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EFFECT OF FLUORIDE EXPOSURE ON TRACE ELEMENT OF KIDNEY AND THIGH MUSCLES OF RAT

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Abstract: ***Drinking water containing fluoride is the major source of fluorosis due to geological crust contamination. Aim of the present study is to investigate the changes in the concentration of the trace element such as Zn, Cu, Mn and Fe in kidney and thigh muscles of rat. For the present experiment, healthy Albino rats were intoxicated to fluoride water at different concentration for 72 days. The data reveals that excess fluoride intake disturbs concentration of essential trace elements in the body these changes are related with elimination or accumulation of specific element in the tissue may implicate various disorder.***

Keywords: ***Sodium fluoride, Iron, Zinc, Copper, Manganese.***

I. INTRODUCTION

Ground water is one of the most important sources of drinking water and contamination of ground water with fluoride is increasingly becoming a matter of great concern, as 17 states in India have been declared endemic for fluorosis, and of these 5 states have indicated hyperendemicity for fluorosis (Choubsia, 2001). Fluoride is an essential trace element for human beings and animals. In small amounts fluoride is beneficial as it is believed to impart stability to bone and enamel, thereby preventing dental carries and osteoporosis to some extent but its higher concentration is highly toxic to humans and animals alike. The permissible limits of fluoride in drinking water as suggested by Bureau of Indian Standards varies between 0.6 to 1.2 ppm BIS (1984), and World Health organization WHO (WHO 1984). Permits a maximum of 1.5 ppm of it. Chronic exposure to fluoride above the permissible limits causes a disease called “Fluorosis”. Fluorosis is an important clinical and public health problem in several parts of the world. As fluoride is found in small quantities in almost all foods, it enters the human body mainly through the oral route along with food and water. It can be rapidly absorbed by passive diffusion through stomach, small intestine, mouth, lungs and skin.10 (Khandare *et al.,* 2001). Interaction of fluoride with various trace elements and their metabolism is interesting as it has been shown that chronic ingestion of fluoridated water does influence systemic biochemical homeostasis in experimental animals as well as in humans (Bhatnagar et. al., 2003). Trace elements such as Fe, Cu, Mn, I, F, etc. though occur in low concentration in the body serve some useful functions and their imbalance may affect important biological functions in both animals as well humans, including bone and teeth development, immunity, reproduction, etc. (Vohra, 1982). Pillai and Mane (1984) studied the effect of fluoride effluent on some metabolites and minerals in fry of *Catla catla*.

II. MATERIAL AND METHODS

CHEMICALS: Sodium fluorides (NaF) were obtained from Chaiga traders.

EXPERIMENTAL ANIMALS: 20 Adult albino rats, 60-day-old (weighing 250-300g) were obtained from wadhwani pharmacy Collage Yavatmal. The animals were kept under standard laboratory conditions at 21± 2 °C, fed with balanced diet and water ad-libitum and exposed to 12h light / 12 h dark cycle for one week prior to the start of the experiments.

The rats were housed in cleaned and husk filled sterilized polypropylene cages and fed with pellet feed and purified water *ad libitum*. The temperature and humidity were maintained at 23±2ºC and 50 to 70%, respectively. The present study was approved by the Institutional Animal Ethics Committee and conducted as per the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA). 20 albino wister rats were divided into four groups, Control groups given deflouridated, deionized water, while experimental groups 2, group 3, and group 4 administered sodium fluoride (Naf) of different concentration for 72 days. At the end of the experiment, animals were sacrificed and their kidney and thigh muscles, will quickly excised. Metal concentrations in the tissue digest will be determined by Atomic absorption spectrophotometer.

MINERAL CONCENTRATIONS: Tissue samples were blotted to remove extra water, weighed, and wet digested with a 3:1 mixture of 70% nitric acid and 70%perchloric acid by heating below 80ºC.12 the digested samples were cooled, and diluted with triple glass-distilled water to a final volume 5.0 mL. The concentrations of Zn, Cu, Fe, and Mn were measured with an atomic absorption spectrophotometer.

III. RESULT AND DISCUSSION

TABLE 1: CHANGES IN LEVEL OF TRACE ELEMENTS (ZN, CU, MN AND FE) IN KIDNEY OF RATS GIVEN VARIED CONCENTRATION OF SODIUM FLUORIDE IN DRINKING WATER.

