

Haemato-Biochemical Study of Chicken Infectious Anaemia Suspected Broilers

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ABSTRACT

The present study was carried out to determine the haemato-biochemical parameters of broiler birds suspected for chicken infectious anaemia (CIA) belonging to 25 commercial farms in and around Anand district. The broiler birds having 10 per cent or above variation in body size were selected for the study. The haematological parameters like Hb, TEC, TLC and PCV were analysed by automatic blood analyser and the differential leukocyte count (DLC) was carried out manually. The biochemical parameters like AST, ALT, BUN, Serum creatinine, AKP and Serum uric acid were analysed on chemistry analyzer BS-120 by using Coral diagnostic kits. The haematological parameters like Hb, PCV, TEC and TLC were found significantly lower in CIA suspected birds as compared to healthy ones. The DLC showed higher value of heterophil and lower value of lymphocyte with no increase or decrease in monocyte and eosinophil count. Whereas, H:L ratio was found significantly higher in suspected birds as compared to healthy birds. The biochemical parameter like AST, ALT, BUN, serum creatinine, AKP and serum uric acid were found significantly higher in suspected birds as compared to healthy birds.

Keywords: Broiler, Chicken Infectious Anaemia, DLC, Haematology, Serum biochemistry.

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INTRODUCTION

Chicken infectious anaemia (CIA) is known to be an emerging disease that affects young broiler chickens from 3 weeks of age (Lucio *et al.*, 1990). Etiological agent of chicken infectious anaemia is *Chicken anaemia virus* (CAV) and is known for its immunosuppressive effects and has been documented in most of the world's poultry producing countries. All the different CAV isolates are reported worldwide, however, it exists as a single serotype. *Chicken anaemia virus* belongs to the *Gyrovirus* genus of *Circoviridae* family, and causes mainly thymus atrophy, aplastic anaemia and immunosuppression. *Chicken anaemia virus* is an important cofactor in poultry for Marek's disease, Infectious bursal disease, *Adenovirus* and reticuloendotheliosis infections. Anaemia with low haematocrit value is the most characteristic clinical symptom. *Chicken anaemia virus* pathology is due to the destruction of haematopoietic precursor cells in the bone marrow and T-lymphocyte depletion in the thymic cortex. Economic losses due to chicken infectious anaemia derives from poor growth rate, higher mortality rates, carcass condemnations and antibiotic costs used to control secondary bacterial infection (Dren *et al.*, 2000).

MATERIALS AND METHODS

The pathological study comprised of information related to haematological and biochemical parameters in CIA suspected broiler birds as compared to healthy broiler birds.

Collection of Blood and Separation of Serum

About 2 ml of blood was collected from wing vein of 5 random broiler birds suspected for chicken infectious anaemia (CIA)

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as well as from healthy flocks from each poultry farm (Total 25 commercial poultry farms) having minimum 10 per cent variation in body size. One part of blood was taken into K₃EDTA vacutainer for haematological examination and other part was taken into vacutainer having blood clot activator and allowed to clot for 20-30 minutes at room temperature in slant position. Then clot was retracted by placing it under refrigeration followed by centrifugation for 1500 rpm for 15 minutes. Serum was harvested into 2 ml Eppendorf tube for further process. Blood smears were prepared at the time of blood collection for DLC and heterophil : lymphocyte (H:L) ratio.

Table 1: Mean (±SE) values of Hb, PCV, TEC, TLC, DLC and Heterophil/Lymphocyte ratio of suspected and healthy broiler flocks

