

## CHAPTER II

Acute Toxicity of Fluoride to Post-hatched Developing Chicks of Domestic Fowl, *Gallus gallus domesticus*.

The characteristics of exposure and the spectrum of effects come together in a correlative relationship customarily referred to as dose-response relationship. This relationship is the most fundamental and pervasive concept in toxicology. Indeed, an understanding of this relationship is essential for the study of toxic materials. It is this relationship that Trevan (1927) envisioned in his introduction of lethal dose as an index ( $LD_{50}$ ). The  $LD_{50}$  is the statistically derived single dosage of a substance that can be expected to cause death in 50 percent of animals (Doull, 1986).

Determination of  $LD_{50}$  has become a public issue because of increasing concern for the welfare and protection of laboratory animals. However, the  $LD_{50}$  is essential for characterizing the toxic effects of chemicals and thus determining their hazard to humans. In determining the  $LD_{50}$ , more than a number is obtained. Information is obtained on the types of toxic effects the chemical produces, on the onset of toxicity, on the duration of toxicity etc. This information is essential for the rational treatment of humans exposed to the chemical, for the design of experiments and to assess the toxicity of repeated exposure to the chemical (Doull, 1986).

Toxicological effects of fluoride to different animal models have been studied (Shaikh and Hiradhar, 1986; Franke, 1989; Suresh and Hiradhar, 1990a; Karram and Ibrahim, 1992). However, surprisingly, very little effort has been directed to study the median effective dose of fluoride to different animal models used. In one isolated attempt towards this end Pillai *et al.*, (1987) have calculated the  $LD_{50}$  of fluoride for male mice. However, it is well documented that  $LD_{50}$  value of a chemical varies considerably and is affected by several factors (Mier and Theakston, 1986). It is also proved that median lethal dose widely differs even in closely related species (Pillai *et al.*, 1989a). Hence, as a prelude to study the toxicological effect of fluoride to growing chick, it was thought desirable to find out the  $LD_{50}$  of fluoride for female post-hatched developing chicks of domestic fowl *Gallus gallus domesticus*.

## MATERIAL AND METHODS

One day old female Rhode Island Red chicks were obtained from Government Hatchery Baroda. They were divided into seven groups of twenty five birds each by weight, so that the mean and distribution in each group was nearly identical. Chicks in each group were placed in metal coop of 150 x 100 x 75 cm and were provided with water and standard commercial starter diet *ad libitum*. Seven serial concentrations of fluoride were made by dissolving commercial grade sodium fluoride (Sigma Chemical Co., St. Louis, MO) in doubly distilled water according to Standard Methods (APHA, 1989). The treatment schedule was as follows:

Group	I	25 mg F/kg b.w.
	II	35 mg F/kg b.w.
	III	45 mg F/kg b.w.
	IV	55 mg F/kg b.w.
	V	85 mg F/kg b.w.
	VI	100 mg F/kg b.w.
	VII	120 mg F/kg b.w.

For all the groups 1 ml of fluoridated water of appropriate concentration was given orally to produce respective dosages. Mortality was noted for 24 h and LD<sub>50</sub> value was computed by probit method of Finney (1971).

## RESULTS

Results of the toxicity of fluoride are presented in figure 1 and 2. One day old female chicks of domestic fowl were subjected to different dosages of fluoride ranging from 25 to 120 mg F/kg b.w. For 24 h no mortality was observed among birds which received 25 mg F/kg b.w.

Table I A test of the toxicity of fluoride to one-day old female chicks of domestic fowl *G. gallus domestics*.

Dose of fluoride <sup>(mg/kg bw)</sup>	No. of chicks (n)	No. affected	% kill (p)
25	25	0	0
35	25	1	4
45	25	3	12
75	25	11	44
85	25	15	60
100	25	17	68
120	25	21	84

