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Studies on haemato-biochemical changes in calves due to *Toxocara vitulorum* Infection

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Abstract
A study was carried out in both local and cross-bred cattle calves of Assam upto 6 months of age suffering from Toxocara vitulorum infection to estimate the haemato-biochemical changes. Blood samples were collected before treatment and after treatment to analyse the status of Haemoglobin, Packed Cell Volume (PCV), Differential Leukocytic Count (DLC), Total Leukocytic Count (TLC), Total Erythrocytic Count (TEC) and biochemical status such as Total serum Protein and Blood glucose. The pre-treatment values of Hb(g/dl), PCV (%) amd TEC in all the infected groups were significantly lower than the healthy control group whereas, the value of TLC were significantly higher. The biochemical values of Total Serum protein and Blood glucose was found to be significantly lower in infected calves. However, the haemato-biochemical values gradually returned to normal after 7th day onwards post-treatment.

Keywords: toxocara vitulorum, calves, haemato-biochemical, Assam

Introduction
Parasitic diseases are very common in our country particularly in the north-eastern region because of the hot and humid climatic condition of the region. The north-eastern region especially Assam has a relative humidity of 80% and environmental temperature of 15-35℃, which is highly conducive for multiplication and survival of different parasites (Rajkhowa *et al.,* 2001) [9]. More than 80% of diseases of this region is of parasitic origin. Among different endoparasitic infections Toxocariasis is a common problem in cattle mainly in the calves as it accounts for high morbidity and calf mortality. Toxocariasis in bovines is caused by the gastro-intestinal nematode *Toxocara vitulorum*, which mainly affects the younger calves, incidence being highest in calves below 3months of age (Pradhan *et al.,* 1991). Studies also revealed that the reason for higher incidence in calves is due to transmission of the larvae from cows to newborn through colostrums and transplacental route. Toxocariasis is characterized by unthriftiness, pot-bellied or tucked up abdomen, dull and harsh body coat, anaemia, restlessness, weight loss, stunted growth, sub-normal body temperature, constipation followed by diarrhoea and death of calves due to intestinal obstruction may occur (Soulsby, 1982) [13]. There is also significant alteration in the haemato-biochemical status of the affected calves. There is significant increase in packed cell volume and SGOT level, whereas blood parameters like haemoglobin, blood glucose and protein etc. is much decreased (Kumar *et al.,* 2006). Studies also revealed that there was significant increase in Packed cell volume (PCV) in calves with toxocariasis (Baruah *et al.,* 1979) [2]. In a study, calves naturally infected with *Toxocara vitulorum*, showed increased values of MCV and decreased total erythrocytic count, MCHC and indicated macrocytic to normocytic as well as hyperchromic anaemia (Devi *et al.,* 2000) [5]. There is also marked alteration in the mineral status of the affected animals, like levels of Zinc, Copper, and Iron drops significantly in the affected calves (Sarma *et al.,* 2012).

Material and Methods
Grouping of animals: Calves were grouped into 4 clinical groups, out of which Group 1, Group II and Group III were clinically infected with *Toxocara vitulorum* and were given anthelmintic treatment, whereas Group IV was healthy animals. Each group contained 6 calves.

Estimation of haematological parameters
Collection of Blood/ Serum for analysis: Blood samples were collected on 0, 3rd, 7th, 14th and

21st day post treatment for estimation of haematological studies. Sterilized glass vials were used each containing crystals of EDTA (1mg EDTA**:** 1ml blood) were used. Five ml of venous blood were collected aseptically from the Jugular vein of the positive calves with a sterile 5ml disposable syringe with needle. Out of 5ml, 1ml blood was transferred from the syringe to the vial for analysis of Haemoglobin, Packed Cell Volume (PCV), Differential Leukocytic Count (DLC), Total Leukocytic Count (TLC), Total Erythrocytic Count (TEC) and remaining 4ml was transferred to a test tube without EDTA for separation of serum. The serum was separated after 4hrs in a clean centrifuge tube. They were centrifuged at 3500 rpm for 15 minutes. The serum samples were stored at 4^0C till the biochemical analysis was made.

Haemoglobin (Hb g/dl), Packed Cell Volume (PCV %), Total Erythrocyte Count (TEC $\times 10^6$/cumm), Total Leucocyte Count (TLC $\times 10^3$/cumm was estimated by using Automated Cell Counter (Compteir, Haematology Analyzer, Melet Schloesing Laboratories, made in France, serial number-6KE368) following standard method. Differential Leucocyte Count (DLC %) was done following the method described by Schlam (1975). The blood smear was prepared and stained with Leishman's stain. The stained blood smear was examined under an oil immersion objective of a microscope. The different white blood cells were counted to a total of 100. Out of the total count, percentages of different leucocytes were determined.

Estimation of biochemical parameters

Estimation of total serum protein (g/dl) was carried out by Biuret method (Plummer, 1971). Clean dry sterilized test tubes were taken and labeled as Blank, Standard and Test. Blood Glucose (mg/dl) was estimated using automated analyser using commercially available Kit of Crest Biosystem, A Division of Corol Clinical System, Goa.

Statistical analysis

Data were analysed for statiscal interpretation by using SAS System ('Local', X64_7PRO).

Experimental findings

Haemoglobin (g/dl)

The Mean ± SE values of Hb (g/dl) ranged from 7.43 ± 0.15 to 9.83 ± 0.12, 7.59 ± 0.14 to 10.37 ± 0.16, 7.78 ± 0.11 to 10.87 ± 0.09 and 11.93 ± 0.43 to 12.65 ± 0.15 in Group I, Group II, Group III and Group IV respectively (Table 1 & Fig 1)

In Group I, the Mean ± SE values of Hb (g/dl) before treatment was 7.43 ± 0.15. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 7.62 ± 0.14, 8.05 ± 0.06, 9.15 ± 0.10 and 9.83 ± 0.12 respectively. The overall Mean ± SE value of Hb (g/dl) was 8.42 ± 0.18.

In Group II, the Mean ± SE values of Hb (g/dl) before treatment was 7.59 ± 0.14. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 7.68 ± 0.13, 8.07 ± 0.05, 9.35 ± 0.20 and 10.37 ± 0.16 respectively. The overall Mean ± SE value of Hb (g/dl) was 8.61 ± 0.21.

In Group III, the Mean ± SE values of Hb (g/dl) before treatment was 7.78 ± 0.11. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 7.88 ± 0.10, 8.57 ± 0.16, 9.47 ± 0.18 and 10.87 ± 0.09 respectively. The overall Mean ± SE value of Hb (g/dl) was 8.91 ± 0.22.

In Group IV, the Mean ± SE values of Hb (g/dl) before treatment was 11.93 ± 0.43. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 12.10 ± 0.29, 12.23 ± 0.29, 12.38 ± 0.24 and 12.65 ± 0.15 respectively. The overall Mean ± SE value of Hb (g/dl) was 12.26 ± 0.13.

Analysis of variance (Table 1.1) showed the changes in the values of Hb (g/dl) was found to be highly significant (P<0.01) in different days as well as in different groups and their interaction between groups and days of treatment.

Table 1: Mean ± Se Values Of Haemoglobin (G/Dl) In Different Groups Of Calves At Different Days Of Treatment.