Flock no.	Hb (g %)		PCV (%)		TEC (10 ⁶ /cmm)		TLC (10 ³ /cmm)		Differential Leukocyte Count		H/L ratio		
	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	
	Heterophil (%)		Lymphocyte (%)		Heterophil (%)		Lymphocyte (%)		Heterophil (%)		Lymphocyte (%)		
1†	6.43 ± 0.21**	10.78 ± 0.15	23.10 ± 0.29**	33.03 ± 0.25	1.92 ± 0.08*	2.63 ± 0.01	15.26 ± 0.34*	22.22 ± 0.23	51.80 ± 0.48**	36.60 ± 0.24	45.40 ± 0.87**	56.20 ± 0.80	1.14 ± 0.02**
2	6.17 ± 0.17**	10.32 ± 0.22	27.74 ± 0.10*	32.09 ± 0.40	2.21 ± 0.01*	2.51 ± 0.01	13.81 ± 0.12*	20.81 ± 0.22	45.20 ± 0.37*	38.60 ± 0.50	51.60 ± 0.81*	55.20 ± 0.48	0.87 ± 0.01*
3	8.07 ± 0.22*	11.47 ± 0.14	25.71 ± 0.11*	34.08 ± 0.32	2.11 ± 0.02*	2.48 ± 0.02	12.76 ± 0.13**	19.71 ± 0.28	43.20 ± 0.73*	35.80 ± 0.48	51.20 ± 0.91*	56.60 ± 0.50	0.84 ± 0.01*
4†	7.31 ± 0.22*	12.70 ± 0.14	24.52 ± 0.43*	32.19 ± 0.24	2.00 ± 0.08*	2.76 ± 0.02	14.42 ± 0.34*	20.21 ± 0.22	52.20 ± 0.48**	36.00 ± 0.83	43.60 ± 0.87**	55.60 ± 0.50	1.20 ± 0.02**
5	8.28 ± 0.15*	10.33 ± 0.13	28.10 ± 0.12*	37.08 ± 0.10	2.10 ± 0.02*	2.51 ± 0.02	15.76 ± 0.06*	21.88 ± 0.16	44.40 ± 1.20*	36.80 ± 0.58	50.80 ± 0.73*	55.80 ± 0.58	0.87 ± 0.01*
6	7.83 ± 0.10*	10.98 ± 0.20	25.58 ± 0.13*	31.95 ± 0.28	2.01 ± 0.01*	2.65 ± 0.01	14.71 ± 0.21*	20.12 ± 0.30	39.20 ± 1.15	37.20 ± 0.66	56.40 ± 0.67	55.60 ± 0.67	0.69 ± 0.03
7	8.99 ± 0.09*	11.91 ± 0.22	23.16 ± 0.09**	32.30 ± 0.29	1.96 ± 0.01*	2.78 ± 0.02	12.34 ± 0.11**	18.88 ± 0.29	43.60 ± 1.32*	35.40 ± 1.16	51.20 ± 0.80*	56.20 ± 0.80	0.84 ± 0.03*
8	7.06 ± 0.09*	12.46 ± 0.17	24.89 ± 0.16*	31.97 ± 0.11	2.08 ± 0.01*	2.81 ± 0.01	13.23 ± 0.11*	19.05 ± 0.24	45.20 ± 1.11*	36.80 ± 1.15	52.60 ± 0.40*	55.80 ± 0.66	0.85 ± 0.02*
9	7.23 ± 0.08*	10.48 ± 0.16	26.74 ± 0.17*	33.35 ± 0.32	2.01 ± 0.01*	2.60 ± 0.01	16.60 ± 0.18*	22.43 ± 0.21	51.60 ± 1.02**	35.80 ± 0.66	59.40 ± 1.02**	55.80 ± 0.66	1.04 ± 0.01**
10	8.32 ± 0.12*	13.33 ± 0.10	27.61 ± 0.18*	37.79 ± 0.32	1.97 ± 0.02*	2.55 ± 0.01	14.41 ± 0.15*	20.04 ± 0.25	43.40 ± 1.20*	36.60 ± 0.40	52.20 ± 0.91*	56.20 ± 0.80	0.82 ± 0.03*
11	8.05 ± 0.21*	10.47 ± 0.15	26.87 ± 0.12*	36.22 ± 0.26	2.11 ± 0.01*	2.74 ± 0.01	15.87 ± 0.17*	21.85 ± 0.33	44.00 ± 1.00*	36.80 ± 0.86	52.60 ± 0.60*	56.80 ± 0.58	0.83 ± 0.02*
12	9.37 ± 0.07*	11.54 ± 0.19	23.10 ± 0.12**	32.38 ± 0.14	2.07 ± 0.02*	2.87 ± 0.01	12.89 ± 0.10**	18.97 ± 0.19	44.80 ± 1.35*	36.00 ± 1.04	51.20 ± 0.80**	55.80 ± 0.66	0.87 ± 0.03**
