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Impact of Sewage Disposal on the Hemotological and Biochemical Parameters of Dairy Cows

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Rapid industrialization and urbanization coupled with modern agricultural techniques not only create pollution problems but are also a major threat to environmental purity. The sewage water washed away from industries and municipality are disposed on land as a means of disposal and recycling. The reuse of waste water and sludges from these sources for agriculture is a beneficial option in increasing crop production. The sewage water and sludge of industries and municipalities supply nitrogen, organic carbon and other plant nutrients (Shuman 1988). At the same time the dangers associated with the metals, xenobiotics, parasites and pathogens present in the sewage water and sludge (Brams et al. 1989) have become matters of social and scientific concern. The contaminants and parasites influence the blood parameters in different species of animals (Schalm et al. 1975). The present study was undertaken to investigate the effect of sewage pollution on the hemotological and biochemical parameters of the cattle grazed on the pasture land irrigated with sewage water or fed by fodder grown on sewage water and sludge.

MATERIALS AND METHODS

The present investigation was carried out in a sewage disposal area of Madurai City, Tamil Nadu, India (9'55" N 7° 07 '02' E); Avaniapuram Sewage Farm (ASF). This farm receives 2 million gallons of sewage water everyday from Madurai city through a closed drainage system. The sewage water is disposed onto ASF land where fodder grasses like buffalo grass, guinea grass and paddy are raised to meet the nutritional requirements of cattle present around the disposal site area. The cattle that were fed with fodder grown on sewage irrigated area may have the chance of infection with parasites and pathogens or contaminated with xenobiotics and heavy metals either directly from the soil or indirectly through food chain translocation.

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Thirty two lactating cows were selected from Avaniapuram sewage farm (ASF) area which grazed the sewage water irrigated pasture land or were fed by the fodder grown on the soil irrigated with sewage water or soil amended with sludge. This served as the experimental group. Control cows were selected from two dairy farms, viz. Thiagarajar Mills dairy farm and K.T.K. dairy farm at Thirumangalam, Madurai District, India., 20 miles away from ASF which neither grazed the waste water disposal area nor were fed by the fodder grasses grown on sewage water disposal soil or sludge amended soil. A total of 30 lactating control cows were selected, 14 from Thiagarajar Mills dairy farm and 16 from K.T.K. dairy farm. All the sample animals were apparently healthy and were in third to fifth lactation (5 to 7 years old). The parameters elucidated were

i) Total and Differential leucocyte counts (TLC and DLC)
ii) Total erythrocyte count (TEC)
iii) Blood hemoglobin (Hb)
iv) Packed cell Volume (PCV)
v) Serum Total Protein (TSP), Albumin (A), Globulin (G) and Albumin/Globulin ratio (A/G ratio)

Blood samples were collected from each individual cow by jugular venepuncture by means of a sterile disposable syringe after surface sterilization of the area with ethanol. To avoid cross contamination separate syringes and needles were used for each sample. To carry out hemotological parameters; Total and Differential leucocyte count (TLC and DLC), Total erythrocyte count (TEC), Hemoglobin (Hb) and packed cell volume (PCV), 5ml of blood was collected from each individual into a set of sterile tubes containing an anticoagulant, dipotassium ethylene diamine tetraacetic acid (EDTA).

The blood samples of both experimental and control cows collected in anticoagulant tubes were brought to the laboratory within an hour after bleeding. Using a Thomas type WBC pipette and an Improved Neubauer Hemocytometer, the total leucocyte count (TLC) was estimated as outlined by Dacie and Lewis (1975). The differential leucocyte count (DLC) was made using the standard protocol adopted by Dacie and Lewis (1975). Hemoglobin was estimated in blood samples of both control and experimental groups using Sahli's hemoglobinometer as carried out by Dacie and Lewis (1975). Total erythrocyte count (TEC) and Packed cell volume (PCV) were determined as described by Bray (1957).

Total protein and albumins in the serum were estimated **in vitro** using a diagnostic reagent kit supplied by M/S Span Diagnostic Pvt. Ltd., Surat, India by modified Biuret and Dumas method (Varley 1980). Serum globulin and Albumin/Globulin ratio were calculated from the values of total protein and albumin.

RESULTS AND DISCUSSION

The results presented in Table 1. compare the total leucocyte count (TLC) between control and experimental cows. The values obtained

for controls falls within the reported normal range of cows. The leucocyte count of the experimental group is about 9.3% below the range of the control group.

