Vyatchina E.S., Skalnyi А.V.

 “Analytical and Nanotechnological Institute” Moscow
State Educational Institution Orenburg State University, Bioelementology Institute, Orenburg

ZINC SULFATE PROTECTIVE FUNCTION FOR FETUS IN CASE OF ALCOHOL USE

The article describes the results of experiment held on males of outbred rats. They were given 15% of ethanol solution during 100 days with or without adding zinc sulfate (groups A and A+Zn) into their meals. The outcome showed that zinc influences on metabolism of Mg, K, Fe and Zn in the rats’ cerebral cortex, on metabolism of Mn and on increase of Zn, Cu, Mg, K and Na in the hippocampus, on metabolism of Mn and on increase of K, Na, Fe in the rats’ tentorium. The experiment proved that ZnSO4 protects brain of rats that are given alcohol.

Zinc is one of the most important microelements in a body. It is a catalytic, structural, and regulative ion that participates in homeostasis, immune reactions, apoptosis, regulates oxygenic stress, ageing. Zinc-bounding proteins (metallothioneins) protect a body from stresses, bad influence of toxic metals, infections [1]. The wide range of zinc influence can be explained by its participating in enzymes formations, such as DNA- and RNA polymerases, thymidinekinases, alkaline phosphatase, carbonic anhydrase, etc. [2]. Zinc-dependent enzymes are alcohol dehydrogenase, lactic dehydrogenase, superoxide dismutase and others with induction of which positive influence of zinc salts is observed on chronic and acute alcohol intoxication. The deficit of zinc is proved to destroy ethanol metabolism [3].

 Brain dysfunction as well as inflammations is related to inability to achieve zinc homeostasis [4]. Different authors present the data that amount of zinc in the brain is sufficiently stable and can be changed only if liver is damaged (especially its protein synthesis system) or if there is lack of zinc in a body. However many neurophysiological processes are related to significant changes in the amount of free or associated forms of zinc in brain and especially in hippocampus, not depending on the abovementioned dysfunctions. Now a lot of foreign scientists are involved into defining the role of zinc in hippocampus. [6, 7]. They stated that in case of excitement Ca-dependent ions of zinc are migrated selectively from hippocampus neurons, especially from its mossy fibers. Such migration leads to a rough increase of their concentration in extracellular space that significantly influences on different neutrally mediated processes. Zinc is considered to bind organic ligands and prevents interaction of neuromediators with receptors [8].

Thus even small concentration of free Zn++ ions prevents GABA influence [6, 9] and blocks conductibility of amino acids activated by receptors in neurons of hippocampus[8] (these processes are strictly dependent on ions concentration), and enkephalines with opiate and beta-carbolines with benzodiazepine receptors [10, 11]. It is important to note that enkephalinase brain tissue contains is zinc-dependent [12].

The recent researches showed that intracellular accumulation of ions can lead to damage of nerve cells in certain parts of brain, including hippocampus, amygdaloid nucleus and cortex caused by epilepsy or ischemia [13]. The deficit of zinc created by alcohol can lead to the brain structure damage in case of intoxicant complex of congenital malformations. Alcohol use in the period of active brain development makes tentorium lose Purkinje's cells, but experiment on rats showed that there is no connection with the deficit of zinc [14]. Chronic alcoholics have zinc 15-30% less in different structures of their brains [5] the process is attended by typical symptoms of zinc deficit [15, 16]. Different experiments proved the formation of alcoholic addiction within animal subjects who were given alcohol without adding zinc to their meals [7].

The present experiment was held on males of outbred rats who were given 15% of ethanol solution during 100 days with or without adding zinc sulfate (groups A and A+Zn) into their meals. ICP-AES method (ICAP-9000 Thermo Jarrell Ash (USA)) was used to define the amount of Ca, Mg, P, K, Na, Fe, Zn, Cu, Mn, Pb, Cd and Sr in their cerebral cortex, tentorium and hippocampus. The research was aimed to describe zinc influence on macro and micro elements distribution in the brains of subjects injected with alcohol and their descendants.

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Materials and methods

The experiment was held on 60-day-old males of outbred rats that were descendants of rats - males and females injected with alcohol. The subjects’ parents were divided into 3 groups: The first Group (K) was to maintain control (n = 10); the second Group (А) included rats injected with alcohol and the third Group (A+Zn) included rats injected with alcohol and zinc sulfates added into their meals (n = 7). The experiment was held for 100 days including pregnancy of subjects (20-25 ml of 15% ethanol solution, i.e. 12-17.5 g of ethanol/kg body mass). The rats that form the third Group were given ZnSO4^7H2O optionally (~ 6.72 mg Zn/l, i.e. 0,06 mg Zn/kg daily). At the end of experiment ICP-AES method (ICAP-9000 Thermo Jarrell Ash (USA)) with preparing subjects materials by wet combustion (HNO3:H2O2) was used to define the amount of Ca, Mg, P, K, Na, Fe, Zn, Cu, Mn, Pb, Cd and Sr in cerebral cortex, tentorium and hippocampus.

The results of research

Table 1 reveals that males and females of outbred rats injected with alcohol during 100 days including pregnancy of subjects have significant damages of ultimate composition in cortex of reproductive descendants. The concentration of Mg, K, Na, Fe and Zn concentration is lower in the Group A than in the Control Group. It was difficult to detect Pb and Cd in hippocampus and tentorium because of small amounts of samples. The concentration of Mn in hippocampus of descendants of rats injected with alcohol is lower in the Group A than in the control Group, but the concentration of Mg, K, Na, Zn and Mn is higher in the Group A than in the Group A+Zn (table 2). The increase of concentration of Zn and Mn is observed in tentorium of descendants in the Group A (table 3).