13	9.01 ± 0.13*	11.93 ± 0.14	26.63 ± 0.12*	35.08 ± 0.22	2.11 ± 0.01*	2.52 ± 0.01	12.36 ± 0.16**	19.06 ± 0.31	50.00 ± 1.34**	36.40 ± 0.87	47.00 ± 0.89**	56.00 ± 0.70	1.06 ± 0.03**
14	7.90 ± 0.05*	10.98 ± 0.26	22.86 ± 0.16**	30.99 ± 0.32	1.99 ± 0.01*	2.63 ± 0.01	15.86 ± 0.16*	21.71 ± 0.19	44.80 ± 0.37*	37.40 ± 0.92	50.80 ± 0.37*	55.60 ± 0.81	0.88 ± 0.01*
15	8.10 ± 0.08*	10.39 ± 0.14	25.71 ± 0.19*	32.20 ± 0.16	2.17 ± 0.01*	2.71 ± 0.01	16.64 ± 0.11*	22.06 ± 0.32	46.60 ± 1.16*	37.80 ± 1.11	51.40 ± 0.60*	56.80 ± 0.80	0.90 ± 0.02*
16†	7.28 ± 0.20*	12.48 ± 0.16	23.85 ± 0.38**	35.10 ± 0.15	1.75 ± 0.06**	2.60 ± 0.01	13.58 ± 0.23*	20.12 ± 0.21	51.40 ± 0.37**	37.40 ± 1.02	44.60 ± 0.81**	54.80 ± 0.37	1.14 ± 0.01**
17	7.88 ± 0.10*	13.44 ± 0.47	22.92 ± 0.17**	30.05 ± 0.17	1.89 ± 0.01**	2.49 ± 0.01	14.44 ± 0.18*	21.36 ± 0.16	43.00 ± 0.54*	36.20 ± 1.06	52.20 ± 0.73*	56.00 ± 0.70	0.82 ± 0.01*
18	6.01 ± 0.12**	11.68 ± 0.21	26.90 ± 0.19*	31.79 ± 0.22	2.04 ± 0.01*	2.62 ± 0.02	12.46 ± 0.20**	19.22 ± 0.26	40.80 ± 1.20	38.40 ± 1.16	56.00 ± 0.77	56.60 ± 0.50	0.71 ± 0.02
19	7.08 ± 0.12*	10.78 ± 0.27	28.68 ± 0.10*	36.34 ± 0.13	1.86 ± 0.01**	2.54 ± 0.01	15.54 ± 0.08*	21.17 ± 0.23	45.40 ± 1.16*	37.80 ± 0.80	52.80 ± 0.73*	55.60 ± 0.81	0.85 ± 0.03*
20	8.94 ± 0.18**	11.38 ± 0.16	26.91 ± 0.14*	34.99 ± 0.20	2.19 ± 0.02*	2.71 ± 0.01	14.42 ± 0.18*	19.91 ± 0.24	44.80 ± 1.39*	36.60 ± 1.16	51.40 ± 0.87*	55.20 ± 0.73	0.80 ± 0.02*
21	6.96 ± 0.14**	11.78 ± 0.21	25.95 ± 0.16*	32.12 ± 0.19	1.97 ± 0.01*	2.80 ± 0.02	15.77 ± 0.06*	21.19 ± 0.17	44.40 ± 12.4*	37.60 ± 0.92	53.20 ± 0.37*	56.80 ± 0.58	0.83 ± 0.02*
22†	7.98 ± 0.25*	10.84 ± 0.10	26.33 ± 0.06*	34.24 ± 0.23	1.81 ± 0.09**	2.58 ± 0.02	13.25 ± 0.29*	20.08 ± 0.25	52.80 ± 0.58**	37.60 ± 0.50	45.40 ± 0.81**	54.80 ± 0.37	1.15 ± 0.01**
23	8.76 ± 0.12*	12.38 ± 0.10	28.03 ± 0.17*	36.23 ± 0.18	1.95 ± 0.01*	2.60 ± 0.01	15.68 ± 0.15*	21.98 ± 0.22	44.60 ± 1.36*	36.40 ± 0.67	51.80 ± 0.80*	56.80 ± 0.58	0.85 ± 0.03*
24	6.50 ± 0.13**	11.33 ± 0.17	24.09 ± 0.15*	30.86 ± 0.31	2.02 ± 0.01*	2.57 ± 0.02	14.85 ± 0.19*	21.84 ± 0.33	44.20 ± 1.15*	36.60 ± 0.92	52.80 ± 0.37*	55.60 ± 0.50	0.83 ± 0.02*
25	7.16 ± 0.17*	10.48 ± 0.14	26.53 ± 0.10*	32.18 ± 0.22	2.18 ± 0.01*	2.70 ± 0.01	12.44 ± 0.17**	19.66 ± 0.20	50.80 ± 1.24**	38.40 ± 0.67	46.60 ± 0.81**	56.40 ± 0.67	1.08 ± 0.02**