PARAMETERS	CONTROL	EXPT- 1	EXPT- 2	EXPT- 3
ZINC	1.53±1.23	1.72±1.31*	1.91±1.38**	2.10±1.45***
COPPER	0.177±0.42	0.160±0.4*	0.148±0.38*	0.124±0.35**
MAGNESE	1.84±1.35	1.66±1.28*	1.52±1.23**	1.26±1.22***
IRON	12.16±3.48	12.95±3.59**	13.12±3.62**	14.80±3.84***

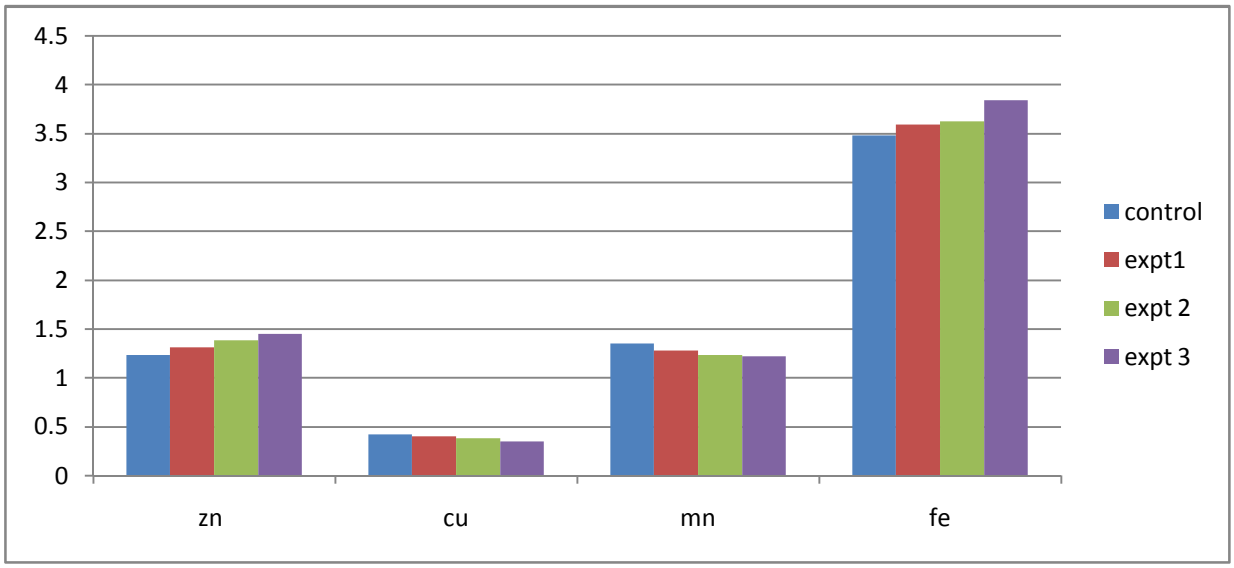
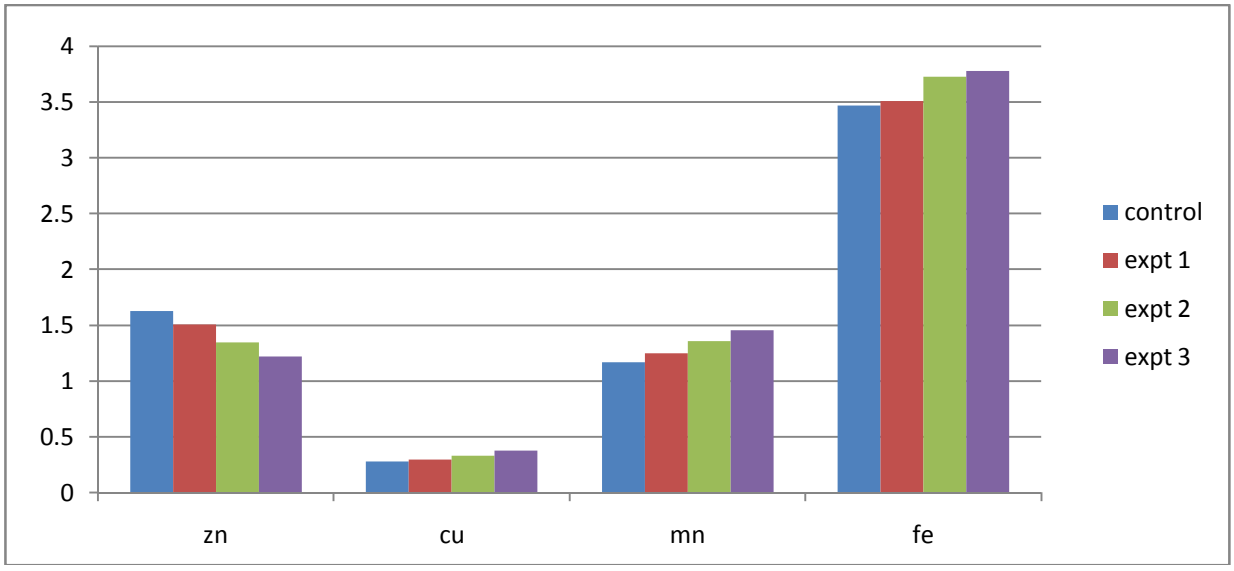


TABLE 2: CHANGES IN LEVEL OF TRACE ELEMENTS (ZN, CU, MN AND FE) IN THIGH MUSCLES OF RATS GIVEN VARIED CONCENTRATION OF SODIUM FLUORIDE IN DRINKING WATER.

