highest mortality was recorded during rainy (0.32%), followed by summer (0.19%) and winter (0.14%) seasons (Table 5). Prathapkumar *et al.* (1997) reported 10% mortality and 20% drop in egg production due to aflatoxin B1 in the diet. Choudary (1986) reported reduction in mortality and gradual increase in egg production when feed suspected for aflatoxicosis was changed.

Parasitic diseases

Ascaridiasis

Mortality due to *Ascaridia galli* infection was recorded in 0.22% in chickens (Table 4). This helminth parasite was recorded in growing (0.08%), pullet (0.03%) and adult layer (0.09%) birds (Table 4). Rahman and Samad (2003) reported highest case fatality in pullet (43.33%), followed by adult layers (18.52%) reared in litter system. Significantly ($p < 0.01$) highest mortality rate during both in summer and winter (0.08%) and lowest during rainy (0.05%) season (Table 5), which supports the findings of Rahman and Samad (2003).

Tapeworm infestation

The occurrence of *Raillietina* spp. in chickens has been reported from Bangladesh (Samad *et al.,* 1985; 1986). This study recorded only 12 (0.32%) chickens affected with tapeworms, of which 6 (0.16%) birds died (Table 4). Higher prevalence rate of cestodes have been reported in chickens in backyard flocks in Bangladesh (Samad, 2000). Highest mortality of tapeworm infestation was recorded during rainy (0.08%), followed by winter (0.05%) and summer (0.03%) seasons (Table 5).

Coccidiosis

Coccidiosis, caused by *Eimeria* spp. is the only recorded protozoan disease in chickens, which is characterized by blood tinged feces, ruffled feathers, loss of appetite, poor growth and reduced egg production (Karim and Trees, 1990; Mosleuddin *et al*., 1993; Samad and Chakraborty, 1993b). This study recorded an overall 1.32% (n = 49) mortality rate in large type chickens supports the report of Sil *et al.* (2002) who reported 2.29% mortality among 8 to 20 weeks old cockerels. However, higher case fatality rates due to outbreaks of coccidiosis have been reported from Bangladesh by Bhattacharjee *et al*. (1996) and Talha *et al.* (2001) who reported 9.40 and 5.51% case fatality rate in chickens due to coccidiosis. The reason for decreasing the morbidity and mortality rates caused by coccidiosis could be due to improve hygienic management in cage system and routine use of coccidiostats in their flocks.

Coccidiosis was recorded from growing (> 3 weeks age) birds up to laying stage (Table 4), and during all the seasons of the year (Table 5) but significantly ($p < 0.01$) higher mortality was recorded during winter (0.62%) months in comparison to summer (0.43%) and rainy (0.27%) seasons (Table 5).

Nutritional deficiency

It is necessary to supply balanced feed to layer chickens to express their genetic potential and for peak production. Due to deficiency of nutrients uneven growth, rough feather development, decreased egg production and lowered hatchability may occur, however some characteristic signs and lesions are developed in severe deficiency of specific nutrients. An overall 47 (1.27%) chickens showed the deficiency signs during he study period of which 25 (0.68%) layer chickens died due to nutritional deficiency.

Nutritional deficiency was recorded in all age groups of chickens (Table 4). Significantly ($p < 0.01$) highest mortality in chickens due to nutritional deficiency was recorded during rainy (0.27%) in comparison to summer (0.24%) and winter (0.16%) seasons (Table 5). These findings support the report of Rahman and Samad (2003).

Ascites and Hydropericardium hepatitis syndrome (HHS)

These disorders caused mortality of 0.49% in chickens (Table 4). These disorders commonly occur in growing layer chickens (Table 4). Clinically affected layer birds with ascites were smaller the normal and depressed with ruffled feathers and showed abdominal distension with respiratory distress and cyanosis. Necropsy lesions included hypertrophy of the right ventricle, presence of straw color fluid in the peritoneal cavities. HHS was first reported by Rahman *et al.* (2001) in Bangladesh. In HHS, excess accumulation of fluid in the pericardial sac and multifocal hepatic necrosis were present. However, this disease was recorded in all the three seasons but significantly ($p < 0.01$) highest in summer (0.24%), followed by rainy (0.14%) and winter (0.11%) seasons (Table 5). These results support the findings of Rahman and Samad (2003) who reported 46.15% HHS in summer in comparison to rainy (23.08%) and winter (30.77%) months.

Cannibalism

Cannibalism are recognized as feather pulling, vent and head picking followed by hemorrhages. Cannibalism caused mortality in 0.27% layer egg type chickens which could be compared well with the earlier report of Rahman and Samad (2003) who reported 0.17% cases of cannibalism in Bangladesh. In layer it was 0.18%, followed by pullets (0.08%) and growing (0.02%) birds (Table 4). Highest mortality rate was recorded during summer (0.11%) in comparison to winter (0.08%) and rainy (0.08%) seasons (Table 5). The light intensity, stocking density, vitamin and mineral deficiency, insufficient feeder or drinker space, irritation from external parasites have been reported to be the predisposing factors of cannibalism.

Egg bound disorder

Egg bound disorder is a condition in which an egg is lodged in the vagina but can not be laid. It may be due to inflammation of the oviduct, partial paralysis of the muscles of the oviduct or production of a large egg that is difficult to lay. Young pullets laying an unusually large egg are more prone to the problem. When impaction occurs in the uterus or vagina, egg enclosed by shell membranes may be found in the abdominal cavity. This indicates that eggs continued to form but were refluxed back into the peritoneal cavity. Mortality due to this disorder was recorded as 0.50% in layer chickens (Table 4). The egg bound problem in layer chickens has also been reported from Bangladesh by Rahman and Samad (2003) and Bhattacharjee *et al.* (1996).

Egg peritonitis

Mortality due to the egg peritonitis was recorded as 0.25% layer chicken which supports the report of Rahman and Samad (2003) who reported 2.74% proportionate case fatality rate due to egg peritonitis in layer chickens. This disorder of laying hen was uniformly distributed through all the season of the year (Table 5).

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