Days of Observation		Groups			
		I	II	III	IV
Pre-treatment	0	$7.43 \pm 0.15^{a}_{A}$	$7.59 \pm 0.14^{a}_{A}$	$7.78 \pm 0.11^{a}_{A}$	$11.93 \pm 0.43^{b}_{A}$
Post-treatment	3rd	$7.62 \pm 0.14^{a}_{A}$	$7.68 \pm 0.13^{a}_{AB}$	$7.88 \pm 0.10^{a}_{A}$	$12.10 \pm 0.29^{b}_{A}$
	7th	$8.05 \pm 0.06^{a}_{B}$	$8.07 \pm 0.05^{a}_{B}$	$8.57 \pm 0.16^{a}_{B}$	$12.23 \pm 0.29^{b}_{A}$
	14th	$9.15 \pm 0.10^{a}_{C}$	$9.35 \pm 0.20^{a}_{C}$	$9.47 \pm 0.18^{a}_{C}$	$12.38 \pm 0.24^{b}_{A}$
	21st	$9.83 \pm 0.12^{a}_{D}$	$10.37 \pm 0.16^{b}_{D}$	$10.87 \pm 0.09^{c}_{D}$	$12.65 \pm 0.15^{d}_{A}$
Overall Mean ± SE		8.42 ± 0.18^{a}	8.61 ± 0.21^{a}	8.91 ± 0.22^{b}	12.26 ± 0.13^{c}

Means bearing atleast one similar superscript in a row do not differ significantly.

Means bearing atleast one similar subscript in a column do not differ significantly.

Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.1: Analysis Of Variance (Anova) Of Haemoglobin (g/dl).

Sources Of Variation	d.f	SS	MS	F
GROUP	3	297.5247	99.1749	470.69**
DAYS	4	85.84167	21.4604	101.85**
GROUP×DAYS	12	16.20367	1.35031	6.41**
ERROR	100	21.07	0.2107	

** P<0.01, Highly significant

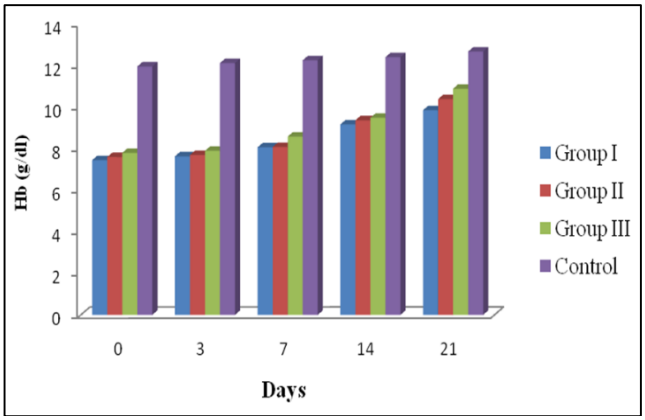

Fig. 1: Haemoglobin (G/Dl) Of Different Groups Of Calves In Different Days Of Treatment

Packed Cell Volume (%)

The Mean ± SE values of PCV (%) ranged from 26.98 ± 1.64 to 33.83 ± 0.67, 28.87 ± 2.11 to 33.75 ± 1.06, 27.60 ± 1.75 to 32.25 ± 0.83 and 32.47 ± 1.94 to 33.08 ± 1.30 in Group I, Group II, Group III and Group IV respectively (Table 1.2 & Fig. 1.1)

In Group I, the Mean ± SE values of PCV (%) before treatment was 26.98 ± 1.64. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 28.17 ± 1.44, 29.52 ± 1.18, 32.40 ± 0.95 and 33.83 ± 0.67 respectively. The overall Mean ± SE value of PCV (%) was 30.18 ± 0.69.

In Group II, the Mean ± SE values of PCV (%) before treatment was 28.87 ± 2.11. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 30.77 ± 1.80, 32.13 ± 1.33, 33.17 ± 1.08 and 33.75 ± 1.06 respectively. The overall Mean ± SE value of PCV (%) was 31.74 ± 0.71.

In Group III, the Mean ± SE values of PCV (%) before treatment was 27.60 ± 1.75. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 29.45 ± 0.92, 30.33 ± 1.08, 31.18 ± 0.92 and 32.25 ± 0.83 respectively. The overall Mean ± SE value of PCV (%) was 30.16 ± 0.56.

In Group IV, the Mean ± SE values of PCV (%) before treatment was 32.47 ± 1.94. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 33.00 ± 1.97, 33.75 ± 1.85, 33.35 ± 1.67 and 33.08 ± 1.30 respectively. The overall Mean ± SE value of PCV (%) was 33.13 ± 0.74.

Analysis of variance (Table 1.3) showed that the changes in the values of PCV (%) was found to be highly significant (P<0.01) in different days as well as in different groups but their interaction between groups and days of treatment was non-significant.

Table 1.2: Mean±Se Values of Pcv (%) In different groups of calves at different days of treatment.

Days of observation		GROUPS			
		I	II	III	IV
Pre-treatment	0	$26.98±1.64^{a}_{A}$	$28.87±2.11^{a}_{A}$	$27.60±1.75^{a}_{A}$	$32.47±1.94^{a}_{A}$
Post-treatment	3rd	$28.17±1.44^{a}_{A}$	$30.77±1.80^{a}_{A}$	$29.45±0.92^{a}_{AB}$	$33.00±1.97^{a}_{A}$
	7th	$29.52±1.18^{a}_{AB}$	$32.13±1.33^{a}_{A}$	$30.33±1.08^{a}_{AB}$	$33.75±1.85^{a}_{A}$
	14th	$32.40±0.95^{a}_{BC}$	$33.17±1.08^{a}_{A}$	$31.18±0.92^{a}_{AB}$	$33.35±1.67^{a}_{A}$
	21st	$33.83±0.67^{a}_{C}$	$33.75±1.06^{a}_{A}$	$32.25±0.83^{a}_{B}$	$33.08±1.30^{a}_{A}$
Overall Mean ± SE		$30.18±0.69^{a}$	$31.74±0.71^{ab}$	$30.16±0.56^{a}$	$33.13±0.74^{b}$

Means bearing atleast one similar superscript in a row do not differ significantly.

Means bearing atleast one similar subscript in a column do not differ significantly

Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.3 analysis of variance (anova) of packed cell volume (%)

Sources of variation	d.f	SS	MS	F
GROUP	3	182.579	60.8596	4.89^{**}
DAYS	4	276.882	69.2205	5.57^{**}
GROUP×DAYS	12	94.0132	7.83443	0.63^{NS}
ERROR	100	1243.72	12.4372	

** P<0.01, Highly significant; NS: Non-significant.

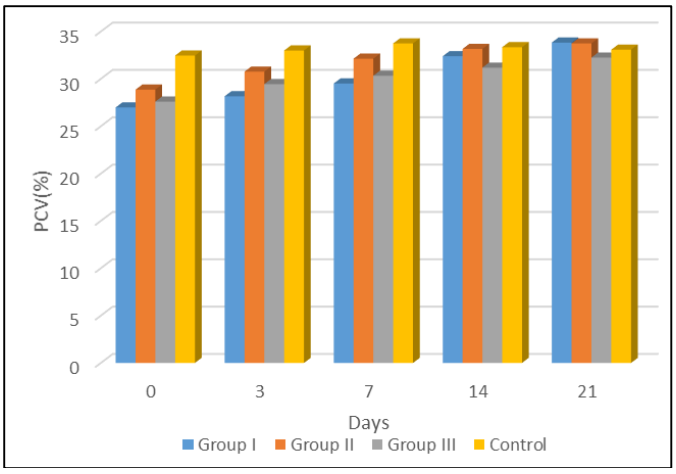

Fig 1.1: Pcv (%) of different groups of calves in different days of treatment

Total erythrocytic count (×10⁶/ cumm)

The Mean ± SE values of TEC (×10⁶/ cumm) ranged from 4.97 ± 0.29 to 5.81 ± 0.22, 4.86 ± 0.29 to 6.02 ± 0.14, 5.31 ± 0.27 to 5.84 ± 0.20 and 6.87 ± 0.14 to 6.96 ± 0.12 in Group I, Group II, Group III and Group IV respectively (Table 1.4 & Fig. 1.2).