PARAMETERS	CONTROL	EXPT- 1	EXPT- 2	EXPT- 3
ZINC	2.76±1.63	2.28±1.51**	1.84±1.35***	1.49±1.22***
COPPER	0.079±0.28	0.094±0.30*	0.114±0.33**	0.149±0.38***
MAGNESE	1.38±1.17	1.57±1.25*	1.85±1.36**	2.14±1.46***
IRON	12.10±3.47	12.37±3.51**	13.98±3.73**	14.36±3.78***

The kidney represents the major route for the removal of fluoride from the body, and fluoride is concentrated to much higher levels in the kidney tubules than it is present in plasma. Bhatnagar *et al.,* (2003) studied trace element concentration in various tissues of female mice like brain, liver, kidney and muscles following fluoride administration. They reported significant depletion in concentration of iron in kidney and muscle. Copper (Cu) is plentiful in the environment and essential for the normal growth and metabolism of all living organisms (Schroeder *et al.*,1966: Carbonell and Tarazona, 1994) Abnormal levels of copper intake may range from levels as low as to induce a nutritional deficiency to levels as high as to be acutely toxic (Environmental protection Agency,1980) Copper is an essential component of the animal system and plays an important physiological role in haematopoiesis, myelin formation, phospholipids formation, connective tissue metabolism and enzyme systems.



Copper is normally present in higher concentration in kidney therefore copper deficiency is rare occurrence in these organs, but in the present study Cu fell significantly in kidney while increased in muscles similar results were observed by Bhatnagar *et al.,* 2003. Zinc is an essential trace element for all living organisms. Zn has an important role in many metabolic processe especially in the activation of enzymes and the regulation of gene expression (Prasad, 1979) [24]. Zinc is involved in numerous aspects of cellular metabolism (Classen *et al.,* 2011). It was estimated that about 10% of human proteins potentially bind zinc, in addition to hundreds which transport and traffic zinc. It is required for the catalytic activity of more than 200 enzymes (Sandstead, 1994: McCarthy ,1992) and it plays a role in immune function (Sandstead, 1994: Solomons, 1998), wound healing (Sandstead, 1994) , protein synthesis, DNA synthesis and cell division (Prasad, 1995) . Zinc is required for proper sense of taste and smell. (Heyneman, 1996: Prasad, 1997) .Level of Zn fell significantly in muscles but increases in kidney. This observation are consistent with the ealier reports (Cotzias *et al.,* 1968) Iron is also associated with effective immunocompetence of the body. The decrease in iron content in the present study signifies an altered state of iron metabolism, which might have been triggered by fluoride ions. Benard *et al.,* (1958) explained anaemia in fluorosed rabbits due to inhibition of 59Fe and glycine incorporation into protoporphyrin, a precursor of haemoglobin and not due to to want of iron. Fluoride is reported to increase the membrane permeability of cells because of its inhibition of pyrophosphate activity (Daniel, 1963).In present study level of Fe increases significantly in kidney and muscles. Mn is associated with bone development, and with amino acid, lipid, and carbohydrate metabolism Mn level fell in kidney but it significantly increases in muscles.(Bhatnagar *et al.,* 2003). Mn is found in different enzymes, e.g. mitocondrial Mn superoxide dismutase, glutamine synthetase, arginase, and activates several hydrolases, transferases and carboxylases. Mn is transported in the body by transferrin and by macroglobulins and albumin (Davis and Greger, 1992; Rabin *et al.,* 1993).

IV. STATISTICAL ANALYSIS

Statistical analysis of the mean and standard deviation of treated and control groups were done by one –way ANOVA without replication. Data related to trace metal concentration in control and experimental tissue are summarized in Table 1 and 2 changes observed in Cu, Mn, Fe and Zn level in kidney and muscles of the rat intoxicated by fluoride

V. CONCLUSION

In an effort to better our understanding, the present study was designed to investigate the effects of sodium fluoride on trace elements such as the level of zn, cu, mn and fe in soft tissue of kidney and thigh muscles at different level of fluoride intoxication in rat, from the observation it demonstrated that there is a close link between excess fluoride intake and possible consequences via imbalance in trace element of kidney and muscles. Disturbance in trace element observed in these study is very interesting as fluoride taken in excess causes both bone and dental fluorosis. Role of fluoride in disturbing trace element concentration is due to its highly electronegative and thus form complex with proteins alternatively it binds with Cu, Zn, Mn and Fe to form complexes resulting in alternating in level of respective element. In the present study result also indicated dose-dependent manner in most of the trace element. Interaction of different trace minerals with highly electronegative F ions within the gut, and other body tissues may be primarily responsible for these changes. The dose response relationship showed a linear pattern and changes were more prominent in most of the tissues of rat exposed to higher level of fluoride intake. The study shows, that excess fluoride intake disturbs essential trace elements homeostasis in body. In conclusion, we found that ingestion of fluoride by rat provoke change in the concentration of trace elements and hence effect the functioning.

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