*Significant (p<0.05), **Highly Significant (p<0.01) and †Chicken Infectious Anaemia affected flocks detected based on PCR.



Table 2: Mean (± SE) values of AST, ALT, AKP, Uric acid, BUN and Creatinine of suspected and healthy broiler flocks

Flock no.	AST (IU/L)		ALT (IU/L)		AKP (IU/L)		URIC ACID (mg/dl)		BUN (mg/dl)		CREATININE (mg/dl)	
	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy	Suspected	Healthy
1†	247.74 ± 2.04*	185.83 ± 2.33	48.90 ± 1.14*	32.71 ± 0.84	564.79 ± 1.14*	482.83 ± 1.76	7.50 ± 0.15*	6.02 ± 0.05	4.68 ± 0.13**	2.36 ± 0.05	0.765 ± 0.01*	0.230 ± 0.01
2	235.03 ± 2.03*	178.84 ± 2.83	45.09 ± 1.14*	30.25 ± 0.45	485.12 ± 1.48	470.45 ± 1.44	6.73 ± 0.10	5.97 ± 0.17	2.01 ± 0.03	1.89 ± 0.04	0.340 ± 0.01	0.331 ± 0.01
3	229.39 ± 1.13*	170.83 ± 3.08	46.70 ± 1.42*	31.62 ± 0.67	562.55 ± 2.37*	446.09 ± 1.28	7.01 ± 0.14*	5.39 ± 0.06	4.47 ± 0.02**	2.10 ± 0.07	1.102 ± 0.01**	0.401 ± 0.01
4†	252.74 ± 3.64**	192.80 ± 2.39	50.88 ± 1.40**	34.92 ± 1.11	603.30 ± 1.22**	485.11 ± 0.73	8.69 ± 0.17*	5.74 ± 0.07	3.86 ± 0.12*	1.76 ± 0.07	0.694 ± 0.01*	0.114 ± 0.01
5	231.69 ± 2.48*	165.93 ± 2.22	47.63 ± 1.05*	32.50 ± 0.82	501.44 ± 2.55	511.43 ± 1.69	6.58 ± 0.16	6.28 ± 0.08	2.25 ± 0.02	2.06 ± 0.08	0.254 ± 0.01	0.236 ± 0.01
6	245.43 ± 2.30*	172.88 ± 2.52	41.47 ± 1.33*	29.69 ± 0.06	543.43 ± 1.67*	501.13 ± 2.81	8.67 ± 0.11*	5.77 ± 0.13	4.31 ± 0.01*	2.15 ± 0.05	0.687 ± 0.01*	0.178 ± 0.01
7	195.50 ± 2.01	186.52 ± 3.34	31.89 ± 1.28	30.56 ± 0.95	552.47 ± 2.08*	399.45 ± 1.89	6.57 ± 0.18	6.13 ± 0.08	3.33 ± 0.02*	1.67 ± 0.06	0.806 ± 0.01*	0.220 ± 0.01
8	255.82 ± 2.70**	192.69 ± 4.53	53.20 ± 1.80**	35.03 ± 0.94	569.33 ± 1.54*	472.78 ± 2.08	7.36 ± 0.11*	6.20 ± 0.13	4.59 ± 0.02**	2.21 ± 0.06	0.890 ± 0.01*	0.301 ± 0.01
9	246.75 ± 2.66*	174.59 ± 1.74	47.63 ± 1.64*	33.42 ± 0.72	499.42 ± 1.82	482.11 ± 1.86	5.92 ± 0.11	5.86 ± 0.09	2.39 ± 0.01	2.30 ± 0.05	0.320 ± 0.01	0.324 ± 0.01
10	185.65 ± 1.92	170.84 ± 3.84	33.00 ± 1.33	31.99 ± 0.63	499.58 ± 1.38*	508.49 ± 1.32	7.85 ± 0.16*	6.11 ± 0.12	3.67 ± 0.02*	1.95 ± 0.07	1.010 ± 0.01**	0.431 ± 0.01
11	226.24 ± 1.30**	150.82 ± 2.96	43.36 ± 0.68**	30.76 ± 0.81	560.89 ± 2.38*	469.20 ± 1.46	8.51 ± 0.18*	5.87 ± 0.13	3.49 ± 0.01*	1.89 ± 0.08	0.767 ± 0.01*	0.223 ± 0.01
