ORIGINAL ARTICLE

Effects of gumboro disease on productivity of poultry farmers in Ogun state, Nigeria

Coster Adeleke Sabitu[1], Awe Olusegun Olajide[2] and Akintunde Olaide Kamila[3]

[1]Department of Agricultural economics and Farm management, Federal University of Agriculture, Abeokuta.

[2]Department of Agricultural Education, Tai Solarin College of Education, Omu-Ijebu, Ogun State, Nigeria

[3]Department of Agricultural Economics and Agribusiness Management, Osun State University, Osogbo.

Corresponding author: lekecoster@yahoo.co.uk

ABSTRACT

Infectious bursal disease (Gumboro) is a highly contagious viral disease of poultry that produces effects such as morbidity and mortality of the poultry birds which result in serious economic losses to the farmers as well as reduce their productivity. Data were collected with the aid of well-structured questionnaires to elicit information from 160 poultry farmers selected through multi stage random sampling technique. Data obtained were analyzed using descriptive statistics and ordinary least square regression (OLS). Findings showed that all the farms visited had at one time or the other had cases of gumboro disease, which affected birds of all ages with its attendant losses of over 60% of the population of the affected flock. The presence of vermin in the various farms shows that the causative virus is always present on the farm because they act as contaminated vectors that aided the transmission of the disease. Result of OLS estimation technique showed that age, education and farming experience were positive significant determinant of productivity. However, bird's mortality, frequency of disease outbreak and cost of treatment of gumboro disease has the effect of declining farmers' productivity. To ensure effective control and minimized economic losses, farmers were advised to use the combined measures of biosecurity/hygiene and vaccination against the gumboro disease, vermin of all sorts should be screen out of the poultry farms, extension agents should be encouraged and motivated to improves farmers' knowledge in the management of disease control.

Keywords: Prevalence, mortality, productivity, control measures, poultry farmers.

INTRODUCTION

Infectious bursal disease (IBD) Ojo *et al*. (1973), first reported the disease in Nigeria. Subsequent studies have shown that the disease has acquired endemic status among the Nigerian poultry populations (Durojaiye *et al*., 1984; Abdu, 1988). The importance of the disease is represented by the high mortality, reduced productivity amongst infected chicks and accrued prone to other infections (Sharma *et. al.* 2000; Zeleke *et. al*., 2005).

Infectious Bursal Disease (IBD) is a major setback to productivity and profitability in the poultry industries of both developing and industrialized nations (Shane, 1997; Sainsbury, 2000; De-Wit *et. al*., 2001). Musa *et. al.* (2012) estimated economic losses of over three billion Nigerian currency by the farmer over the period of 3 years (2009-2011) recurrent IBD outbreaks. The economic losses associated with outbreaks of IBD in farms appeared unimaginable to the farmer. Many a times the farmer concern is the present monetary mortality value of the lost flock and never sees beyond if the birds were to survive. Infectious bursal disease (Gumboro) had been reported to cause heavier losses in chicken for up to 10-75% (Sah 1995). The disease is characterized by lameness severe morbidity and mortality in chickens. The disease is considered to be the Acquired Immune Deficiency Syndrome (AIDS) of the chicken because it adversely affects the chicken's immune system. Bursa of fabricius one of the organs responsible for antibody production in chicken is usually invaded by the IBD virus and get destroyed completely which in turn results in very high losses in egg type layers for up to 36.65% (Singh 1994) and 20% (Rao *et. al.,* 1990). Birds of all ages were susceptible to IBD, however, losses in between the age of 2-12 weeks were higher (32-76%) than any other stage of life (Phillip and Moitra, 1993, Van den Berg *et.al*., 2000). However, cases of IBD have also been reported in chickens 14-20 weeks in Nigeria over the years (Dashet *et. al*., 2009; Musa *et. al*., 2010; Aiyedun 2014).