In Group I, the Mean ± SE values of TEC (×10⁶/ cumm) before treatment was 4.97 ± 0.29. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.10 ± 0.28, 5.29 ± 0.27, 5.55 ± 0.26 and 5.81 ± 0.22 respectively. The overall Mean ± SE value of TEC was 5.34 ± 0.12.

In Group II, the Mean ± SE values of TEC (×10⁶/ cumm) before treatment was 4.86 ± 0.29. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 4.98 ± 0.31, 5.18 ± 0.28, 5.43 ± 0.21 and 6.02 ± 0.14 respectively. The overall Mean ± SE value of TEC was 5.29 ± 0.13.

In Group III, the Mean ± SE values of TEC (×10⁶/ cumm) before treatment was 5.31 ± 0.27. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.40 ± 0.27, 5.61 ± 0.22, 5.61 ± 0.16 and 5.84 ± 0.20 respectively. The overall Mean ± SE value of TEC was 5.55 ± 0.10.

In Group IV, the Mean ± SE values of TEC (×10⁶/ cumm) before treatment was 6.87 ± 0.14. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 6.90 ± 0.13, 6.86 ± 0.13, 6.89 ± 0.11 and 6.96 ± 0.12 respectively. The overall Mean ± SE value of TEC was 6.90 ± 0.05.

Analysis of variance (Table 1.5) showed that the changes in the values of TEC (×10⁶/cumm) was found to be highly significant (P<0.01) in different days as well as in different groups. The interaction between groups and days of treatment was non-significant.

Table 1.4 Mean±Se Values of Tec (×10⁶/Cu Mm) in different groups of calves at different days of treatment

Days of observation		GROUPS			
		I	II	III	IV
Pre-treatment	0	$4.97 ± 0.29^{a}_{A}$	$4.86 ± 0.29^{a}_{A}$	$5.31 ± 0.27^{a}_{A}$	$6.87 ± 0.14^{b}_{A}$
Post-treatment	3rd	$5.10 ± 0.28^{a}_{A}$	$4.98 ± 0.31^{a}_{A}$	$5.40 ± 0.27^{a}_{A}$	$6.90 ± 0.13^{b}_{A}$

	7th	5.29 ± 0.27$^{a}_{A}$	5.18 ± 0.28$^{a}_{A}$	5.61 ± 0.22$^{a}_{A}$	6.86 ± 0.13$^{b}_{A}$
	14th	5.55 ± 0.26$^{a}_{A}$	5.43 ±0.21$^{a}_{AB}$	5.77 ± 0.21$^{a}_{A}$	6.89 ± 0.11$^{b}_{A}$
	21st	5.81 ± 0.22$^{a}_{A}$	6.02 ± 0.14$^{a}_{B}$	5.84 ± 0.20$^{a}_{A}$	6.96 ± 0.12$^{b}_{A}$
Overall Mean±SE		5.34 ± 0.12^{a}	5.29 ± 0.13^{a}	5.58 ± 0.10^{a}	6.90 ± 0.05^{b}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.5 Analysis of variance (Anova) of total erythrocytic count (×10^{6} /cu mm)

Sources of variation	d.f	SS	MS	F
Group	3	51.61	17.20	56.25**
Days	4	6.35	1.59	5.19**
Group × Days	12	2.62	0.22	0.71^{NS}
Error	100	30.58	0.31	

** P<0.01, Highly significant; NS: Non-significant

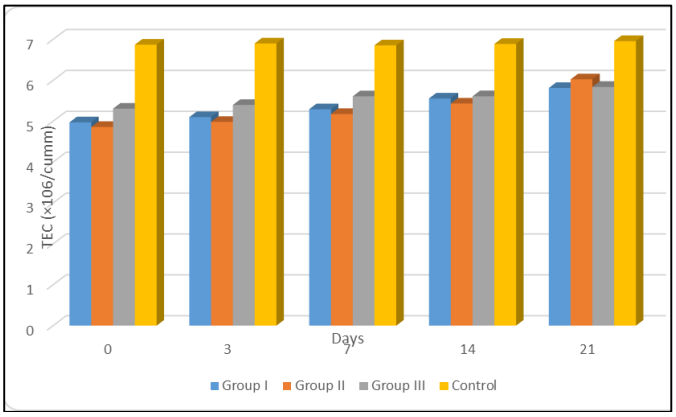

Fig 1.2: Tec (×106/Cumm) of different groups of calves in different days of treatment

Total leukocytic count (×10^{3} cu mm)

The Mean ± SE values of TLC (×10^{3}/ cumm) ranged from 11.91 ± 0.53 to 10.08 ± 0.41, 10.85 ± 0.59 to 9.70 ± 0.49, 10.97 ± 0.78 to 9.38 ± 0.78 and 9.50 ± 0.41 to 9.58 ± 0.51 in Group I, Group II, Group III and Group IV respectively (Table 1.6 & Fig. 1.3)

In Group I, the Mean ± SE values of TLC before treatment was 11.91 ± 0.53. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 11.69 ± 0.54, 11.13 ± 0.54, 10.28 ± 0.42 and 10.08 ± 0.41 respectively. The overall Mean ± SE value of TLC was 11.02 ± 0.24.

In Group II, the Mean ± SE values of TLC (×10^{3}/ cumm) before treatment was 10.85 ± 0.59. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 10.63 ± 0.58, 10.28 ± 0.61, 9.89 ± 0.51 and 9.70 ± 0.49 respectively. The overall Mean ± SE value of TLC was 10.27 ± 0.25.

In Group III, the Mean ± SE values of TLC (×10^{3}/ cumm) before treatment was 10.97 ± 0.78. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 10.83 ± 0.80, 10.27 ± 0.80, 9.80 ± 0.79 and 9.38 ± 0.78 respectively. The overall Mean ± SE value of TLC was 10.25 ± 0.35.

In Group IV, the Mean ± SE values of TLC (×10^{3}/ cumm) before treatment was 9.50 ± 0.41. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 9.63 ± 0.45, 9.52 ± 0.48, 9.60 ± 0.48 and 9.58 ± 0.51 respectively. The overall Mean ± SE value of TLC was 9.57 ± 0.19.

Analysis of variance (Table 1.7) showed that the changes in the values of TLC (×10^{3}/ cumm) was found to be highly significant in different days (P<0.01) as well as in different groups (P<0.05). The interaction between groups and days of treatment was non-significant.