12	192.54 ± 1.87	183.76 ± 4.12	30.75 ± 1.23	28.50 ± 0.62	548.04 ± 1.29*	480.24 ± 1.49	8.06 ± 0.05*	6.09 ± 0.10	2.21 ± 0.01	1.97 ± 0.05	0.380 ± 0.01	0.376 ± 0.01
13	205.30 ± 2.28	190.13 ± 1.96	35.85 ± 1.20	35.60 ± 1.16	507.65 ± 2.86	488.77 ± 1.62	6.56 ± 0.15	6.18 ± 0.05	2.35 ± 0.01	2.26 ± 0.04	0.280 ± 0.01	0.278 ± 0.01
14	243.07 ± 1.37*	184.02 ± 2.35	48.43 ± 1.01*	32.80 ± 0.85	549.42 ± 1.54*	474.84 ± 1.42	7.73 ± 0.15*	6.22 ± 0.08	4.50 ± 0.01**	2.14 ± 0.08	0.850 ± 0.01*	0.299 ± 0.01
15	265.44 ± 1.37**	202.26 ± 2.12	49.76 ± 0.84**	34.92 ± 0.43	546.08 ± 3.04*	402.72 ± 1.67	6.81 ± 0.17*	5.67 ± 0.11	3.81 ± 0.01*	1.70 ± 0.06	0.933 ± 0.01*	0.311 ± 0.01
16†	225.18 ± 2.01*	159.74 ± 2.61	40.22 ± 0.49*	29.22 ± 1.01	601.69 ± 1.04**	480.99 ± 0.83	8.65 ± 0.06*	5.96 ± 0.04	4.00 ± 0.14*	1.84 ± 0.03	0.663 ± 0.01*	0.198 ± 0.01
17	241.58 ± 2.34*	179.22 ± 2.68	43.03 ± 1.07*	31.61 ± 0.90	575.20 ± 2.24**	467.41 ± 2.16	7.73 ± 0.14*	6.01 ± 0.08	3.76 ± 0.02*	1.69 ± 0.06	1.204 ± 0.01**	0.426 ± 0.01
18	198.65 ± 2.47	182.37 ± 2.71	34.48 ± 1.55	32.74 ± 1.08	487.87 ± 1.82	423.86 ± 2.18	6.60 ± 0.15	6.17 ± 0.09	2.40 ± 0.01	2.36 ± 0.06	0.203 ± 0.01	0.198 ± 0.01
19	241.24 ± 2.37*	176.81 ± 2.56	45.32 ± 1.22*	34.29 ± 0.86	581.92 ± 2.32**	478.04 ± 1.88	7.78 ± 0.18*	5.73 ± 0.11	4.59 ± 0.02**	2.20 ± 0.08	0.907 ± 0.01*	0.369 ± 0.01
20	181.12 ± 0.58	169.91 ± 3.76	33.64 ± 0.99	31.76 ± 0.90	552.88 ± 2.37*	481.80 ± 1.76	8.01 ± 0.12*	6.14 ± 0.11	4.29 ± 0.02*	2.13 ± 0.07	0.645 ± 0.01*	0.189 ± 0.01
21	248.19 ± 2.31*	178.20 ± 3.95	48.99 ± 0.72*	35.14 ± 0.94	516.23 ± 1.04	504.19 ± 1.29	6.66 ± 0.08	6.00 ± 0.09	2.09 ± 0.03	2.00 ± 0.06	0.259 ± 0.01	0.265 ± 0.01
22†	250.08 ± 2.45**	182.52 ± 3.50	51.29 ± 1.08**	32.27 ± 0.69	599.14 ± 1.13**	481.78 ± 1.27	7.50 ± 0.16*	5.84 ± 0.11	3.99 ± 0.13*	1.77 ± 0.07	0.699 ± 0.01*	0.196 ± 0.01
23	199.26 ± 2.46	200.86 ± 3.33	31.58 ± 1.45	31.41 ± 0.55	541.99 ± 1.78	490.99 ± 1.23	6.44 ± 0.18	5.99 ± 0.12	2.42 ± 0.02	2.36 ± 0.06	0.343 ± 0.01	0.348 ± 0.01
24	247.40 ± 1.24*	173.96 ± 4.26	44.46 ± 1.06*	34.39 ± 0.65	574.06 ± 1.62**	478.87 ± 0.80	8.27 ± 0.09*	5.80 ± 0.09	4.11 ± 0.02*	1.93 ± 0.08	0.811 ± 0.01*	0.297 ± 0.01
25	251.66 ± 2.32**	182.13 ± 2.85	41.40 ± 1.62**	28.53 ± 0.90	500.37 ± 1.19*	519.89 ± 1.92	7.71 ± 0.17*	5.92 ± 0.13	4.89 ± 0.02**	2.45 ± 0.03	0.943 ± 0.01*	0.379 ± 0.01