To use zinc as zinc sulfate ZnSO4^7H2O with water for remodeling subjects’ parents injected with alcohol is to significantly increase the concentration of Zn and other elements in descendants’ hippocampus (such as Mg, Na, Zn and Mn) and in tentorium (Mn). The present data comply with the results of previously held researches [12, 18].Menzano E., Carlen P.L. (1994) have already described that zinc compounds with other elements can be effective in treating acute form of abstinence syndrome and brain dysfunction caused by alcohol.

The level of zinc in brain is regulated alimentary. If there is lack of the element in consumed food, than a high aptitude exists to become alcohol addicted and get memory disturbance. Even though zinc is essential for the central nervous system its high concentrations can be neurotoxic. Thus it is very important to define the most effective form of zinc to support the system [19]. Now a lot of researches are conducted to find an optimal form of zinc regarding its bioavailability and safety.

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Table 1. Elements in cerebral cortex of males’ descendants of rats injected with alcohol.

|  |  |  |  |
| --- | --- | --- | --- |
| Element | К | A | A + Zn |
| Ca | 463±132 | 292±72,82 | 294±30,6 |
| Mg | 1271±145 | 753±127\* | 1137±104\*\* |
| P | 8939±983 | 7202±1287 | 8243±798 |
| K | 30886±3652 | 18092±3211\* | 27281±2184\*\* |
| Na | 8582±1029 | 4855±896\* | 7722±599\*\* |
| Fe | 126±13 | 71,9±13,92\* | 119±7,99\*\* |
| Zn | 121±14 | 73,7±14\* | 124±12,9\*\* |
| Cu | 16±1,86 | 11,7±1,76 | 15,9±2 |
| Mn | 2,41±0,25 | 2,85±0,88 | 2,46±0,17 |
| Pb | 0,87±0,372 | 1,53±0,451 | 1,28±0,58‘ |
| Cd | 0,14±0,049 | 0,31±0,11 | 0,23±0,054‘ |
| Sr | 0,87±0,28 | 0,39±0,192 | 0,39±0,0313\* |

1 n=4; 2 n=5; 3 n=6;

* p<0,05 in comparison with Group К; \*\* p<0,05 in comparison with Group A.

Table 2. Elements in hippocampus of males’ descendants of rats injected with alcohol

|  |  |  |  |
| --- | --- | --- | --- |
| Element | К | A | A + Zn |
| Ca | 222,1±24,6 | 223±37,6 | 372±69 |
| Mg | 489±49,4 | 510,8±40,2 | 631±30,4\* \*\* |
| P | 3953±356 | 3772,8±313 | 4142±224 |
| K | 10808±1118 | 11070±912 | 13022±585\* |
| Na | 3326±329 | 3276±273 | 3936±191\*\* |
| Fe | 111±16,4 | 74,2±18,8 | 86,7±9,27 |
| Zn | 52,2±6,2 | 58,1±5,59 | 76,2±9,21\* \*\* |
| Cu | 10±0,74 | 10,8± 1,37 | 12,5±0,71\* |
| Mn | 2,19±0,15 | 1,57±0,24\* | 2,37±0,16\*\* |
| Pb | ND | ND | ND |
| Cd | ND | ND | ND |
| Sr | 0,43±0,063‘ | 0,525±0,124 | 0,5±0,17 |

ND – not detected; 1 n=9;

* p<0,05 in comparison with Group К; \*\* p<0,05 in comparison with Group A.

Table 3. Elements in tentorium of males’ descendants of rats injected with alcohol

|  |  |  |  |
| --- | --- | --- | --- |
| Elements | К | A | A + Zn |
| Ca | 305±74,4 | 181±15,2 | 238±26,9 |
| Mg | 423,2±32,1 | 462±38,4 | 498±25,5 |
| P | 5525±437 | 5893±519 | 6473±339 |
| K | 9856±744 | 11471±1000 | 11909±592\* |
| Na | 2928±201 | 33098±9 | 3512±203\* |
| Fe | 70,4±5,3 | 78±6,12 | 90,9±6,99\* |
| Zn | 31,4±2,58 | 45,6±3,79\* | 44,4±2,43\* |
| Cu | 10,8±0,86 | 12,1± 1,1 | 12±1,10 |
| Mn | 1,88±0,1 | 0,23±0,14‘\* | 1,8±0,14\*\* |
| Pb | ND | ND | ND |
| Cd | ND | ND | ND |
| Sr | 0,5±0,13 | 0,25±0,044 | 0,32±0,044 |

ND – not detected; 1 n=3;

* p<0,05 in comparison with Group К; \*\* p<0,05 in comparison with Group A.

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Conclusion

Chronic use of alcohol by subjects’ parents as well as alcohol influence on a fetus lead to changes in macro- and microelements in brains of rats’ descendants.

Zinc influences on metabolism of Mg, K, Na, Fe and Zn in cerebral cortex of rats injected with alcohol, on metabolism of Mn, on increase of Zn, Cu, Mg, K and Na in hippocampus, on metabolism of Mn and increase of K,

Na, Fe in rats’ tentorium.

Thus ZnSO4 protects elements that brain of injected with alcohol rats’ descendants contains.

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