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Alteration of Protein Profile after fluoride Intoxication in rat, *Rattus rattus* (Wistar)

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Abstract

Fluoride is the most electronegative and reactive of all elements. Fluoride is known to reduce protein synthesis. The present study was designed to investigate the biochemical changes in liver of rats after exposing them to sodium fluoride. The present study data indicate alteration in total proteins, mitochondrial proteins, microsomal proteins, cytosolic proteins, soluble proteins, insoluble proteins, acidic proteins and basic proteins in the liver of rat. A significant alteration of protein content was noted in all rat, during sodium fluoride intoxication. It was also found that the effects of fluoride were directly proportional to the concentration as well as duration of fluoride intoxication.

Key word: Albino rat, biochemical changes, sodium fluoride, liver.

Introduction

More than half a million people are affected by the disease called fluorosis. Fluorosis is an endemic public health problem in nearly 22 nations around the world. The World Health Organization (WHO) guideline is that 1.5 ppm of fluoride is the desirable upper limit in drinking water. Accidental exposures to high level of toxic substances are known to cause liver damage. Fluoride poisoning arises from drinking fluoride rich ground water. Excess intake of fluoride results in mainly three forms of fluorosis namely: Dental fluorosis [1]. Skeletal fluorosis [2-4] and Nonskeletal fluorosis [5] . Fluoride is recognized as an important natural and industrial environmental pollutant [6].

Groundwater contains variable concentration of fluoride depending upon the nature of the rocks and the occurrence of fluoride-bearing minerals [7]. It is continually used in aluminium industries, in the manufacture of fluoridated dental preparations and in the fluoridation of drinking water, thus increasing the risk of fluoride exposure to human being [7]. Additionally, other daily sources of fluoride exposure are food, fluoride additives, toothpastes and professional administration of fluoride gel [8].

Materials and method

Experimental animal

Albino rat, *Rattus rattus* (Wistar) weighting 150-200 g, were used. Animals were purchased from Wadhwani pharmacy Collage Yavatmal and acclimatized for two weeks in Animal House in the Department of Zoology, Govt. Vidharbha Institute of Science and Humanities, Amravati. The Institutional Animal Ethical Committee already approved this study for the use of Rat. The rat were housed in well-ventilated animal house and caged also well, at room temperature and exposed to 10-12 h of daylight.

Rats were divided into four groups having five animals each.1st group was used for control and 2nd , 3rd and 4th groups were ingested with 0.02 gm, 0.04gm, and 0.06 gm of fluoride water respectively for 7 and 35 days. Animals from each dose group were deprived of food overnight and sacrificed at the end of 7 days. They were stunned by a blow on the head and operated. The liver was removed with adhering material by dipping in chilled normal saline and homogenized.

Chemical

All the reagents were purchased from Chaiga Traders, Yavatmal and were of analytical grade.

Biochemical Analysis

The estimation of total protein, mitochondrial protein, microsomal protein, cytosol protein, soluble and insoluble protein, acidic and basic protein was done from liver tissue. The proteins were determined by the biuret method using crystalline bovine serum albumin as the standard.

Statistical analysis

Data were described by proportion, mean, SD, range etc. The data were statistically analysed by using one way analysis of variance (ANOVA). The Statistical analysis was done by using student t test for estimation of significant results in experimental and control group of rat. P value of <0.05, 0.01 and 0.001 were considered as significant.

Results and observation

Table 1 depicts the levels from total protein to Acidic and basic protein in the liver of control and experimental groups of rats. There was slightly decrease in total protein, mitochondrial protein, microsomal protein, cytosol protein, soluble and insoluble protein, acidic and basic protein.

Table 1: Changes in protein profile of rat exposed to sodium fluoride at different concentrations for 07 days exposure periods.

parameters	Control	0.02 gm/kg body weight	0.04 gm/kg body weight	0.06 gm/kg body weight
Total protein	0.38±0.62	0.38±0.62	0.38±0.61	0.38±0.62
Mitochondrial protein	0.11±0.34	0.11±0.33	0.11±0.33	0.11±0.33
Microsomal protein	0.44±0.66	0.44±0.66	0.44±0.66	0.43±0.66
Cytosolic protein	0.12±0.35	0.12±0.35	0.12±0.35	0.12±0.34
Soluble protein	0.16±0.41	0.16±0.40	0.16±0.40	0.16±0.40
Insoluble protein	0.05±0.24	0.05±0.24	0.05±0.23	0.05±0.23
Acidic & Basic protein	0.13±0.36	0.13±0.36	0.13±0.36	0.12±0.35

Table 2: Changes in protein profile of rat exposed to sodium fluoride at different concentrations for 35 days exposure periods.

parameters	control	0.02 gm/kg body weight	0.04 gm/kg body weight	0.06 gm/kg body weight
Total protein	0.41±0.64	0.40±0.63*	0.38±0.62**	0.37±0.60**
Mitochondrial protein	0.12±0.35	0.12±0.34**	0.11±0.33*	0.10±0.32**
Microsomal protein	0.44±0.66	0.44±0.66*	0.43±0.65*	0.36±0.60**
Cytosolic protein	0.13±0.37	0.11±0.34*	0.11±0.33*	0.11±0.33*
Soluble protein	0.17±0.41	0.08±0.28**	0.08±0.28**	0.07±0.27**
Insoluble protein	0.07±0.27	0.06±0.25**	0.05±0.22**	0.05±0.22**
Acidic& Basic protein	0.14±0.37	0.13±0.36**	0.12±0.36**	0.12±0.35**

