ARE HERBAL ANTIOXIDANTS SUITABLE BIOMEDICINES IN HEAVY METAL DETOXIFICATION?

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Abstract: Number of studies have claimed that herbal antioxidants are quite useful in heavy metal detoxication and serve as antistressor agents. To verify this view, six well known herbal (ashwagandha, brahmi, garlic, amla, moringa oil and C-phycocyanin) products, two inherent antioxidants (glutathione, vitamin E) and one vitamin, associated with general of cell, vitamin B complex, were used to eliminate hexagonal chromium and release the animals from stress. Newly hatched chicks (Broiler) were divided into 10 groups (N 9). All groups were intoxicated with a daily intramuscular injections of potassium dichromate (5 mg/kg body weight) for 7 day. Out of these, group 1 was kept as such for another 7 days and sacrificed on 15th day. This was considered as chromium intoxicated group and served as control for rest 9 groups. Group 2 to 10 were treated with different therapeutic agents (ashwagandha, brahmi, garlic, amla, moringa oil and C-phycocyanin), natural antioxidants (glutathione, vitamin E) and vitamin B complex). Controls were also maintained and the animals were given vehicle only as the case may be. All animals were sacrificed on 15th day and blood was immediately collected and centrifuged at 1500 rpm for 10 min to separate serum and RBC. The liver, kidney, muscles and brain were also dissected out washed in double distilled cold water, dried with blotting paper and stored in refrigerator until used. The chromium content was analyzed using Inductive Coupled Plasma Atomic Emission Spectrometer (ICP) and AAS. Student’s t-test and ANOVA were employed to obtain statistical significance of data. Study shows that antioxidants application is useful in metal elimination up to some extent as metal enters in all compartments of cell and antioxidant have different power of penetration. On account of this a mixed therapy containing herbal, natural and synthetic antioxidants which can reach all cellular compartments, is recommended.

Key words: Herbal antioxidants, Heavy metal

INTRODUCTION

The survival of human race depends upon, better environmental management. Therefore, continuous and sincere efforts will have to be carried out by everyone involved in environmental management, protection, monitoring, assessment, research, education, planning, conservation and sustainable development to use the resources.

ATSDR toxicological profiles [1-7], published in USA, have reported a number of hazardous chemicals and characterized the toxicological and adverse health effects. Nevertheless, these as well as other recent studies are incapable to provide much information about therapeutic data. Therefore, studies have been carried out by several investigators where the animals were intoxicated with hazardous heavy metals, such as mercury, methylmercury, lead, chromium, cadmium, aluminium, zink, and other toxicants such as floride and arsenic etc. and thereafter, therapy was provided to eliminate the toxicants, to improve
their health and to restore the altered conditions caused.

Chelation therapy is the only treatment of choice. However, many times the chelators themselves are toxic. Levine [12] claimed the following criteria to consider any compound as an antidote: 1). Antidote complexes with the poison rendering it inert, 2). The treatment should start before chronic poisoning, 3). Antidote accelerates metabolic conversion of toxic to a non-toxic product, 4). Antidote blocks metabolic formation of toxicant from less toxic precursor, 5). Antidote specifically accelerates the excretion of toxicants, 6). Antidote competes with the toxicant for essential receptors, 7). Antidote blocks receptors that are responsible for toxic effects and 8). Antidote restores normal functions by repairing or bypassing the effects of toxicants. Nevertheless, it is difficult to get an antidote, which fulfills all the eight criteria mentioned above except the natural detoxifying system exists in the animal body. The GSH is one of such cell-generated xenobiotic, which plays such role of detoxification.

For the last two decades in the Lab. of Neuro-biology and Toxicology, Department of Biosciences, Saurashtra University, Rajkot, the investigator is working on potential health effects of various forms of mercury and other heavy metals to evaluate the therapeutic potencies of various chemical compounds against their poisoning in experimental animals. Our findings indicate that various organs have differential capacities to absorb, store, metabolize and excrete metals depending upon dose and duration of intoxication [9,10].

In this laboratory many well-known therapeutic agents, used by earlier workers for heavy metals elimination, have been rescreened [9-12]. Most of these agents are able to remove mercury from non-nervous tissues but not from brain [9]. Discouraged from these findings, body’s physiological agents like glutathione and vitamins were tried. Results were quite exciting as they eliminated mercury both from nervous and non-nervous tissues [13-15]. Encouraged from these findings, the monothiols like glutathione and N-acetyl-DL- homocysteine thiolactone and vitamins (B-complex and E) were successfully used for mercury elimination from the central nervous system along with other tissues in rat, mice, chick and fish. These agents were also found to restore biochemical lesions and histopathological changes especially in central nervous system caused by mercury and methylmercury intoxication [15-30].