The higher incidence of IBD in egg type layers could probably be due to poor vaccination and susceptibility of chickens to IBD (Farooq *et. al.,* 2000). It was reported that vaccination against IBD at the age of 14-21 days partially controlled the problem (Kouwenhoven *et. al.,* 1994), and that in spite of the vaccination, atrophy of bursa could not be protected even if there was a mild infection of IBD (Sultan and Elsavy 1997). IBD is spread by contaminated water, feed and faeces of infected animal (Rao 1997). Vectors that can harbor the virus include the lesser mealworms and rats. Clinical signs of IBD are; elevated body temperature (111^{o}f or 44^{o}c) watery diarrhea, anorexia, depression, ruffled feathers, head trembles, sleepiness and lameness (Farooq *et. al.,* 2000). Morbidity approaches 80% in white leg-horns and 50% in broiler (Sah 1995). Hyper virulent strains occur and can cause up to 100% mortality. The virus is immuno-suppressive and very common throughout the world (Sah 1995). Immunosuppressed flocks have poor performance that results in reduced economic returns (Tactacan *et. al*., 2009). It has been a greater concern for the poultry industry for the past decade. Indeed, its "re-emergence" invariant or highly virulent forms have been the cause of significant economic losses. Post mortem lesions include enlarged bursa (2-4 times), which may be haemorrhagic and or oedematous early (3-5 days) in the course of infection. Other lesions are; an increase in kidney urates, swollen necrotic spleen and increase mucous in the intestine (Phillip and Motra, 1993). Diagnosis includes oedematous swelling of the bursa of fabricius in young birds, clinical history, lesion and histopathology.

As regards treatment of this disease, no specific treatment is available. Use of multivitamins supplement and antibiotic medication may be indicated if secondary bacterial infection occurs. Vitamins and minerals and or glucose in drinking water to prevent dehydration replace lost electrolytes and provide energy (Kouwenhoven *et. al.,* 1994). Due to the hardy nature of infectious bursal disease virus and the widespread distribution of the virus, prevention and control of this disease requires a well-coordinated approach, balancing biosecurity / hygiene measures and vaccination. In the context of the above, it becomes imperative to study the prevalence of the disease, the spreading among poultry birds and the economic losses as it affects farmers' productivity in the study area.

MATERIALS AND METHODS

Study Area

The study area is Ogun state, Nigeria. The state has natural vegetation that is broadly of two types: the forest and the savannah vegetation which are almost evenly distributed throughout the zone. The climate in the state is characterized by a generally high but uniform temperature, a high relative humidity and a marked rainy season. The State is divided into four Agricultural Development Programme zones (namely the Egba, Ijebu, Remo and Yewa zones) by the Ogun State Agricultural Development Programme (OGADEP) Authorities. The state has 20 local government areas. What is the major economic activity of the people of the state?

Sampling Procedure

The study respondents were selected through a multi-stage sampling procedure. The first stage comprised a random selection of two ADP zones from the four zones delineated by Ogun State Agricultural Development Programme (OGADEP). They are Ijebu zonal division i.e Ijebu North LGA and Odogbolu local government areas; Egba zonal division i.e Odeda LGA and Obafemi-Owode LGA. The second stage involved random selection of five villages from each of the four local government areas while the third stage involved the random selection of one hundred and eighty five poultry farmers irrespective of the type of birds raised and the scale of farming operations in a proportionate sampling method based on the list of all poultry farmers obtained from the village extension

agents covering these areas. However data collected from one hundred and sixty respondents with complete information were used for analysis.

Sources of data: Primary data were collected for this study. The data were collected through the aid of well-structured questionnaire. The questionnaire covered the socio-economic characteristics of the poultry farmers (like age, sex, level of education, house hold size, and poultry farming experience), poultry inputs and output activities (types of bird raised, number of birds reared, feed consumption in kg, vaccination, labour cost, total value of egg sold per farm, total value of stocked at year end) and poultry management activities (awareness of Gumboro disease, frequency of occurrence, methods of diagnosis, control measures, cost of treatment, diagnosis methods etc.). This was achieved through the administration of questionnaire and personal discussions.

Data Analysis

The data collected were analyzed using simple descriptive statistics and multiple regression analysis.

Descriptive statistics: descriptive statistics involves the use of frequency, percentages and standard deviation. This was used to analyze the awareness, incident and prevalence of gumboro disease outbreak, vaccination methods, and control measures in the study area.

Regression analysis

Ordinary Least Square regression was used to determine the effect of gumboro outbreak on productivity poultry farmers. The regression model is implicitly specified as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10})$ …….(1)

The explicit form of the model is as follows

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \beta_{10}X_{10} + \mu$..... (2)

Where; Y= Productivity (Value of output/ value of input); X_1=Gender (1=male, 0=female), X_2= Age (years)

X_3= Education (years), X_4= Contact with extension agents (number of visit), X_5= Access to credit (1=have access, 0=otherwise), X_6= Farming experience (years), X_7= Household size (number), X_8= Mortality (number of birds lost to gumboro), X_9= frequency of gumboro outbreak (no. of occurrence), X_{10} = Cost of treatment (Naira), μ = error term