Significant result shows *P≤0.05, **P≤0.01 and *** P≤0.001

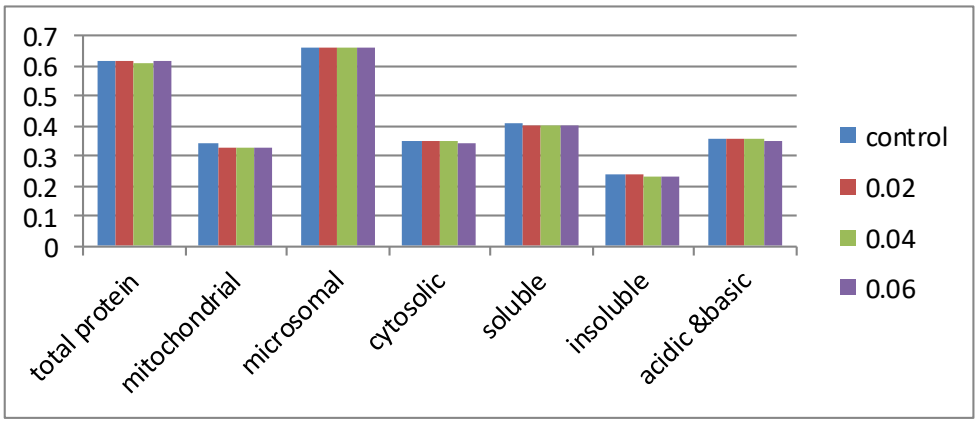

Figure 1: Changes in protein profile of rat exposed to sodium fluoride at different concentrations for 07 days exposure periods.

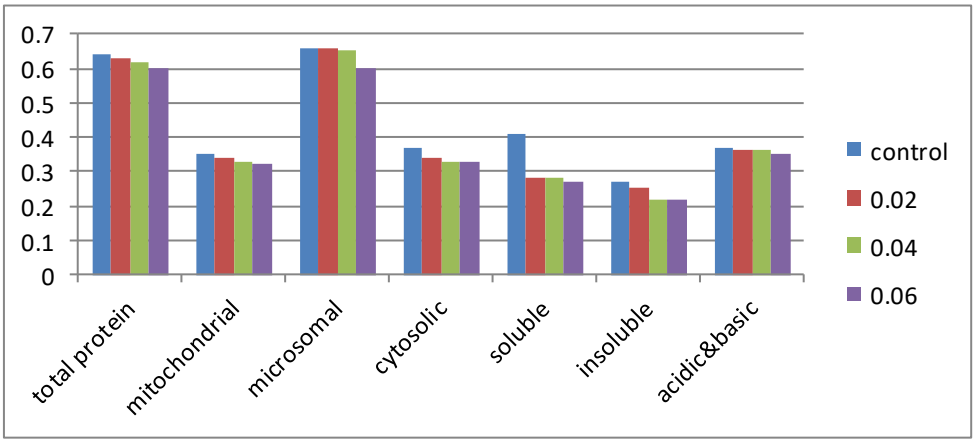

Figure 2: Changes in protein profile of rat exposed to sodium fluoride at different concentrations for 35 days exposure periods.

As shown in Table 2 total protein, mitochondrial protein, microsomal protein, cytosol protein, soluble and insoluble protein, acidic and basic protein was significantly decreased.

Discussion

Liver is the principal organ responsible for metabolism and involved in the metabolism of toxic compounds produced during systemic processes and exogenous toxins entering into the organisms from the environment [9]. In present study, the total protein level was low in study group than comparison group. Cenesiz *et al.*, [10] showed that the serum total protein level was low in case than in control. Serum total protein level was also reported to decrease in rats [11] and sheep [12,13] with chronic fluorosis which were similar to our study findings. Fluorosis can inhibit protein synthesis by weakening the beginning of the peptide chain and by preventing the production of peptide chains in ribozomes [14,15].

Shashi *et al.,*[16] found significant decline in acidic, basic, and total proteins rabbits treated with NaF for 100 days. Present study also shows that decrease in acidic, basic, and total proteins in sodium fluoride treated rat. A decline in protein levels occurred in various soft tissues of rodents treated with different doses of NaF after 30 to 70 days [17-21]. The results of the present study corroborate the above data as a significant decline in the levels of total proteins in rat was obtained after 35 days of treatment. The present study also shows that significant decrease in mitochondrial proteins , microsomal proteins, cytosolic proteins, soluble proteins, insoluble proteins in sodium fluoride treated rat.

Sarkar and Pal [22] studied that alteration in protein synthesis by fluoride has been indicated by decreased contents of acidic, basic, neutral and total protein in cerebrum, cerebellum, pons and medulla. The treatments of sodium fluoride caused a significant decline of protein levels in liver, which might be due to changes in protein synthesis. Earlier reports [19,23-25] on individual NaF and $AlCl_3$ treatments in rats, mice, and guinea pigs corroborate results of the present study

Conclusion

A significant alteration of protein content was noted in all rat, during sodium fluoride intoxication. The decrease in the physiological functions of metabolising enzymes with increase in duration of intoxication of fluoride. Different effects of metabolising enzymes on protein was reported during dose and duration response of sodium fluoride.

In the present study the efforts were taken to determine the toxic effects of fluoride on protein profile of rat, *Rattus rattus* (Wistar) at different concentration of fluoride and at different time intervals. Study report showed that rats were more sensitive to fluoride ingested than normal group. It also showed that the effects of fluoride are directly proportional to the concentration as well as duration of fluoride intoxication.

Conflicts of interest: The authors stated that no conflicts of interest.

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