Table 1.6: mean±se values of tlc (×10^{3}/cu mm) in different groups of calves at different days of treatment

Days of observation		GROUPS			
		I	II	III	IV
Pre-treatment	0	11.91±0.53$^{a}_{A}$	10.85±0.59$^{ab}_{A}$	10.97±0.78$^{ab}_{A}$	9.50±0.41$^{b}_{A}$
Post-treatment	3rd	11.69±0.54$^{a}_{AB}$	10.63±0.58$^{ab}_{A}$	10.83±0.80$^{ab}_{A}$	9.63±0.45$^{b}_{A}$
	7th	11.13±0.54$^{a}_{BC}$	10.28±0.61$^{a}_{A}$	10.27±0.80$^{a}_{A}$	9.52±0.48$^{a}_{A}$
	14th	10.28±0.42$^{a}_{BC}$	9.89±0.51$^{a}_{A}$	9.80±0.79$^{a}_{A}$	9.60±0.48$^{a}_{A}$
	21st	10.08±0.41$^{a}_{C}$	9.70±0.49$^{a}_{A}$	9.38±0.78$^{a}_{A}$	9.58±0.51$^{a}_{A}$
Overall Mean±SE		11.02±0.24^{a}	10.27±0.25^{ab}	10.25±0.35^{ab}	9.57±0.19^{b}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control

Table 1.7 Analysis Of Variance (Anova) Of Total Leukocytic Count (×10^{3} /cu mm)

Sources of variation	D.F	SS	MS	F
GROUP	3	31.69	10.56	5.03**
DAYS	4	22.84	5.71	2.72*
GROUP×DAYS	12	9.70	0.81	0.38^{NS}
ERROR	100	210.10	2.10	

**P<0.01: Highly significant; *P<0.05: Significant; NS: Non-significant.

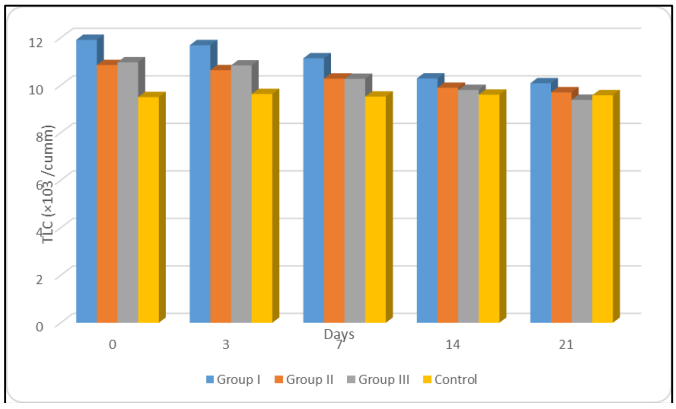

Fig 1.3: tlc (×10^{3}/cumm) of different groups of calves in different days of treatment

Differential Leukocytic Count

Neutrophil (%)

The Mean ± SE values of Neutrophil (%) ranged from 30.50 ± 0.94 to 27.10 ± 1.07, 30.62 ± 0.76 to 27.92 ± 0.34, 30.68 ± 0.65 to 27.48 ± 0.44 and 28.68 ± 0.75 to 28.51 ± 0.78 in Group I, Group II, Group III and Group IV respectively (Table 1.8 & Fig. 1.4)

In Group I, the Mean ± SE values of Neutrophil (%) before treatment was 30.50 ± 0.94. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 30.23 ± 1.01, 28.77 ± 1.23, 27.38 ± 1.12 and 27.10 ± 1.07 respectively. The overall Mean ± SE value of Neutrophil was 28.80 ± 0.52.

In Group II, the Mean ± SE values of Neutrophil (%) before treatment was 30.62 ± 0.76. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 30.27 ± 0.76, 29.53 ± 0.72, 28.68 ± 0.47 and 27.92 ± 0.34 respectively. The overall Mean ± SE value of Neutrophil was 29.40 ± 0.32.

In Group III, the Mean ± SE values of Neutrophil (%) before treatment was 30.68 ± 0.65. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 30.32 ± 0.65, 29.43 ± 0.66, 28.31 ± 0.62 and 27.48 ± 0.44 respectively. The overall Mean ± SE value of Neutrophil was 29.25 ± 0.34.

In Group IV, the Mean ± SE values of Neutrophil (%) before treatment was 28.68 ± 0.75. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 28.42 ± 0.72, 28.45 ± 0.70, 28.47 ± 0.71 and 28.51 ± 0.78 respectively. The overall Mean ± SE value of Neutrophil was 28.51 ± 0.30.

Analysis of variance (Table 1.9) showed that the changes in the values of Neutrophil (%) was found to be highly significant (P<0.01) in different days but non-significant in different groups. The interaction between groups and days of treatment was also non-significant.

Table 1.8: Mean±Se values of neutrophil (%) in different groups of calves at different days of treatment

Days of observation		Groups			
		I	II	III	IV
Pre-treatment	0	$30.50\pm0.94^{a}{}_{A}$	$30.62\pm0.76^{a}{}_{A}$	$30.68\pm0.65^{a}{}_{A}$	$28.68\pm0.75^{a}{}_{A}$
Post-treatment	3rd	$30.23\pm1.01^{a}{}_{A}$	$30.27\pm0.76^{a}{}_{A}$	$30.32\pm0.65^{a}{}_{A}$	$28.42\pm0.72^{a}{}_{A}$
	7th	$28.77\pm1.23^{a}{}_{A}$	$29.53\pm0.72^{a}{}_{AB}$	$29.43\pm0.66^{a}{}_{AB}$	$28.45\pm0.70^{a}{}_{A}$
	14th	$27.38\pm1.12^{a}{}_{A}$	$28.68\pm0.47^{a}{}_{AB}$	$28.31\pm0.62^{a}{}_{BC}$	$28.47\pm0.71^{a}{}_{A}$
	21st	$27.10\pm1.07^{a}{}_{A}$	$27.92\pm0.34^{a}{}_{B}$	$27.48\pm0.44^{a}{}_{C}$	$28.51\pm0.78^{a}{}_{A}$
Overall Mean±SE		28.80 ± 0.52^{a}	29.40 ± 0.32^{a}	29.25 ± 0.34^{a}	28.51 ± 0.30^{a}

Means bearing atleast one similar superscript in a row do not differ significantly.

Means bearing atleast one similar subscript in a column do not differ significantly.

Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.9 Analysis of variance (ANOVA) Of Neutrophil (%)

Sources of variation	D.F	SS	MS	F
GROUP	3	15.231	5.077	1.37^{NS}
DAYS	4	98.0003	24.5001	6.61^{**}
GROUP×DAYS	12	34.4057	2.86714	0.77^{NS}
ERROR	100	370.527	3.70527	

**P<0.01, Highly significant; NS: Non-significant.

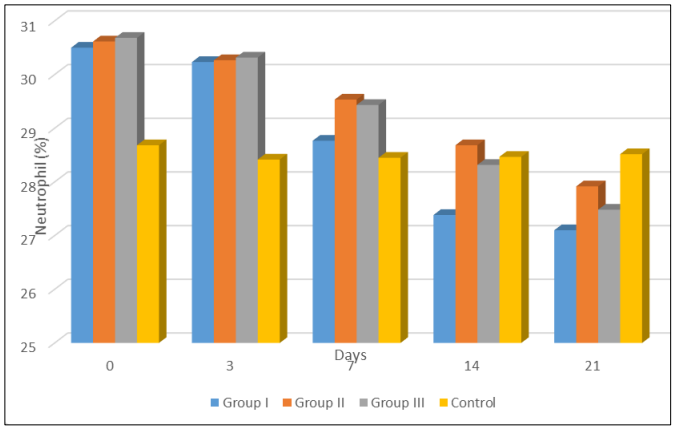

Fig 1.4: Neutrophil (%) of different groups of calves in different days of treatment

Lymphocyte (%)

The Mean ± SE values of Lymphocyte (%) ranged from 61.05 ± 1.03 to 66.17 ± 1.11, 60.60 ± 0.61 to 64.95 ± 0.35, 60.48 ± 0.70 to 66.18 ± 0.42 and 65.05 ± 0.76 to 65.01 ± 0.64 in Group I, Group II, Group III and Group IV respectively (Table 1.10 & Fig 1.5)

In Group I, the Mean ± SE values of Lymphocyte (%) before treatment was 61.05 ± 1.03. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 61.38 ± 1.09, 63.48 ± 1.33, 65.57 ± 1.20 and 66.17 ± 1.11 respectively. The overall Mean ± SE value of Lymphocyte was 63.53 ± 0.62.