RESULTS AND DISCUSSION

Table 1 shows the distribution of respondents by the type of poultry reared. Most (41.2%) of the farmers were into broiler and layers production. About 28.1%, 16.3% and 5% of the poultry farmers reared layers only, broiler production only and cockerels only respectively while 9.4% of the sampled combined the three enterprises. This indicates that poultry farmers in the study area were likely to have cases of gumboro diseases since the disease prevailed mostly in birds flock

Table 1: Distribution of Respondents by type of poultry birds reared

Type of birds	Frequency	Percentage
Broilers only	26	16.3
Cockerels only	8	5.0
Layers only	45	28.1
Broilers + Layers	66	41.2
Broilers + Cockerels + Layers	15	9.4
Total	**160**	**100**

Source: Field survey, 2019.

Table 2 shows IBD's incidence, rate of occurrence and mortality in the last two years. The result indicates that all the sampled poultry farmers in the study area were aware of the occurrence of gumboro disease as they have had cases of gumboro disease outbreak on their respective farm, suggesting that the study area is an endemic for infectious bursal disease (IBD). The prevalence rate of the disease in this area can be categorized to be 50% (twice/year), 30% (thrice/year) and 20% (once/year) respectively on large number of farms. This is quite undesirable for the poultry industry in this locality in that overall cumulative losses to this disease can be enormous, if adequate measures are not taken to control the disease. As shown in Table 2, gumboro disease outbreak is disastrous to most farms in the study area in the sense that wherever and whenever it occurs, it produces over 60% mortality in most cases. This further confirm the observations of Philip and Moitra (1993), OIE, (2004) that put the losses at 32-76% and Sah, (1995) that reported losses in chicken for up to 10-75% due to IBD.

Table 2. IBD's incidence, rate of occurrence and mortality in the last two years

Response	Frequency	Percentage
Have cases of gumboro disease		
Yes	160	100
No	-	-
Total	160	100
Rate of occurrence		
Once/year	32	20
Twice/year	80	50
Thrice/year	48	30
Total	160	100
Mortality rate		
< 50%	8	5
51%-60%	40	25
>60%	112	70
Total	160	100

Source: Field survey, 2019.

Table 3 show the the ages birds affected by gumboro disease. Majority (70%) of the poultry farmers opined that birds were affected mostly at the 6-14 weeks of age. 22.5% and 7.5% of the farmers claimed that birds were attacked by gumboro disease at 14-20 weeks and 0-5 weeks of ages respectively. This indicates that gumboro disease are more prevalent among young birds of the age range between 6-14 weeks. This result is in consonants with the findings of Philip and Moitra, 1993, Van den Berg *et.al.* (2000), Musa *et. al.*, (2010) and Aiyedun, (2014) that bird of ages of 2-12 weeks are mostly affected by IBD.

Table 3. Ages of birds affected by gumboro disease

Age of birds in week	Frequency	Percentage
0-5 weeks	12	7.5
6-14 weeks	112	70
14-20 weeks	36	22.5
Above 20 weeks	-	-
Total	**160**	**100**

Source: Field survey, 2019.

Table 4 show the poultry farmers' response to the period of vaccinating birds against gumboro disease. Result shows that 55% of the farmers vaccinated their birds against gumboro prior to the disease incidence on farms while 45% of the farmers vaccinated their birds after the attacked by gumboro disease. This finding indicates that the disease still occurred even after vaccination against the disease. This supports the findings of Owoade *et. al.*, (2004); Musa *et.al.*, (2010); Mbuko *et.al.,* (2010) who reported outbreak of IBD in vaccinated flocks. This could be due to failure of the farmers to revaccinate their birds after the first vaccination which they undertake at 14 days.

Table 4: Poultry farmers' response to the period of vaccinating birds against gumboro disease

Response	Frequency	Percentage
Before incidence	88	55
After incidence	72	45
Total	**160**	**100**

Source: Field survey, 2019.

Table 5 show the response of sampled poultry farmers to the observation of vermin on farms. Most of the farmers agreed that vermin (i.e lizards, rats etc) live with them on their various farms. This indicates that the causative virus is always present on the farm. This is because the vermin act as reservoir of infection for the disease in that they harbor the virus and cancontaminate the feed and water of poultry birds by their activities in trying to share feed with birds from time to time. This result corroborates the findings of Lukert and Saif, (1997) that source of the continuous infection to subsequent batches of chicks may be due to persistence of the virus in the environment between outbreaks.