*Significant (p<0.05), **Highly Significant (p<0.01) and † Chicken Infectious Anaemia affected flocks detected based on PCR.

Haematological Estimation

The haematological parameters like haemoglobin (Hb), total erythrocyte count (TEC), total leukocyte count (TLC) and pack cell volume (PCV) were analysed by automatic blood analyser (Mindray; BC-2800 Vet, China).

Differential Leukocyte Count (DLC)

Differential leukocyte count (DLC) was carried out manually after staining of blood smears with Leishman-Wright's stains. Heterophiles to lymphocyte ratio was calculated by dividing total heterophils count by total lymphocytes count.

Serum Biochemical Investigation

The serum biochemical parameters like aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea nitrogen (BUN), serum creatinine, alkaline phosphatase (AKP) and serum uric acid were analysed on chemistry analyzer BS-120 (Shenzhen Mindray Bio-Medical Electronics Co. Ltd., China) by using diagnostic kits (Coral Clinical Systems; a division of Tulip Diagnostics Private Limited).

Statistical Analysis

Independent sample 't' test was used to analyse the haematological and biochemical parameters by using software SPSS. All data have been presented as mean \pm SE.

RESULTS AND DISCUSSION

Mean values of Hb, PCV, TEC, TLC, DLC and H:L ratio for all 25 flocks have been presented in Table 1. There was highly significant decrease in Hb concentration in birds of flocks 1, 2, 18, 21 & 22 suspected for CIA as compared to apparently healthy birds of same farms. The PCV values of birds suspected for CIA in flock 1, 7, 12, 14, 16 & 17 were also significantly lower as compared to apparently healthy birds of same farms. There was highly significant decrease in TEC values of birds suspected for CIA in flock 16, 17, 19 & 22 as compared to apparently healthy ones. There was highly significant decrease in TLC values of birds suspected for CIA in flocks 3, 7, 12, 13, 18 & 25 as compared to apparently healthy birds of same flock. Overall, the haematological parameters like Hb, PCV, TEC and TLC were found significantly lower in birds suspected of chicken infectious anaemia (CIA) as compared to healthy birds of same farms. These findings were in agreement with the reports of Vachhani (2005), Jivani (2010), Krishan *et al.* (2015), Kamdi *et al.* (2016) and Abdelwahab and Mansour (2019). The significantly lowered values of Hb, PCV, TEC and TLC recorded in the present study could be due to anaemic condition of birds which may be due to poor diet or possibly a malabsorption problem, destruction of red blood cells, hypoplasia of bone marrow and destruction of lymphocyte or immunosuppression.

The DLC showed higher value of heterophil and lower value of lymphocyte with no increase or decrease in monocyte and eosinophil count. Whereas, H:L ratio was found significantly higher in suspected birds as compared to healthy birds (Table 1). There was significant increase in heterophil values and decrease in lymphocyte values with increased H:L ratio of all flocks suspected for CIA except flock 6 & 18 as compared to apparently healthy flock of same farm. There was highly significant increase in heterophil and decrease in lymphocyte of flock 1, 4, 9, 13, 22 & 25 suspected for CIA as compared to apparently healthy flock of same farm. These findings were in agreement with the reports of Vachhani (2005), Karimi *et al.