In Group II, the Mean ± SE values of Lymphocyte (%) before treatment was 60.60 ± 0.61. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 60.88 ± 0.58, 62.33 ± 0.60, 63. 82 ± 0.30 and 64.95 ± 0.35 respectively. The overall Mean ± SE value of Lymphocyte was 62.52 ± 0.37.

In Group III, the Mean ± SE values of Lymphocyte (%) before treatment was 60.48 ± 0.70. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 60.63 ± 0.71, 62.28 ± 0.74, 63.82 ± 0.69 and 66.18 ± 0.42 respectively. The overall Mean ± SE value of Lymphocyte was 62.68 ± 0.48.

In Group IV, the Mean ± SE values of Lymphocyte (%) before treatment was 65.05 ± 0.76. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 65.35 ± 0.64, 65.28 ± 0.63, 65.20 ± 0.62 and 65.01 ± 0.64 respectively. The overall Mean ± SE value of Lymphocyte was 65.18 ± 0.27.

Analysis of variance (Table 1.11) showed that the changes in the values of Lymphocyte (%) was found to be highly significant (P<0.01) in different days as well as in different groups. The interaction between groups and days of treatment was significant (P<0.05).

Table 1.10: Mean±Se values of lymphocytes (%) in different groups of calves at different days of treatment

Days of observation		Groups			
		I	II	III	IV
Pre-treatment	0	$61.05\pm1.03^{a}{}_{A}$	$60.60\pm0.61^{a}{}_{A}$	$60.48\pm0.70^{a}{}_{A}$	$65.05\pm0.76^{b}{}_{A}$
Post-treatment	3rd	$61.38\pm1.09^{a}{}_{A}$	$60.88\pm0.58^{a}{}_{AB}$	$60.63\pm0.71^{a}{}_{A}$	$65.35\pm0.64^{b}{}_{A}$
	7th	$63.48\pm1.33^{ab}{}_{AB}$	$62.33\pm0.60^{a}{}_{B}$	$62.28\pm0.74^{a}{}_{AB}$	$65.28\pm0.63^{b}{}_{A}$

	14th	65.57± 1.20$^{a}_{B}$	63.82±0.30$^{a}_{C}$	63.82±0.69$^{a}_{B}$	65.20±0.62$^{a}_{A}$
	21st	66.17±1.11$^{a}_{B}$	64.95±0.35$^{a}_{C}$	66.18±0.42$^{a}_{C}$	65.01±0.64$^{a}_{A}$
Overall Mean±SE		63.53 ± 0.62^{a}	62.52 ± 0.37^{a}	62.68 ± 0.48^{a}	65.18 ± 0.27^{b}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.11: Analysis of variance (ANOVA) of lymphocyte (%)

Sources Of Variation	d.f	SS	MS	F
GROUP	3	133.81	44.60	12.08**
DAYS	4	252.59	63.15	17.11**
GROUP×DAYS	12	99.41	8.28	2.24*
ERROR	100	369.09	3.69	

**P<0.01, Highly significant; *P<0.05, Significant.

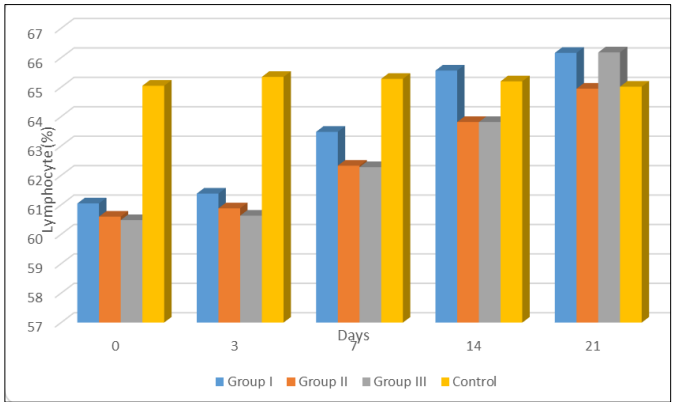

Fig 1.5: Lymphocyte (%) of different groups of calves in different days of treatment

Eosinophil (%)

The Mean ± SE values of Eosinophil (%) ranged from 5.90 ± 0.16 to 2.97 ± 0.07, 6.08 ± 0.11 to 2.95 ± 0.12, 6.02 ± 0.12 to 2.92 ± 0.10 and 2.82 ± 0.11 to 2.70 ± 0.14 in Group I, Group II, Group III and Group IV respectively (Table 1.12 & Fig. 1.6)

In Group I, the Mean ± SE values of Eosinophil (%) before treatment was 5.90 ± 0.16. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.78 ± 0.16, 4.93 ± 0.13, 3.68 ± 0.08 and 2.97 ± 0.07 respectively. The overall Mean ± SE value of Eosinophil was 4.65 ± 0.22.

In Group II, the Mean ± SE values of Eosinophil (%) before treatment was 6.08 ± 0.11. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.97 ± 0.11, 4.85 ± 0.16, 3.80 ± 0.09 and 2.95 ± 0.12 respectively. The overall Mean ± SE value of Eosinophil was 4.73 ± 0.23.

In Group III, the Mean ± SE values of Eosinophil (%) before treatment was 6.02 ± 0.12. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.90 ± 0.13, 4.88 ± 0.14, 3.82 ± 0.17 and 2.92 ± 0.10 respectively. The overall Mean ± SE value of Eosinophil was 4.71 ± 0.23.

In Group IV, the Mean ± SE values of Eosinophil (%) before treatment was 2.82 ± 0.11. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 2.78 ± 0.08, 2.75 ± 0.08, 2.62 ± 0.11 and 2.70 ± 0.14 respectively. The overall Mean ± SE value of Eosinophil was 2.73 ± 0.05.

Analysis of variance (Table 1.13) showed that the changes in the values of Eosinophil (%) was found to be highly significant (P<0.01) in different days as well as in different groups but their interaction between groups and days of treatment was non-significant.

Table 1.12 Mean±Se values of eosinophils (%) in different groups of calves at different days of treatment

Days of observation		Groups			
		I	II	III	IV
Pre-treatment	0	5.90 ± 0.16$^{a}_{A}$	6.08 ± 0.11$^{a}_{A}$	6.02 ± 0.12$^{a}_{A}$	2.82 ± 0.11$^{b}_{A}$
Post-treatment	3rd	5.78 ± 0.16$^{a}_{A}$	5.97 ± 0.11$^{a}_{A}$	5.90 ± 0.13$^{a}_{A}$	2.78 ± 0.08$^{b}_{A}$
	7th	4.93 ± 0.13$^{a}_{B}$	4.85 ± 0.16$^{a}_{B}$	4.88 ± 0.14$^{a}_{B}$	2.75 ± 0.08$^{b}_{A}$
	14th	3.68 ± 0.08$^{a}_{C}$	3.80 ± 0.09$^{a}_{C}$	3.82 ± 0.17$^{a}_{C}$	2.62 ± 0.11$^{b}_{A}$
	21st	2.97 ± 0.07$^{a}_{D}$	2.95 ± 0.12$^{a}_{D}$	2.92 ± 0.10$^{a}_{D}$	2.70 ± 0.14$^{a}_{A}$
Overall Mean ± SE		4.65 ± 0.22^{a}	4.73 ± 0.23^{a}	4.71 ± 0.23^{a}	2.73 ± 0.05^{b}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.13: Analysis Of Variance (Anova) Of Eosinophil (%)

Sources of variation	D.F	SS	MS	F
Group	3	86.8229	28.941	320.56**
Days	4	98.6455	24.6614	273.16**
Group × Days	12	29.1292	2.42743	26.89**
Error	100	9.02833	0.09028	

*P<0.01, Highly significant.