Table 5. Response of sampled poultry farmers to the observation of vermin on farms

Response	Frequency	Percentage
Yes	160	100
No	-	-
Total	**160**	**100**

Source: Field survey, 2019.

Table 6 shows the types of the personnel used for the diagnosis of the disease condition and the control measures adopted by the sampled farmers in the study area. Results showed that majority (60%) of the farmers engaged veterinary doctor, 15% engaged animal health technologists and 25% of the farmers do self-diagnosis. This indicates that a handful of the farmers had requisite experience on disease diagnosis. This supports the finding of Dashe *et. al.* (2009) who reported that experienced farmers carried out vaccination by them in order to reduce cost of production. Control measures adopted by the farmers (Table 6) revealed that 55% of the farmers relied on vaccination as the method of control, 25% relied on biosecurity or hygiene method and 20% of the poultry farmers combined the two measures. This may explain why the disease kept on recurring and prevalent in the study area. This agrees with the findings of Okoye and Uzokwu (2001) and Musa *et. al*. (2010). The few that combined the application of the control measures were right, in that viral infections are usually contagious and can be easily spread, even in between farms by visitor from an infected to the yet to be infected farm.

OLS Regression result

Table 7 presents the estimates of ordinary least square regression results. The four functional forms of regression were run and the Double Log gave the best fit and hence the lead equation. This was based on the magnitude of the R^2 and the significance of the explanatory variables. The value of coefficient of determination R^2 was 0.662 and statistically significant at 1 % level. This implies that the included explanatory variables accounted for 66.2% of the variation in the productivity of poultry farmers. The adjusted R^2 (0.634) is a little lower than R-squared but not too much suggesting that the model do not have a serious over fittings problem. The F-statistic (F = 24.604***) indicates that the overall model is significant at I% and Durbin Watson (2.886) indicates that the overall model is significant and well behaved.

Table 6. Diagnosis and Control measures

Personnel engaged in diagnosis	Frequency	Percentage
Veterinarians	96	60
Animal health technologists	24	15
Self	40	25
Total	160	100
Control measures		
Bio-security/hygiene	40	25
Vaccination	88	55
Combinationsof measures	32	20
Total	**160**	**100**

Source: Field survey, 2019.

Result showed that variables of age, education and farming experience were positive and statistically significant while variables of extension contact, bird's mortality, frequency of disease occurrence and cost of treatment were negative and significant determinant of poultry farmers productivity. The co-efficient of age is positive and significant (0.456 $p<0.05$). This indicates that as the farmer increases in age likewise his productivity increases. By implication, increase in farmer's age enable him to accumulate adequate experience in the management and control of gumboro disease which in turn has the advantage of increasing his productivity. The co-efficient of education is positive and significant (0.437 $p<0.001$). This indicates that increase in farmer's education by a year will increase farmer's productivity by 43.7%. An implication that educated poultry farmers would be able to promptly notice and take early preventive control to combat the outbreak of the gumboro disease which translate to improved productivity. The coefficient of extension contact is negative and significant at 5%. This indicates that poultry farmers did not receive adequate information about gumboro disease due to reduction in the number of extension visits. This has the implication of declining poultry farmers' productivity by 12.1%. Information dissemination is a necessary prerequisite to adequate control measures against adverse effect of disease outbreak on farms. The coefficient of farming experience is positive and statistically significant (0.343 $p<0.05$). This indicates that farmer's experience in taking appropriate measures of controlling gumboro outbreak increases the productivity. It is noteworthy that experienced farmer would be able to stem the tide of declining bird's population occasioned by outbreak of gumboro disease which in-turn increases productivity. This agreed with the findings of Dashe *et. al.* (2009) that experienced farmers carried out vaccination by themselves in order to reduce cost of production. The coefficient of bird's mortality due to gumboro disease outbreak is negative and significant at 1%. This implies that increase in number of birds lost to gumboro disease has the effect of reducing farmer's productivity by 67.6%. This implies that bird's mortality due to gumboro disease outbreak impacted negatively on the poultry farmers' productivity in the study area. This is in line with the findings of Aiyedun (2014) that direct losses due to mortality of 82,469 poultry birds estimated about 24,555,460 million naira per year resulted in untimely death of five poultry farmers. Similarly, the frequency of gumboro disease outbreak on farms in the study area has the effect of declining farmer's productivity by 54.1%. Result showed that increase in the cost of treatment of gumboro disease has the effect of declining farmer's productivity by 41.2%. This portends that it is better to prevent the outbreak of gumboro disease than incur greater loss as a result of treatment of the disease when eventually occurs in the farms. This agreed with the findings of Ahmed and Akhter (2003) that indirect losses as a result of vaccination failure led to reduction in productivity.