Nevertheless, in all above studies investigator never come across any incident where heavy metals were completely eliminated from the animal body. Chundawat et al. [31] applied GSH and vitamins (B and E) to eliminate hexagonal chromium from chick tissue including brain. However, they could reduce the burden of metal up to some extent only. Therefore, it was decided to use herbal, natural and synthetic antioxidants, either alone or in various combinations. In present contribution herbal antioxidants (ashwagandha, brahmi, garlic, amla, moringa oil and C-phycocyanin), natural antioxidants (glutathione, vitamin E) and vitamin B complex were studied individually in chromium elimination from animal tissues.

MATERIALS AND METHODS

Newly hatched chicks (Broiler) were procured from hatchery. They were acclimatized in animal house for two days and divided in to 10 groups (N 9). All groups were intoxicated with a daily intramuscular injection of potassium dichromate (5 mg/kg body weight) for 7 day. Out of these, group 1 was kept as such for another 7 days and sacrificed on 15th day. This was considered as chromium intoxicated group and served as control for rest 9 groups. After 7 days of intoxication, group 2 to 10 were treated with different therapeutic agents { (ashwagandha, brahmi, garlic, amla, moringa oil and C-phycocyanin), natural antioxidants (glutathione, vitamin E) and vitamin B complex} as shown in table A. Controls were also maintained and the animals were given vehicle only as the case may be. All animals were sacrificed on 15th day.

Preparation of tissues: All animals were sacrificed under light anesthesia and blood was immediately collected and centrifuged at 1500 rpm for 10 min to separate serum and RBC. The tissues liver, kidney, muscles and brain were also dissected out washed in double distilled cold water, dried with blotting paper and stored in refrigerator until used.
Fig. 1: Fluctuation of chromium concentration in liver of intoxicated and therapeutic developing chick. Best results are seen in C-phycosynin application (arrow).

Fig. 2: Fluctuation of chromium concentration in kidney in toxicated and therapeutic developing chick. Best results are seen in Brahmi application (arrow).

Fig. 3: Fluctuation of chromium concentration in muscles in toxicated and therapeutic developing chick. Best results are seen in Vitamin E application (arrow).
Analysis of chromium content: The chromium content was analyzed using Inductive Coupled Plasma Atomic Emission Spectrometer (ICP) and AAS. Student’s t-test and ANOVA were employed to obtained statistical significance of data.

RESULTS AND DISCUSSION

Figures 1 to 6 represent chromium content in various tissues, RBC and serum. Study shows highest concentration of chromium in liver (Fig.1) followed by blood cells (Fig. 5), kidney (Fig. 2) and muscles (Fig. 3). The brain and serum revealed comparatively less deposition of metal (Figs. 4,6).

Nine herbal antioxidants: (Ashwagandha, brahmi, garlic, amla, moringa oil and C-phycocyanin), natural antioxidants (glutathione, vitamin E) as well as vitamin B complex were employed to eliminate Cr from different tissues of experimental animals. Study shows diverse effect of different herbal and natural antioxidants on different tissues. As for example in liver C-phycocyanin (Fig.1), in kidney brahmi (Fig. 2), in muscles vitamin E (Fig. 3), in brain amla (Figs. 4), in blood cells vitamin B complex (Fig. 5) and in serum moringa oil and vitamin B complex (Fig. 6) demonstrated the best results.

Under above conditions it is difficult it assume which antioxidant is better and should be recommended for therapy. Simultaneously it is also true that all of them have been suggested as potent antioxidants in one or another study. Though the applications of these herbal and inherent antioxidants are able to reduce metal burden, significantly from one or another tissues, but in no case a complete elimination was possible.

Antioxidants are classified into two broad divisions, depending on whether they are soluble in water (hydrophilic) or in lipids (hydrophobic). In general, water-soluble antioxidants react with oxidants in the cell cytosol and the blood plasma, while lipid-soluble antioxidants protect cell membranes from lipid peroxidation [32].

Antioxidants protect the body from oxidative damage induced by free radicals and reactive oxygen species by (i) suppressing their formation; (ii) acting as scavengers and (iii) acting as their substrate. Antioxidants boost immunity system also by playing other important roles such as in cellular metabolism, signal transduction, gene activation, and transcription.

CONCLUSION

From overall study it is concluded that herbal antioxidants application is useful in metal elimination up to some extent as metal enters in all compartments of cell and antioxidant have different power of penetration. On account of this a mixed therapy
Fig 4: Fluctuation of chromium concentration in brain in toxicated and therapeutic developing chick. Best results are seen in Amla and GSH applications (arrow).

Fig 5: Fluctuation of chromium concentration in blood cells in toxicated and therapeutic developing chick. Best results are seen in Vitamin B complex application (arrow).

Fig 6: Fluctuation of chromium concentration in serum in toxicated and therapeutic developing chick. Best results are seen in C-phycosynin and Vitamin B complex applications (arrows).
containing herbal, natural and synthetic antioxidants may be more useful.

REFERENCES