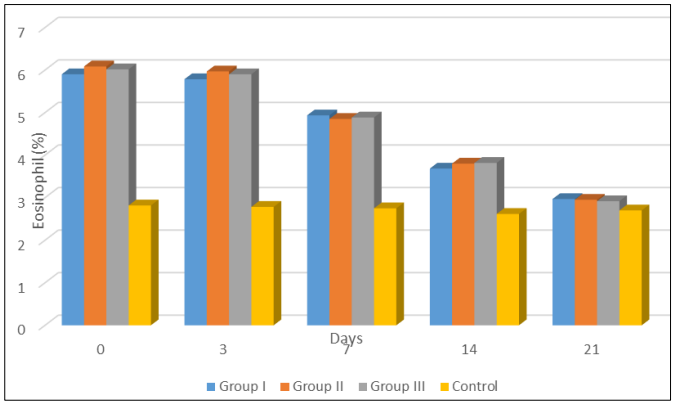

Fig. 1.6: Eosinophil (%) of different groups of calves in different days of treatment

Monocyte (%)

The Mean ± SE values of Monocyte (%) ranged from 2.57 ± 0.19 to 3.72 ± 0.13, 2.70 ± 0.16 to 4.13 ± 0.16, 2.78 ± 0.19 to 4.30 ± 0.13 and 3.43 ± 0.14 to 3.81 ± 0.26 in Group I, Group II, Group III and Group IV respectively (Table 1.14 & Fig. 1.7).

In Group I, the Mean ± SE values of Monocyte (%) before treatment was 2.57 ± 0.19. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 2.63 ± 0.15, 2.80 ± 0.13, 3.32 ± 0.04 and 3.72 ± 0.13 respectively. The overall Mean ± SE value of Monocyte was 3.01 ± 0.10.

In Group II, the Mean ± SE values of Monocyte (%) before treatment was 2.70 ± 0.16. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 2.87 ± 0.18, 3.25 ± 0.17, 3.48 ± 0.18 and 4.13 ± 0.16 respectively. The overall Mean ± SE value of Monocyte was 3.29 ± 0.12.

In Group III, the Mean ± SE values of Monocyte (%) before treatment was 2.78 ± 0.19. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 2.97 ± 0.23, 3.37 ± 0.21, 3.97 ± 0.19 and 4.30 ± 0.13 respectively. The overall Mean ± SE value of Monocyte was 3.48 ± 0.13.

In Group IV, the Mean ± SE values of Monocyte (%) before treatment was 3.43 ± 0.14. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 3.52 ± 0.14, 3.57 ± 0.16, 3.72 ± 0.23 and 3.81 ± 0.26 respectively. The overall Mean ± SE value of Monocyte was 3.61 ± 0.08.

Analysis of variance (Table 1.15) showed that the changes in the values of Monocyte (%) was found to be highly significant (P<0.01) in different days as well as in different groups but their interaction between groups and days of treatment was non-significant.

Table 1.14: MEAN±SE values of monocytes (%) in different groups of calves at different days of treatment

Days Of Observation		GROUPS			
		I	II	III	IV
Pre-treatment	0	$2.57 \pm 0.19^{a}_{A}$	$2.70 \pm 0.16^{a}_{A}$	$2.78 \pm 0.19^{a}_{A}$	$3.43 \pm 0.14^{b}_{A}$
Post-treatment	3rd	$2.63 \pm 0.15^{a}_{A}$	$2.87 \pm 0.18^{a}_{AB}$	$2.97 \pm 0.23^{a}_{A}$	$3.52 \pm 0.14^{b}_{A}$
	7th	$2.80 \pm 0.13^{a}_{A}$	$3.25 \pm 0.17^{ab}_{BC}$	$3.37 \pm 0.21^{b}_{A}$	$3.57 \pm 0.16^{b}_{A}$
	14th	$3.32 \pm 0.04^{a}_{B}$	$3.48 \pm 0.18^{ab}_{C}$	$3.97 \pm 0.19^{b}_{B}$	$3.72 \pm 0.23^{ab}_{A}$
	21st	$3.72 \pm 0.13^{a}_{B}$	$4.13 \pm 0.16^{ab}_{D}$	$4.30 \pm 0.13^{b}_{B}$	$3.81 \pm 0.26^{ab}_{A}$
Overall Mean ± SE		3.01 ± 0.10^{a}	3.29 ± 0.12^{b}	3.48 ± 0.13^{bc}	3.61 ± 0.08^{c}

Means bearing atleast one similar superscript in a row do not differ significantly.

Means bearing atleast one similar subscript in a column do not differ significantly.

Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.15 Analysis Of Variance (ANOVA) OF Monocyte (%)

Sources Of Variation	d.f	SS	MS	F
GROUP	3	6.163	2.05433	11.32**
DAYS	4	20.4203	5.10508	28.12**
GROUP×DAYS	12	3.70033	0.30836	1.70^{NS}
ERROR	100	18.1533	0.18153	

*P<0.01, Highly significant; NS: Non-significant.

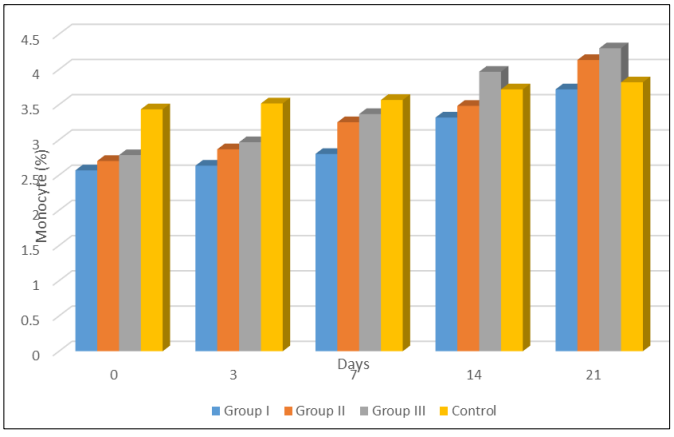

Fig 1.7: Monocyte (%) of different groups of calves in different days of treatment

Biochemical Changes

Total serum protein (g/dl)

The Mean ± SE values of Total serum protein (g/dl) ranged from 5.35 ± 0.08 to 5.93 ± 0.15, 5.43 ± 0.08 to 5.87 ± 0.12, 5.37 ± 0.10 to 5.80 ± 0.07 and 6.98 ± 0.15 to 6.92 ± 0.05 in Group I, Group II, Group III and Group IV respectively (Table 1.16 & Fig.1.8).

In Group I, the Mean ± SE values of Total serum protein (g/dl) before treatment was 5.35 ± 0.08. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.40 ± 0.04, 5.55 ± 0.06, 5.75 ± 0.10 and 5.93 ± 0.15 respectively. The overall Mean ± SE value of Total serum protein was 5.59 ± 0.06.

In Group II, the Mean ± SE values of Total serum protein (g/dl) before treatment was 5.43 ± 0.08. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.48 ± 0.09, 5.65 ± 0.12, 5.73 ± 0.14 and 5.87 ± 0.12 respectively. The overall Mean ± SE value of Total serum protein was 5.63 ± 0.05.