Table 7: Regression estimates of Gumboro disease Outbreak on Productivity

Variables	Parameters	Coefficient	T-value
Gender (X_1)	β_1	0.356	1.378
Age (X_2)	β_2	0.456	2.097**
Education ($X_{3)}$	β_3	0.437	4.329***
Extension contact (X_4	β_4	-0.121	-1.885*
Access to income (X_5)	β_5	0.006	0.785
Farming experience(X_6	β_6	0.343	2.303**
Household size (X_7)	β_7	0.564	0.258
Bird's mortality (X_8)	β_8	-0.676	-2.588**
Frequency of occurrence (X_9)	β_9	-0.541	-1.876*
Costs of treatment (X_{10})	β_{10}	-0.412	-3.324***
Constant	β_0	0.112	2.656**
R^2	0.662		
Adj. R^2	0.634		
F-statistics	24.604***		
DW	2.886		

Source: Computed from field survey, 2019.
Legend: ***significant at 1%; **significant at 5%; *significant at 10%.

CONCLUSION

The study revealed that gumboro disease can be said to be endemic i.e. always present as nearly all the sampled farmers have had one cases or the other of its outbreak on their farms. Findings showed that gumboro disease affected bird of all ages and its impact is so disastrous as over 60% bird's mortality occurred during the period. The study revealed further that bird's mortality, frequency of gumboro outbreak and cost of treatment of gumboro disease has negative effect on farmers' productivity. The study recommended that preventive measures such as biosecurity and vaccination should be strictly adhered. More importantly farmers should be observant enough to detect signs of abnormalities or ill health and separate affected ones from yet to be affected ones. Dead birds should be removed from poultry house immediately they are sighted and be burnt or buried deeply where other birds will not have access to the posted dead birds. Birds should be vaccinated against IBD at least twice before 6 weeks of age. Farmers should screen out vermin in the poultry pens

by fumigating with formalin fumes periodically. Extension agents should be motivated and encourage to increase their number of visits to farms in order to improve farmer's knowledge in the administration and management of disease control in the study area.

REFERENCES

Abdu, P.A., 1988. Case report; Infectious bursal disease in a flock of broilers and local chicken in Nigeria. *Bull. Anim. Health Prod.* Africa, 36: 269-271.

Ahmed, Z. and S. Akhter (2003). Role of maternal antibodies in protection against infectious bursal disease in commercial broilers. *Int. J. Poult. Sci*., 2: 251-255.

Aiyedun, J.O (2014). Prevalence and Economic Implications of Infectious Bursal Disease (Gumboro disease) in Kwara State, Nigeria. *International Journal of Agriculture Innovations and Research.* Vol:3, 2319-1473

Dashe, Y. G, Okewole, P, Jwande, D L and Alasa, M. U (2009). Gumboro disease outbreak in a vaccinated pre new pen house. Central Diagnostic Department. NVRI Vom Nigeria.

De-Wit, J.J., Graat, E.A.M, Smestsres, H., Heijmans, J.F and Saatkamp, H.W (2001). Epidemiology and economic aspects of infectious bursal disease in the Netherlands. *Proceedings of the International Symposium on Infectious Bursal Disease and Chicken Infectious Anemia,*June 16-20, 2001, Germany, pp: 278-287.

Durojaiye, O.A., Ajibade, H.A and Olafimihan, G.O (1984). An outbreak of infectious bursal disease and prevention in 20 weeks old birds. *Trop. Vet.,* 2: 175-176.

Farooq M, Durrani, F.R and Faisal S. (2000): Incidence of Infectious Bursal Disease among Birds submitted to a Diagnostic Laboratory in NWFP Pakistan. *Pak. vet J.* 20 (2) 77-80

Kouwenhoven B, Bas Vanden J. (1994). Control of very virulent Infectious Bursa Bursal Disease (Gumboro Disease) in the Neitherlands with more virulent vaccine: International Symposium on Infectious Bursal Disease and Chicken Infectious Anemia, World Vet. Poult. Association Ravischholzhavsen, Germany 264-271

Lukert, P.D. and Y.M. Saif, 1997. Infectious Bursal Disease. In: Diseases of Poultry, 10th Edn., Calnek, B.W., H.J. Barnes, C.W. Beard, L.R. McDougald and Y.M. Saif (Eds.). Iowa State University Press, Ames., pp: 721-738.

