Individual and Combined Effect of Meso-2,3-Dimercaptosuccinic Acid and Allicin on Blood and Tissue Lead Content in Mice

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Abstract

It has been shown that garlic and its main bioactive component, allicin, as natural chelating agents can reduce blood and tissue lead content in animal models. In this study the effect of allicin, alone or combined with meso-2,3-dimercaptosuccinic acid (DMSA), in decreasing lead content of blood and tissues of mice was evaluated. Swiss albino mice were exposed to 1000 ppm of lead in water for 35 days and then placed in various treatment groups including groups administered oral allicin, DMSA, or their combination. The concentrations of lead in blood, kidney, liver, bone, and brain were measured using atomic absorption spectrophotometry. Both, allicin and DMSA decreased the blood and tissue lead concentration. There was an additive effect of the combined administration of allicin and DMSA in reducing bone lead. No side effect was observed in all treated groups. Combined use of DMSA and allicin seems to be a better choice in the treatment of chronic lead intoxication.

Introduction

Lead, a nonbiodegradable heavy metal, is a persistent and common environmental contaminant. It is the most common heavy metal intoxication and continues to pose health hazards for humans and animals [1–3]. The major source of lead are industries where lead and lead-based components are used, such as lead acid battery manufacturing, cable and wire products industry, rubber and plastic industries, soldering activities, and in foundry work such as forging, casting and grinding activities [4]. Lead interferes with several aspects of the cellular metabolism in tissues throughout the body, resulting in multisystemic effects. It has high affinity for binding to proteins, including enzymes which contain vicinal thiol groups or accessible carboxyle groups [1]. Lead, as other toxic heavy metals, also increases the production of free radicals and decreases the availability of antioxidant reserve to respond to the resultant damage [5].

Various chelating agents have been used for treatment of lead intoxication in humans and animals. In general, sulphydryl-containing compounds are used for treating lead intoxication based on their chelating activity. Meso-2, 3-dimercaptosuccinic acid (DMSA-succimer), one such chelating agent, is an orally administered, water soluble, sulphydryl containing compound approved in the United States since 1991 for use in children with chronic lead poisoning [6]. DMSA has also successfully reduced blood lead concentrations in dogs, cats, rats and some birds [7–10].

It is believed that some antioxidants have chelating capacities: antioxidants such as vitamins, when administered either alone or in combination with a chelating agent, proved to be effective in mobilizing lead from different tissues [11]. We recently showed that allicin (diallylthiosulfinate), the most biologically active ingredient of garlic (Allium sativum, Liliaceae) has some potential effect in reducing blood and tissue lead contents in sheep [12]. Allicin is formed in crushed garlic by the interaction of nonprotein amino acid allin with allinase [13, 14]. Besides various beneficial health effects of allicin, it has been known that it prevents lipid peroxidation; in addition, it was found to be an effective antioxidant [15, 16].

The purpose of the study reported here was to compare the efficacy of DMSA and allicin administered alone and in combination for the treatment of lead toxicosis in mice.