Fig. 1. Dose response Curve

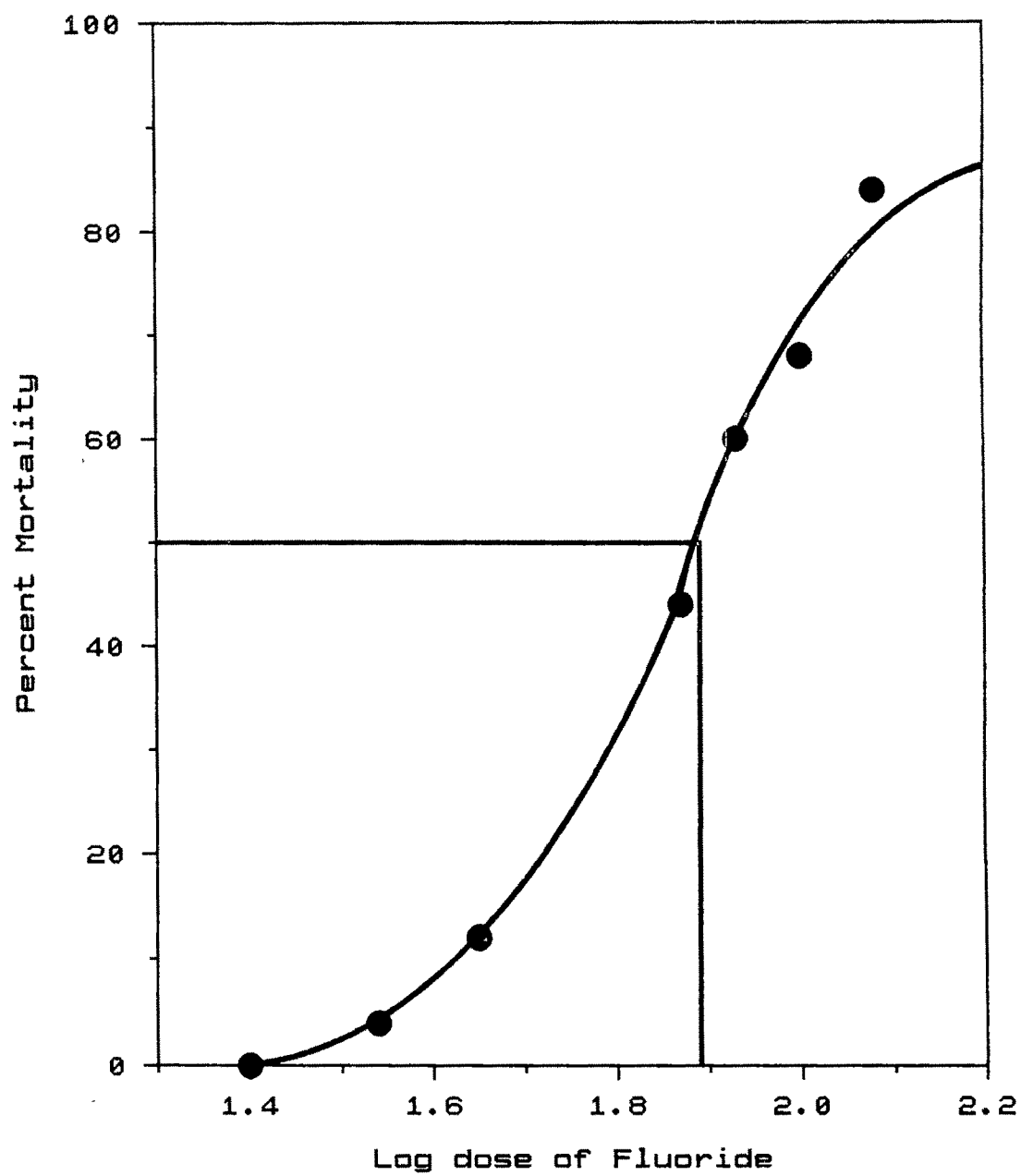
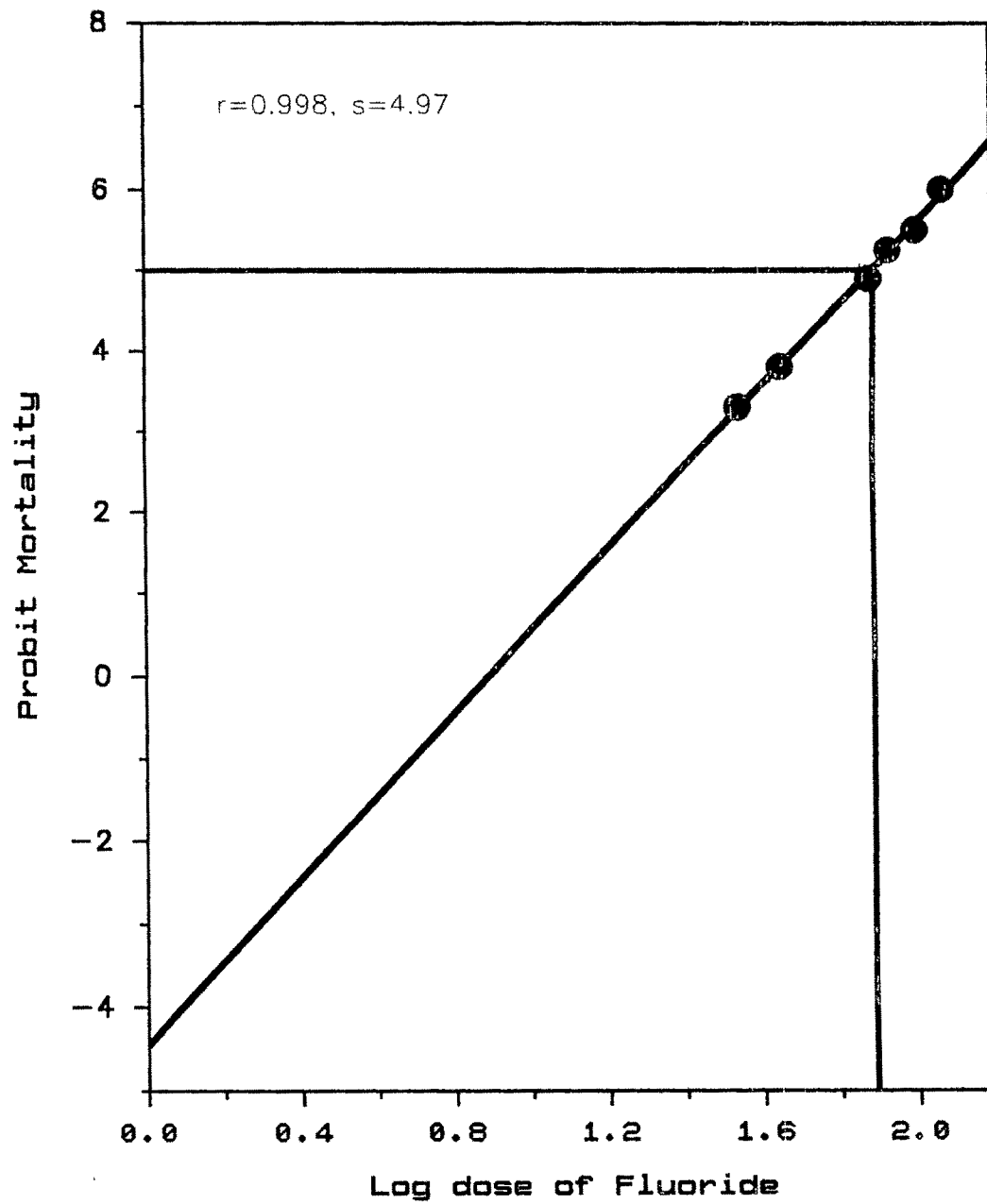