* (2010) and Kamdi *et al.* (2016). The significantly higher heterophil value, lowered lymphocyte value, increased H:L ratio with no significant increase or decrease in mean value of monocytes and eosinophils recorded in the present study could be due to marked inflammatory reaction, presence of infectious agents like bacteria, virus and destruction of lymphocyte or immunosuppression. The increase in H:L ratio observed during present study indicate presence of various stressors, heat stress or viral infection. It also indicates lowered immunity to respond to other infectious agents and succumbs to many bacterial infections.

Mean values of AST, ALT, BUN, Serum creatinine, AKP and Serum uric acid in 25 flocks studied have been summarized in Table 2.

There was significant increase in AST and ALT values of birds in all flocks suspected for CIA, except flock 7, 10, 12, 13, 18, 20 & 23, as compared to apparently healthy birds of same farm. Moreover, highly significant increase in AST and ALT values were observed in birds of flock 4, 8, 11, 15, 22 & 25 suspected for CIA as compared to apparently healthy birds of same farm. There was significant increase in BUN and creatinine values of birds suspected for CIA in all flocks, except flock 2, 5, 9, 12, 13, 18, 21 & 23 as compared to apparently healthy birds of same farm. There was highly significant increase in BUN values of birds in flock 1, 3, 8, 14, 18 & 25 suspected for CIA as compared to apparently healthy birds, while creatinine values of birds in flock 3, 10 & 17 suspected for CIA were highly significantly increase as compared to apparently healthy birds of same farm. There was significant increase in AKP values of birds suspected for CIA in all flocks, except flock 2, 5, 9, 13, 18, 21 & 23 as compared to apparently healthy birds of same farm, while the AKP values of birds in flock 3, 16, 17, 19, 22 & 24 suspected for CIA were highly significantly increased as compared to apparently healthy birds of same farm. The uric acid values of birds suspected for CIA all flocks, except flock 2, 5, 7, 9, 13, 18, 21 & 23 were significantly increased as compared to apparently healthy birds of same farm. However, there was no significant variation among suspected groups for CIA and those found positive based on molecular study. In general, the biochemical parameters like AST, ALT, BUN, Serum



creatinine, AKP and Serum uric acid were found significantly higher in suspected birds as compared to healthy flocks of the same farms. These findings were in agreement with the reports of Krishan *et al.* (2015) and Kamdi *et al.* (2016). The significantly higher values of AST, ALT, BUN, Serum creatinine, AKP and Serum uric acid recorded in the present study could be due to damage to hepatocytes, liver dysfunction or liver disease, kidney damage or renal failure and muscular injuries caused by CIA or concurrent bacterial infections.

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