In Group III, the Mean ± SE values of Total serum protein (g/dl) before treatment was 5.37 ± 0.10. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 5.45 ± 0.06, 5.55 ± 0.07, 5.67 ± 0.07 and 5.80 ± 0.07 respectively. The overall Mean ± SE value of Total serum protein was 5.57 ± 0.04.

In Group IV, the Mean ± SE values of Total serum protein (g/dl) before treatment was 6.98 ± 0.15. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 7.00 ± 0.12, 6.97 ± 0.14, 6.98 ± 0.09 and 6.92 ± 0.05 respectively. The overall Mean ± SE value of Total serum protein was 6.97 ± 0.05.

Analysis of variance (Table 1.17) showed that the changes in the values of Total serum protein (g/dl) was found to be highly significant (P<0.01) in different days as well as in different groups but their interaction between groups and days of treatment was non-significant.

Table 1.16 MEAN±SE values of total serum protein (g/dl) in different groups of calves at different days of treatment

Days Of Observation		GROUPS			
		I	II	III	IV
Pre-treatment	0	$5.35 \pm 0.08^{a}_{A}$	$5.43 \pm 0.08^{a}_{A}$	$5.37 \pm 0.10^{a}_{A}$	$6.98 \pm 0.15^{b}_{A}$
Post-treatment	3rd	$5.40 \pm 0.04^{a}_{A}$	$5.48 \pm 0.09^{a}_{A}$	$5.45 \pm 0.06^{a}_{AB}$	$7.00 \pm 0.12^{b}_{A}$
	7th	$5.55 \pm 0.06^{a}_{AB}$	$5.65 \pm 0.12^{a}_{AB}$	$5.55 \pm 0.07^{a}_{AB}$	$6.97 \pm 0.14^{b}_{A}$
	14th	$5.75 \pm 0.10^{a}_{BC}$	$5.73 \pm 0.14^{a}_{AB}$	$5.67 \pm 0.07^{a}_{BC}$	$6.98 \pm 0.09^{b}_{A}$
	21st	$5.93 \pm 0.15^{a}_{C}$	$5.87 \pm 0.12^{a}_{B}$	$5.80 \pm 0.07^{a}_{C}$	$6.92 \pm 0.05^{b}_{A}$
Overall Mean ± SE		5.59 ± 0.06^{a}	5.63 ± 0.05^{a}	5.57 ± 0.04^{a}	6.97 ± 0.05^{b}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.17: Analysis Of Variance (ANOVA) of total serum protein (g/dl)

Sources of Variation	d.f	SS	MS	F
GROUP	3	42.3657	14.1219	229.38**
DAYS	4	1.9325	0.48313	7.85**
GROUP×DAYS	12	0.99683	0.08307	1.35^{NS}
ERROR	100	6.15667	0.06157	

*P<0.01, Highly significant; NS: Non-significant.

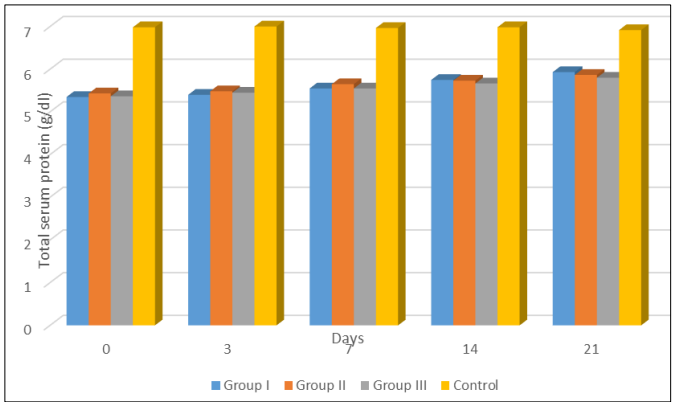

Fig 1.8: Total serum protein (g/dl) of different groups of calves in different days of treatment

Glucose (mg/dl)

The Mean ± SE values of Glucose (mg/dl) ranged from 39.82 ± 1.50 to 48.33 ± 1.09, 39.83 ± 0.79 to 49.33 ± 0.61, 40.08 ± 0.87 to 51.17 ± 0.75 and 53.83 ± 1.42 to 55.50 ± 1.17 in Group I, Group II, Group III and Group IV respectively (Table 1.18 & Fig. 1.9).

In Group I, the Mean ± SE values of Glucose (mg/dl) before treatment was 39.82 ± 1.50. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 39.97 ± 1.50, 42.33 ± 0.92, 45.33 ± 0.56 and 48.33 ± 1.09 respectively. The overall Mean ± SE value of Glucose was 43.16 ± 0.78.

In Group II, the Mean ± SE values of Glucose (mg/dl) before treatment was 39.83 ± 0.79. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 40.17 ± 0.70, 42.00 ± 0.58, 46.17 ± 1.07 and 49.33 ± 0.61 respectively. The overall Mean ± SE value of Glucose was 43.50 ± 0.76.

In Group III, the Mean ± SE values of Glucose (mg/dl) before treatment was 40.08 ± 0.87. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 40.50 ± 0.82, 42.83 ± 0.91, 48.17 ± 1.05 and 51.17 ± 0.75 respectively. The overall Mean ± SE value of Glucose was 44.55 ± 0.89.

In Group IV, the Mean ± SE values of Glucose (mg/dl) before treatment was 53.83 ± 1.42. The Mean ± SEs on 3rd, 7th, 14th and 21st day post-treatment were 54.17 ± 1.35, 54.17 ± 1.11, 54.83 ± 1.19 and 55.50 ± 1.17 respectively. The overall Mean ± SE value of Glucose was 54.50 ± 0.53.

Analysis of variance (Table 1.19) showed that the changes in the values of Glucose (mg/dl) was found to be highly significant (P<0.01) in different days as well as in different groups and their interaction between groups and days of treatment was significant.

Table 1.18 MEAN ± SE values of glucose (mg/dl) in different groups of calves at different days of treatment

Days of observation		Groups			
		I	II	III	IV
Pre-treatment	0	$39.82 \pm 1.50^{a}_{A}$	$39.83 \pm 0.79^{a}_{A}$	$40.08 \pm 0.87^{a}_{A}$	$53.83 \pm 1.42^{b}_{A}$
Post-treatment	3rd	$39.97 \pm 1.50^{a}_{A}$	$40.17 \pm 0.70^{a}_{A}$	$40.50 \pm 0.82^{a}_{AB}$	$54.17 \pm 1.35^{b}_{A}$
	7th	$42.33 \pm 0.92^{a}_{AB}$	$42.00 \pm 0.58^{a}_{A}$	$42.83 \pm 0.91^{a}_{B}$	$54.17 \pm 1.11^{b}_{A}$
	14th	$45.33 \pm 0.56^{a}_{BC}$	$46.17 \pm 1.07^{a}_{B}$	$48.17 \pm 1.05^{a}_{C}$	$54.83 \pm 1.19^{b}_{A}$
	21st	$48.33 \pm 1.09^{a}_{C}$	$49.33 \pm 0.61^{a}_{C}$	$51.17 \pm 0.75^{a}_{D}$	$55.50 \pm 1.17^{b}_{A}$
Overall Mean ± SE		43.16 ± 0.78^{a}	43.50 ± 0.76^{ab}	44.55 ± 0.89^{b}	54.50 ± 0.53^{c}

Means bearing atleast one similar superscript in a row do not differ significantly.
Means bearing atleast one similar subscript in a column do not differ significantly.
Gr I, Gr II & Gr III: Treatment group, Gr IV: Healthy control.