Mean TLC in experimental cows appeared to be affected by sewage pollution. It was apparant that there was a wide variation in TLC between individuals. The reason for the lower count in experimental group may be due to its ability to produce a leucocytosis in response to parasitic infection (Wilson and Paull 1982) and WBC values of the experimental group were similar to one investigated by Wilson and Paull (1982) in red deer. This observation is also in agreement with the parasitic infection demonstrated elsewhere during the course of study in fecal specimens of the experimental cows. The chronic infectious state such as pulmonary tuberculosis would result in leucocytosis in the affected individual. The lower TLC in experimental cows was similar to the findings of Deshpande et al. (1987) in non-pregnant and lactating cows. The decrease of TLC in experimental group fed by sewage irrigated soil grown fodder grasses may be due to the stimulation of corticosteroid production from adrenal cortex which in turn leads to a reduction in the number of circulating leucocytes through suppression of lymphocytes (McDonald 1980).

The study revealed that the differential leucocyte counts vary markedly between individuals. This was in agreement with findings of Wilson and Paull (1982).

The percentage of neutrophils ranged from 16 to 50%, lymphocytes from 43 to 74%, monocytes from 2 to 6% and eosinophils from 2 to 12% (Table 1). The average percentage of lymphocytes (L%) was higher than the average percentage of neutrophils (N%). When compared to control cows, the percentage of neutrophils of the experimental group was low (4%). The mean percentage lymphocytes of the experimental group was higher significantly ($P < 0.05$) than the control group. The mean percentage of monocytes and eosinophils of the control group 4.73% and 6.6% respectively were higher than the mean percentage of the experimental group 3.8% and 4.7% repectively.

The percentage of lymphocytes of both control and experimental groups of this study was higher 56.26% and 60.37% respectively than the neutrophils 32.4% and 31.12% respectively. This was similar to the observations of Schalm et al. (1975) in sheep and cattle. They have shown that N% averaged 30% and 25% respectively in sheep and cattle and L% averaged 62% and 58% respectively. This was in contrast to the onservation of Wilson and Paull (1982) in red deer where N% averaged 53.9% and L% averaged 37.2%. The mean neutrophil, eosinophil and monocyte percentages were lower in the experimental group than the control group. This might be due to the production of corticosteriods (Mc Donald), 1980). But the lymphocyte percentage was higher (7.3%) in the experimental group. This elevated trend of lymphocytes was a phyisiological adaptation in the experimental cows due to its exposure to bacteria, viruses and parasites directly and through food chain.

Table 1: Total leucocyte count (TLC), Differential leucocyte count (DLC), Total erythrocyte count (TEC), Hemoglobin (Hb) and Packed cell volume (PCV) of control and experimental groups.

Mean ± SE

Parameters	Control group n=30	Experimental group n=32	Percent decrease or increase over control
Total Leucocyte count (TLC) Thousand/cmm	6.38±0.15	5.79±0.17	- 9.2%
Neutrophils %	32.40±1.17	31.13±1.43	- 3.9%
Eosinophils %	6.60±0.32	4.69±0.32	-29.0%
Lymphocytes %	56.27±1.69	60.38±1.38@	+ 7.4%
Monocytes %	4.73±0.39	3.81±0.21	-19.5%
Total erthryocyte count (TEC) Million/cmm	6.66±0.09	5.38±0.16	-19.2%
Hemoglobin %	13.32±0.17	10.72±0.31	-19.5%
Packed cell Volume %	40.15±0.51	32.38±0.98	-19.4%

@ Significant $P < 0.05$

The total erythrocyte count (TEC), Packed cell volume (PCV) and Hemoglobin (Hb) (Table 1) showed a lower trend of 19%, 19% and 20% respectively in experimental cows than the control group. When subjected to student 't' test, the trend was not statistically significant.

The mean values of TEC, PCV and Hb were in agreement to the findings of Chaudhri et al. (1988) in the Fasciola gigantica infected buffaloes. The parasitic examination of feces in the experimental group elsewhere in the present study revealed a heavy load of parasites and this parasitic infection might be the reason for low percentage of TEC, PCV and Hb in the study group. The feeding habits of some of the parasites in the early stages and mechanical loss of blood through intrahepatic hemorrhages might have caused the low TEC, PCV and Hb%. The values of these parameters were in contrast to the values reported by Schalm et al. (1975). According to Guyton (1981), increased TEC and PCV condition called

erythropoiesis occurs through stimulatory effects of tissue hypoxia on erythropoietin production.

