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Effect of Airborne Fluoride on Some Hematological Parameters of Chick

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Harmful levels of fluoride compounds in air, water, food or forage due to the preponderance of pollution caused by modern day man-made sources have been reported in many parts of the world (Rose and Marier 1977). Presence of excessive concentration of fluoride containing compounds in the environment can be damaging to all forms of life. Fluoride ion is a protoplasmic poison and only a small amount can be tolerated by any living cell (Pack 1971). Ashbacher (1973) stated that among the air pollutants, fluoride had caused most serious and wide spread damages in cattle. Studies on the effect of fluoride on birds are very limited (Rose and Marier 1977). Ronzani (1909) reported hyperanemia and weight loss in doves inhaled 0.01% fluoride (hydrofluoric acid gas) for an extended period. Balazova and Hluchan (1968) reported higher fluoride content in various tissues and eggs of house sparrows in the vicinity of an aluminium plant. Bone fluoride levels in some species of wild birds were reported by Kay *et al.* (1975).

A few studies have been conducted on fluoride pollution in the vicinity of fluorine industry situated at Bhestan (Dist. Surat, Gujarat State, India). Higher urinary fluoride level in man (Desai *et al.* 1980), foliage injury in plants (Pillai and Mane 1984) have been reported in the vicinity.

The present study deals with changes in some hematological parameters of chicks due to airborne fluoride toxicity in vicinity of fluorine industry situated at Bhestan in Dist. Surat (India).

MATERIALS AND METHODS

Three days old chicks (variety of H.H. 260, Bangalore, India) obtained from the poultry farm were maintained in the laboratory (South Gujarat University, Dist. Surat, Gujarat State, India) for 7 days. During this period they were fed with 'chick-mash' (obtained from local source). water was given *ad libitum*. Thirty

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three chicks were exposed to the atmosphere in vicinity of the fluorine industry for 20 days. Same number of chicks maintained in the South Gujarat University Campus (10 km away from the industry) were treated as the control. During this period the chicks were given 'chick mash' and water (fluoride content < 1.0 ppm) *ad libitum*.

Blood sample was drawn from 3 chicks each from control group and from those exposed to polluted atmosphere daily up to 5th day. After 5th day, the sampling interval was increased by 3 days. Serum and protein-free filtrate (according to Folin and Wu 1920) were separated from the blood of individual chick for the analyses. Fluoride in the serum was determined using a fluoride electrode (Orion Research Inc., USA) as described by Fry and Taves (1970). Phosphorus in the protein-free filtrate was determined according to Fiske and Subbarow (1925). Iron in the protein-free filtrate was determined by the method of Wong (1928). Magnesium in the protein-free filtrate was determined according to Orange and Rhein (1951). Protein in the serum was determined by the method of Lowry *et al.* (1951) using bovine serum albumin as standard. Glucose in the protein-free filtrate was determined according to Folin and Wu (1920). Hemoglobin was determined according to Wong (1928). Method of Bhandaru *et al.* (1977) was employed to determine cholesterol in the serum.

The results were compared using pairing design test (Woolf 1968).

RESULTS AND DISCUSSION

A significant increase ($P < 0.001$) in fluoride was observed in chicks exposed to polluted atmosphere, than the control (Fig. 1). This increase in fluoride was related to the exposure days. This is expressed by the equation : $\ln Y = 0.1162 + 0.1672 \ln X$, where Y = serum fluoride in μ moles/l and X = exposure time in days (Fig. 2). Compared to control, phosphorus and iron contents decreased significantly ($P < 0.01$), whereas magnesium content significantly increased ($P < 0.05$), in chicks exposed to the polluted atmosphere. Phosphorus and magnesium contents in chicks did not change considerably during 1-3 days exposure to the polluted atmosphere. From 3 days onwards, it changed markedly, when compared with the control. Considerable decrease in iron content was observed from 4 days onwards, in chicks exposed to polluted atmosphere, than control (Fig. 1).