Table 1.19: Analysis of variance (Anova) of glucose (mg/dl)

Sources of variation	D.F	SS	MS	F
Group	3	2638.77	879.589	135.6**
Days	4	1064.6	266.151	41.03**
Group × Days	12	251.967	20.9973	3.24**
Error	100	648.677	6.48677	

**P<0.01, Highly significant.

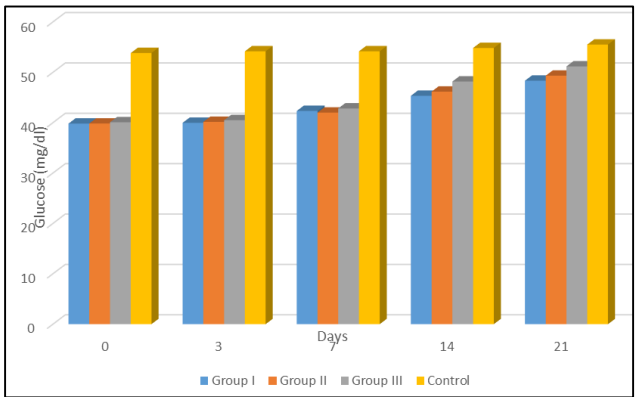

Fig. 1.9: Glucose (mg/dl) of different groups of calves in different days of treatment

Results and Discussion

The pre-treatment haematological values of the calves naturally infected with *Toxocara vitulorum* were compared with their respective values on post-treatment days and with the values of the calves in healthy control group. The pre-treatment values of Hb (g/dl) in the infected groups were significantly lower than the pre-treatment values of the healthy control group. The findings of the present study was similar to those reported by Banerjee *et al.* (1997), Chaudhry *et al.* (1999), Devi *et al.* (2000) and Sarma *et al.* (2012). The results of the present findings are not in accordance with the results of Baruah *et al.* (1979) [2] who found significant increase in the values of Hb in buffalo calves infected with *Toxocara vitulorum*. The higher values of Hb in infected calves could be due to haemoconcentration and the loss of body fluid and electrolytes in extreme diarrhoeic and dehydrated condition. The lower levels of haemoglobin recorded in the infected calves which indicates anaemia, which could be due to inappetance and competition for nutrients by adult parasite in the intestine leading to depletion of certain nutrients like iron, copper and vitamin B_{12} (Coles, 1974). The Hb values increased gradually from 7th day onwards after the treatment. This might be due to the effect of different anthelmentic drugs and other feed supplements given to the infected calves. In the present study the pre-treatment PCV (%) values of all the infected calves were significantly decreased compared to those of the healthy control group Similar findings were also reported by Banerjee *et al.* (1997) [2], Chaudhry *et al.* (1999), Devi *et al.* (2000) and Sarma *et al.*(2012). In contrast Baruah *et al.* (1979), Waghmare *et al.* (2000) and Kumar *et al.* (2006) reported a significant increase in the PCV values in infected calves, which might be due to haemoconcentration and the loss of body fluid and electrolytes in severe diarrhoea and dehydration in infected calves. The PCV values in all the treated groups increased gradually from 7th day onwards and returned to normal on 30th day post treatment, which might be due to the effect of the drugs on the parasites. The pre-treatment TEC level in all the infected groups were significantly lower as compared to healthy control group. The results of the present study are in accordance with the findings of Banerjee *et al.* (1997), Chaudhry *et al.* (1999), Devi *et al.* (2000), Rajguru *et al.* (2002) and Sarma *et al.* (2012) but are not in accordance with the results of Baruah *et al.* (1979) who found significant increase in TEC in infected calves. This increase in TEC may be due to haemoconcentration and the loss of body fluid and electrolytes in severe diarrhoea and dehydration in infected calves. The lower values of TEC in infected calves might be due to suppression of erythropoietic activity of bone marrow by some toxins of the parasites (Chaudhry *et al.*, 1999). The TEC values showed a tendency to return towards normal on 7th day onwards after treatment. The pre-treatment values of TLC in all the infected groups were higher compared to the healthy control group. Similar findings were also reported by Chaudhry *et al.* (1999), Raman *et al.* (1999) and Devi *et al.* (2000). The increase in TLC in the present study might be contributed to the phagocytic role of these cells which may increase as result of stimulation of the host defence mechanism due to chronic parasitic infection. The TEC values showed a tendency to return towards normal on 21st day after treatment. The neutrophil count in all the infected groups before treatment were slightly higher as compared to the healthy control group. Results of the present study are in accordance with the findings of Chaudhry *et al.* (1999). The changes in neutrophil (%) count in different days was found statistically highly significant but changes in different groups and the interaction between different days and groups were not significant. There is no information about the changes of values of neutrophil due to *Toxocara vitulorum* infection. The slight variation of neutrophil in the present study may be due to the phagocytic role of these cells. The pre-treatment lymphocyte count in all the infected groups were significantly lower as compared to healthy control group. Similar findings were also reported by Chaudhry *et al.* (1999) and Roman *et al.* (1999). The decrease in lymphocytes may be due to the toxins produced by *Toxocara vitulorum* which produce stress to the infected animals with significant decrease in the relative and absolute numbers of lymphocytes (Coles, 1974). The pre-treatment eosinophil level in all the infected groups were significantly higher as compared to the healthy control group. Results of the present study are in accordance with the findings of Banerjee *et al.*(1997), Chaudhry *et al.* (1999), Roman *et al.* (1999), Waghmare *et al.* (2000) and Neves *et al.* (2003).Eosinophilia found in the present study may be due to the hypersensitivity of the tissue by migration of *T. vitulorum* larvae in the tissue. Though there is no significant changes in the values of Monocyte due to *T. vitulorum* infection, the pre-treatment values of Monocyte in the infected groups were slightly lower than that of the control group but the values were within the normal range.

The pre-treatment value of total serum protein in all the infected groups were significantly lower as compared to the healthy control group. Results of the present study are in accordance with the findings of Baruah *et al.* (1979) and Chaudhry *et al.* (1999). Hypoproteinemia in the current study might due to lack of proper nutrition or due to improper absorption of dietary constituents from the intestinal tract. Lack of proper absorption of dietary constituents might have also been resulted due to gastrointestinal disturbences caused by *T. vitulorum*. The Total serum protein values SHOWED a tendency to return towards normal gradually from 14th day post-treatment in all the treatment group. The pre-treatment value of blood glucose in all the infected groups were significantly lower as compared to the healthy control group. Results of the present study are in accordance with the findings of Baruah *et al.* (1979), Chaudhry *et al.* (1999), Waghmare *et al.* (2000), Rajguru *et al.* (2002) and Kumar *et al.* (2006). Hypoglycemia in the present study might due to lack of proper diet or due to improper absorption of dietary constituents from the intestinal tract. Lack of proper absorption of dietary constituents might have also been resulted due to gastrointestinal disturbences caused by *T. vitulorum*. Blood glucose level increased gradually on 14th day onwards after the treatment in all the infected group.

Conclusion

It is concluded that haematological parameters like Haemoglobin (g/dl), Packed cell volume (%) and TEC are reduced whereas TLC is slightly higher and mainly eosinophilia is seen. Biochemical parameters like Total serum protein and blood glucose level is decreased in affected calves. Thus along with specific anthelmintic treatment, supportive therapy to correct these haemato-biochemical alterations will help in reducing mortality, regain good health and speedy recovery in calves infected with *Toxocara vitulorum.*

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