Blood hemoglobin levels estimated in experimental group showed a low percentage (10.7%) than the control group (13.3%). This lower trend of hemoglobin indicates the prevalence of parasitic infestation and iron deficiency. The value of PCV was lower in experimental cows (5%) than the control. This observation was similar to that of Gopalakrishna rao et al. (1981) in ongole cows.

The study of Chaudhri et al. (1988) had shown that the buffaloes infected with Fascioliasis suffered from normochromic normocytic anemia which had been indicated by significantly declining value of TEC, Hb, and PCV.

The mean values of Total Serum Protein, Albumin, Globulin and Albumin/globulin ratio were presented in the Table 2. The total serum proteins and globulins of the control group revealed an elevated trend 8.4% and 24.3% respectively over the experimental group. But interestingly, the levels of albumin and A/G ratio were significantly ($P < 0.01$ and $P < 0.001$ respectively) higher in the experimental group. The increase of albumin and A/G ratio was 9.7% and 48.8% respectively over the control cows.

Table 2: Total Protein, Albumin, Globulin and Albumin/Globulin ratio among control and experimental groups.

Mean ± SE

Group	Total Protein g%	Albumin g%	Globulin g%	A/G ratio g%
Control n=30	5.399 ± 0.092	2.190 ± 0.055	3.209 ± 0.098	0.709 ± 0.034
Experimental n=32	0.980 ± 0.214	2.403 ± 0.058	2.580 ± 0.212	1.055 ± 0.091
%Change	-	9.7%	-	48.8%
Significant	NS	$P < 0.01$	NS	$P < 0.001$

The low concentrations of total serum protein and globulin could be attributed to intestinal, managemental and environmental factors (Kulkarani et al. 1983). The present study on the effect of sewage pollution on live stock have revealed the presence of parasites, xenobiotics and heavymetels in soils, sewage sludge, sewage water, fodder grasses and other plants of the sewage water disposal site.

These findings were in agreement with Kulkarani et al, (1983). Available information revealed that reduction in TSP is associated with malmutrition, severe infection and diseased states (Delvin 1985).

In the present observation, the mean value of total serum protein was 5.39 g% in the control group and 4.98 g% in the experimental group. The significant fall in values of the TSP in the experimental group could be attributed to the extensive damage to the liver paranchyma caused by parasitic infections. These results were in agreement with the observation of Chaudhri et al. (1988) who reported a decrease in TSP values in goats infected with F.gigantica and F.hepatica. The variation in the results was also shown by Chaudhri et al. (1988) and the absence of correlation between fascioliasis and total serum protein could be attributed to the differences in severity and duration of infection.

The results shown in Table 2 indicated an increased level of albumin and a decreased level of globulin in the experimental group. But Siddiqua et al. (1989) had reported that the mean level of total serum protein and albumin were found to have decreased in goats naturally infected with intestinal parasites and serum globulin content on the other hand was found to have increased over the control. The decrease in serum albumin and increase in serum globulin during parasitic infection was also reported by Siddiqua et al. (1989) for different species of animals. But the present investigation was in contrast to the findings of Siddiqua et al. (1989). It was reported that gastrointestinal parasities influence the blood parameters in different species of animals (Schalm et al. 1975).

The low serum albumin level, a condition called hypoalbumenaemia was correlated with the reduced fertility and hypoalbumenaemic cows required more number of services for conception than the cows having 3.15 g% of higher concentration of serum albumin. Though the mean level of serum albumin in the experimental group was below the required value needed for normal conception (3.15 g%), the experimental cows did not suffer a reduced fertility.

The mean value of A/G ratio in the experimental group was significantly higher ($P < 0.001$) than the control group. This elevated A/G ratio level could be attributed at least in part to the adaptive response to external stimuli. The increase in A/G ratio was the result of a comparatively major rise in albumin values in comparison to globulin. These findings were in confirmation with those reported by Schalm et al. (1975).

The decrease in the levels of different hemotological parameters and the significant increase of lymphocytes and total proteins strongly suggest that sewage disposal had an impact on hemotological and biochemical parameters of dairy cows.

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