Protein content decreased ($P < 0.10 > 0.05$) in chicks exposed to the polluted atmosphere than the control. Compared to control, significant decrease in glucose content, was observed in chicks exposed to the polluted atmosphere. Hemoglobin content significantly decreased ($P < 0.001$) in chicks exposed to the polluted atmosphere than the control. This decrease was predominant from 4 days onwards. Changes in cholesterol content, compared

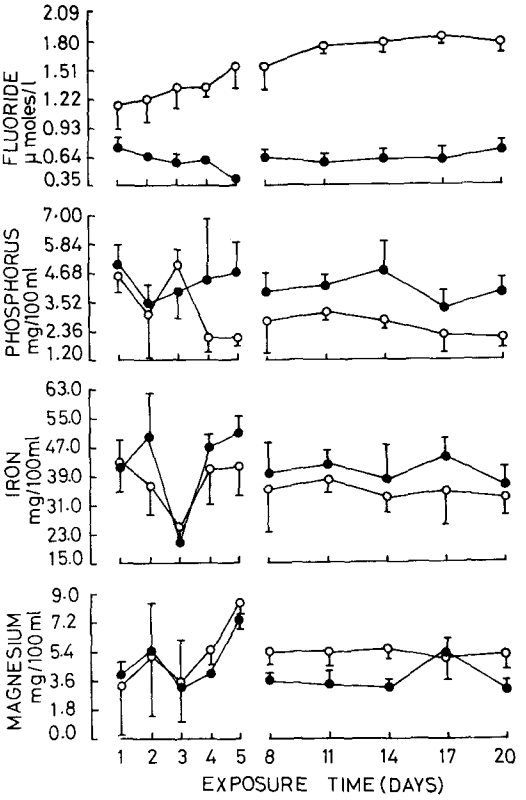

Figure 1. Fluoride (in serum), phosphorus, iron and magnesium (in protein-free filtrate) of chicks. o——o Chicks exposed to the polluted atmosphere; ●——● Control. Vertical bars are standard errors of the mean (n = 3).

to the control, was found insignificant (Fig. 3).

Airborne fluoride is readily absorbed through the respiratory tract (Roholm 1937) and immediately ionises in contact with blood (Waldbott 1963) which is carried by way of blood stream to different parts of the body. In the present study, considerable increase in serum fluoride was observed. This increase in fluoride was directly correlative to the exposure days. Fluoride ingestion may elevate ionic fluoride as stated by Taves (1970) for a shorter duration, but the possibility of existing fluoride in ionic form in blood is rare due to its strong affinity for the hydroxyl lattice sites in bones (Eanes and Posner 1970). Continuous increase in serum fluoride in the present study may be due to the existence of non or low degradable organofluorides, than the ionic fluoride.

Fluoride inhaled from the atmophere adversely affected glucose, protein and hemoglobin contents in the blood of chick

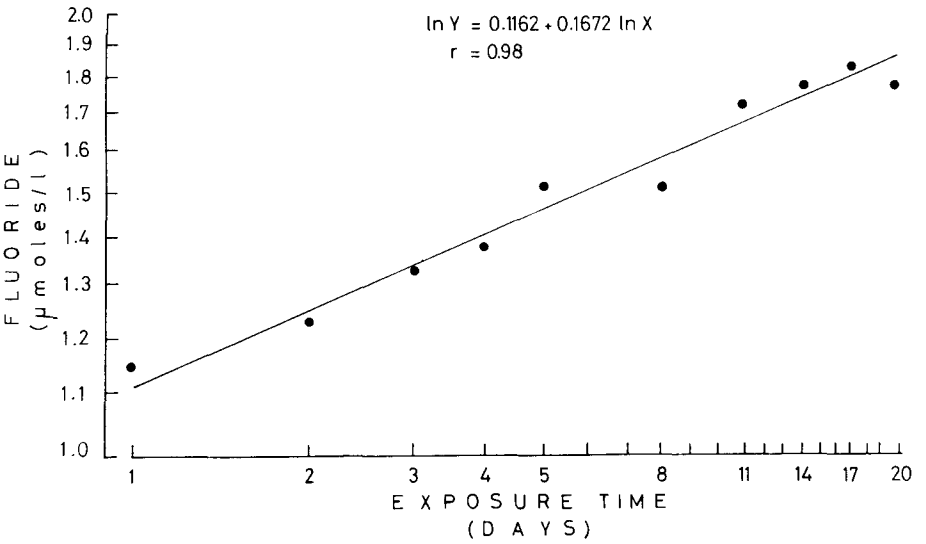

Figure 2. Correlation of serum fluoride with exposeure time.

