

Serum sialic acid level in buffaloes naturally infected with *Theileria annulata*

Tropical theileriosis, caused by *Theileriaannulata*, is the most economically important disease of domestic buffaloes and causing major losses in livestock production in tropical and subtropical regions.

Sialic acids (SA), a family of over 40 neuraminic acid derivatives, are among the most important molecules of life, since they occupy the terminal position on the oligosaccharide chains of glycoconjugates and frequently serve as ligands for receptors such as selectins and siglecs, which mediate a variety of cell-cell adhesion processes in inflammation and in the immune response. The majority of SA is found in either protein bound (PBSA) or lipid bound (LBSA) forms, while a little amount is in the free form. In addition, SA is localized at the end chain of many acute phase proteins. It has been reported that sialic acid concentrations are altered in some parasitic infestation like bovine and ovine Piroplasmosis, but there are no published reports on sialic acids change associated with tropical theileriosis in buffaloes. Therefore, this study was conducted to assess the effect of *T. annulata* infection on sialic acid concentration in blood sera in naturally infected buffaloes.

	No	Parasitemia rates	RBCs ($10^6 \mu\text{L}^{-1}$)	PCV (%)	Hb (g dL ⁻¹)	MCV (fL)	MCHC (g dL ⁻¹)
Control	20	0	6.4 ± 0.04^a	29.13 ± 0.1^a	9.7 ± 0.11^a	25.2 ± 0.6^e	22.2 ± 0.1^e
Diseased	5	Low	6.11 ± 0.02^b	26.01 ± 0.3^b	8.1 ± 0.2^b	29.2 ± 0.1^d	25.1 ± 0.1^d
	7	Moderate	5.74 ± 0.01^c	20.11 ± 0.1^c	5.7 ± 0.03^c	35.3 ± 0.2^e	28.3 ± 0.3^c
	6	High	4.96 ± 0.06^d	14.4 ± 0.4^d	3.6 ± 0.07^d	42.5 ± 0.1^b	31.0 ± 0.1^b
	4	Very high	3.83 ± 0.03^e	9.6 ± 0.2^e	2.2 ± 0.2^e	45.5 ± 0.5^a	33.2 ± 0.2^a

Fig. 1. Mean $\pm$ SEM of hematological parameters in control buffaloes and those infected with *T. annulata*. Different superscript in each column denotes significant differences ($P < 0.05$). SEM standard error of mean, RBCs red blood cells, PCV packed cell volume, Hb hemoglobin, MCV mean corpuscular volume, MCHC mean corpuscular hemoglobin concentration.

In brief, *Theileriaannulata*-infected ($n = 22$) and uninfected control ($n = 20$) adult buffaloes were selected. *Theileria* infection was revealed by Giemsa-stained peripheral blood and was confirmed by nested-PCR using *T. annulata*-specific primers. Based on the detected parasitemia, the infected animals were sub grouped into low $<1\%$, moderate $1-3\%$, high $3-5\%$, very high $>5\%$. Hematological parameters and the concentrations of total sialic acid (TSA), lipid-bound sialic acid (LBSA), and protein-bound sialic acid (PBSA) were measured and correlated to parasitemia.

The results showed significant differences in red blood cells (RBCs), packed cell volume (PCV) and hemoglobin (Hb) and sialic acid concentrations between infected and control groups. As the parasitemia increased, accordingly a significant decrease in RBCs, PCV, Hb and increase in the mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) was observed (Fig. 1).

Moreover, attained findings showed that changes in serum sialic acids content may be involved in the pathogenesis of theileriosis caused by *T. annulata*. As shown in Figure 2, a significant increase in sialic acid concentration (TSA, LBSA, and PBSA) was evident in diseased animals. In addition, sialic acid concentrations showed a positive correlation with different levels of parasitemia

Infection with *T. annulata* stimulates various immune responses and particularly natural killer (NK) cells which are known to play an important role in the innate immunity to *T. annulata* infection. Indeed, NK cells lyse schizont-infected cells and produce interferon gamma (IFN- γ) which activates uninfected macrophages to produce tumor necrosis factor alpha (TNF- α), interleukin-1 (IL-1), IL-6 and nitric oxide (NO). But cell surface hypersialylation hides some antigens, decreasing infected cell susceptibility to NK cells consequently promoting the evasion of the immune response and persistence of parasite in the host. Therefore, we suggested that increased contents of sialic acid would alter receptor-ligand interactions between the sialic acid and its receptors such as selectins and siglecs, which are known to play important roles in the inflammation and in the immune response.

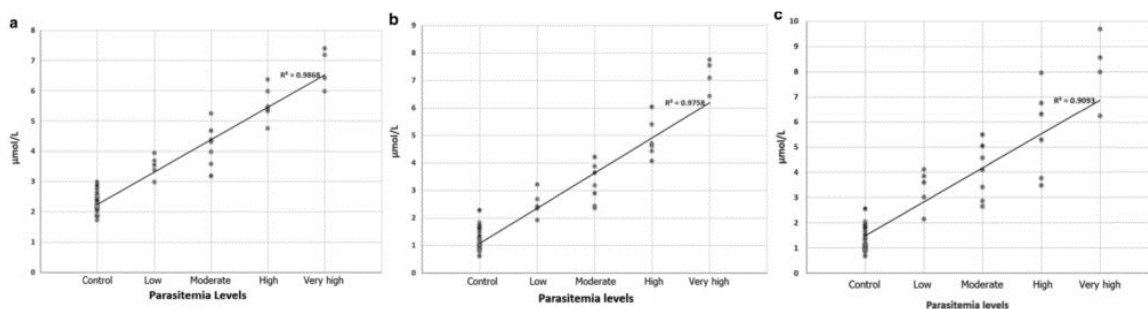


Fig. 2. Correlation among different levels of parasitemia and total sialic acid (A), lipid-bound sialic acid (B) and protein-bound sialic acid (C).

As a result, it seems that *T. annulata* infection could elevate the serum sialic acid concentrations. The increased levels of serum sialic acid concentrations during parasitemia presumably stimulate the host immune response and influence the parasite-host cell adhesion.

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