Mbuko, I.J., W.I. Musa, S. Ibrahim, L. Sa`idu, P.A. Abdu, S.B. Oladele and H.M. Kazeem, 2010. A retrospective analysis of infectious bursal disease diagnosed at poultry unit of Ahmadu Bello University, Nigeria. *Int. J. Poult. Sci.,* 9: 784-790.

Müller, H., M.R. Islam and R. Raue, 2003. Review research on infectious bursal disease-the past, the present and the future. *Vet. Microbiol*., 97: 153-165.

Musa, I.W., L. Saidu, J. Adamu, I.J. Mbuko, B.Y. Kaltungo and P.A. Abdu, 2010. Outbreaks of Gumboro in growers in Zaria, Nigeria. *Niger. Vet. J.,* 31: 306-310.

Musa, I.W., Sai`du, L and Abalaka, E.S (2012). Economic Impact of Recurrent Outbreaks of Gumboro Disease in a Commercial Poultry Farm in Kano, Nigeria. *Asian Journal of Poultry Science,* 6: 152-159.

OIE (2004) Avian Diseases in List B: Infectious Bursal Disease (Gumboro disease). *In:* Manual of diagnostic tests and vaccines for terrestrial animals (mammals, birds and bees). 5th (Ed.), Office International Des Epizooties, Paris, France, pp: 817-832.

Okoye, J.O.A. and Uzoukwu, M. (2001). Histopathogenesis of local Nigerian isolates of infectious bursal disease virus in broilers. *Proceedings of the International Symposium on IBD and CIA,June* 16-20, 2001, Germany, pp: 366-376.

Ojo, M.O., Oduye, O.O., Noibi, L.M., and Idowu, A.L. (1973). Gumboro like disease in Nigeria. *Trop. Anim. Health Prod.,* 5: 52-56.

Owoade, A.A., Mulder, M.N., Kohnen, J., Ammerlann, W and Muller, C.P (2004). High sequence diversity in Infectious bursal disease virus serotype 1 in poultry and turkey suggest West Africa origin of very virulent strain.

Phillip, R.G and Moitra R.N (1993). An outbreak of Infectious Bursal Disease in Poultry. *Bhutan J. Anim Husbandry* 14:29-32

Rao, D.G., Rao P.R and Rao, M.V.S (1990). A Note on Infectious Bursal Disease outbreak in a poultry flock in Andhra Predesh. *Indian Vet. J.* 67 (6): 567-568

Sah, R.L. (1995). Outbreak of acute Infectious Bursal Disease causing High Mortality in chicken. *Indian J. Comparative Microbiology, Immunology and Infectious Disease* 16 (112) 713

Sainsbury, D., (2000). Infectious Bursal Disease: Poultry Health and Management. 4th Edn.,Blackwell Publishers, Oxford, UK., pp: 125-126.

Shane, S., 1997. Infectious Bursal Disease: The Poultry Disease Handbook. American Soybean Association, USA., pp: 57-61.

Sharma, J. J, Kim, J.J, Sautensclein, S.S, Yeh, H.Y (2000). Infectious bursal disease virus of chickens: pathogenesis and immunosuppressant. *Dev Comp Immunol* 24: 223-235.

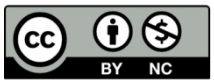
Singh K.C.P (1994) Occurrence of Infectious Bursal Disease in Chickens, Isolation and Clinico Pathology. *Indian J. Virol* 10 (2) 83-89

Sultan H.A, El sawy A. (1997): Administration of non-activated Infectious Bursal Disease Oil Emulsion vaccine to commercial layer chickens at different ages. *Vet. Med. J. Giza* 45 (3) 295-305

Tactacan G.B, Guenter, W. Lewis, N.J, Rodriguez-Lecompte, J.C, House J. D (2009) Performance and welfare of laying hens in conventional and enriched cages, *Poultry Science* 88(4): 698-707.

Van den Berg T.P, Eterradossi N, Toquin D, Meulemans G (2000) Infectious bursal disease (Gumboro disease). Rev Sci Tech, Office International Des Epizooties 19(2): 527-543.

Zeleke A, Gelaye E, Sori T, Ayelet G, Sirak A (2005) Investigation on Infectious Bursal Disease outbreak in Debre zeit, Ethiopia. *International Journal Poultry Science* **7**: 504-506.



ISSN 2220-9325 (Online), ISSN 2203-5802(Print)