in the present study. Corneal epithelium treated with fluoride (*in vitro*) showed 60% reduction in glycogen metabolism (William *et al.* 1981). In the present study, 28% reduction in glucose was observed in chick after 20 days exposure to the polluted atmosphere. Reduction in protein in chick was 31% after 20 days exposure to the polluted atmosphere. The main mechanism for the cytotoxic effect of fluoride is inhibition of protein synthesis (Holland 1979). Tertishmyi (1968) reported a decrease in serum portein level in wether, when it was orally given 1.5 mg sodium fluoride. In the present study, hemoglobin content decreased (12%) markedly after 4 days exposure onward, when the serum fluoride was 1.35 μ moles/l serum. Almost same decrease (12.5%) was observed after 20 days exposure, when the serum fluoride content was 1.78 μ moles/l serum. It shows that optimum reduction in hemoglobin was obtained at 1.35 μ moles/l serum fluoride after which an increase in serum flouride did not further reduce the hemoglobin. Danilov and Kasyanova (1975) observed a reduction in hemoglobin in rat exposed to 0.05, 0.47 and 4.98 mg/m^3 fluoride. In the present study, serum cholesterol was unaffected. This result agrees with the studies conducted in rats by Townsend and Singer (1977).

Andreeva (1957) observed a decrease in serum phosphorus in pups administrated with 20 mg/kg/body weight fluoride. In the present study, decrease in phosphorus (46% after 20 days of exposure) and iron (9% after 20 days exposure), and increase in magnesium (72% after 20 days exposure) contents in blood of chicks exposed to polluted atmosphere are consistent with the studies conducted in mammals. Soldatovic and Nadeljkovic-Tomic

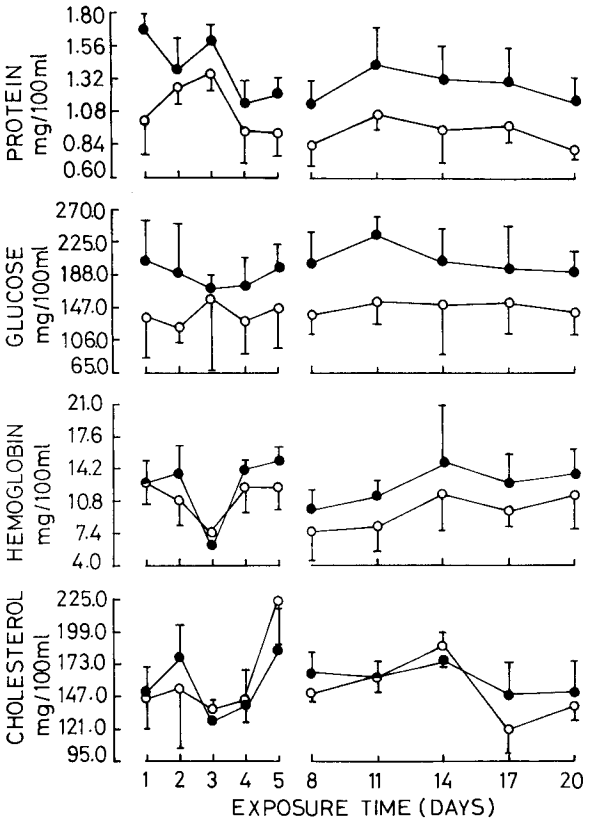

Figure 3. Protein (in serum), glucose (in protein-free filtrate), hemoglobin, and cholesterol (in serum) of chicks. o——o Chicks exposed to the polluted atmosphere; ●——● Control. Vertical bars are standard errors of the mean (n=3).

(1971) reported a decrease in blood iron in rabbits when they were given 20 mg/kg/body weight fluoride daily for 30 days. Studies of Suketa *et al.* (1976) revealed that fluoride could elevate magnesium content in the blood of rat.

The results when compard with the control group showed that the chicks exposed to the polluted atmosphere retained considerable amount of fluoride in the serum. Protein and glucose were more affected than hemoglobin in chicks exposed to the polluted atmosphere. Cholesterol was unaffected. Among the minerals, magnesium content was more affected, followed by phosphorus and iron contents.

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