Fig. 2.. Median Effect Plot



This dosage was taken as  $LD_0$  value. The mortality rate increased with the increase in concentration of fluoride (Table I). When percent mortality of the chicks for a period of 24 h was plotted against log dose of fluoride, a sigmoid curve was obtained (Figure 1). From the graph  $LD_{50}$  value for fluoride was found to be 77.62 mg F/kg b.w.

$LD_{50}$  value was further verified by the probit method according to Finney (1971). When probit of kill was plotted against log dose of fluoride a straight line was obtained as shown in figure 2. Median lethal dose value obtained from this graph was also 77.62 mg F/kg b.w.

### DISCUSSION

Acute toxicity of fluoride to one day old female chicks of domestic fowl was estimated by determining 24 h  $LD_{50}$  value. The calculated 24 h  $LD_{50}$  value according to probit method of Finney (1971) was 77.62 mg F/kg b.w. The 95% fiducial limits of  $LD_{50}$  were 69.68 and 86.48 mg F/kg b.w. The sigmoidal pattern, typical of dose-response relationship was evident (Figure 1). When the dose effect relationship follows the basic principle of law of mass action, the median effect plot should be linear, as obtained in the present study (Finney, 1971). The slope of linear plot signifies the sigmoidicity of the dose effect curve (Figures 1 and 2).

The linear coefficient (r) determines the applicability of the data to the method of analysis (Chou and Chou, 1989). If the 'r' value is usually 0.90, this method of analysis is acceptable for animal toxicological studies. In the current study an acceptable value of 0.998 was obtained for linear coefficient.

The slope (s) of the probit regression line for fluoride in the present study was found to be 4.97. This smaller slope value indicates modest response to slight change in the dosage of fluoride by the birds. This is further substantiated by wide confidence limits around  $LD_{50}$  value.