

Arsenic, arsenic toxicity, role of curcumin as detoxifying agent

Arsenic is a natural element of the Earth's crust and is widely distributed in nature - in the air, water and soil.

The inorganic form of arsenic is highly toxic [1]. The greatest threat to human health is posed by arsenic-contaminated water used for drinking, cooking and irrigation of food crops, which can subsequently end up in the food [2].

It should be noted that arsenic in high concentrations is naturally presented in ground waters of a number of countries, such as China, Morocco, Thailand, South Korea, Russia, Belgium, Bolivia, Japan, Argentina, Bangladesh, India, Mexico, the United States of America and Chile.

Arsenic is widely used as an alloying additive, as well as in processing of glass, dyes, textiles, paper, metal adhesives, wood preservatives, and in the production of ammunition.

Arsenic is also used in tanning processes and, to a limited extent, in the production of pesticides, feed additives and pharmaceuticals [3]. Tobacco smokers may also get exposed to the naturally occurring inorganic arsenic found in tobacco, as tobacco plants absorb a significant amount of arsenic from soil [4,5].

Arsenic can suppress the immune system in animals and humans. Also, arsenic causes excessive formation of reactive oxygen species (ROS), accelerates oxidative stress, affects the genome, proteins, structural carbohydrates and lipids within the cells [6].

Long-term exposure to arsenic causes a variety of disorders, such as:

- diseases of the heart and cardiovascular system (myocardial infarction, myocardial dystrophy, pericarditis, hypertension, thrombocytopenia, pernicious anemia, hemorrhagic aleukia) [7]
- cancer of the skin, lungs, bladder, liver, prostate, and leukemia [8,9]
- stroke and cerebrovascular disease [10]
- chronic diseases of the lower respiratory tract [11]
- neurological disorders (paresthesia, hyperpathy, paralysis, paresis, ataxia, neuritis of the optic and auditory nerves, vestibular disorders, polyneuritis) [12,13]
- disorders of the reproductive organs [14,15]
- liver diseases, including chronic hepatitis [16,17]
- diabetes [18]
- toxic kidney damage [19,20]
- muscle atrophy [21]

According to research data, curcumin is one of the best means for preventing the development of pathological processes in the body caused by toxins [22].

Curcumin is the main curcuminoid [23] found in turmeric root [24]. Curcumin is one of the most widely tested natural compounds. Laboratory studies have shown that curcumin is a therapeutically useful tool for preventing or correcting the negative effects of arsenic on the body.

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The mechanism of action of curcumin is due to the prevention of excessive ROS production [25], counteraction of cell damage and lipid peroxidation by increasing the levels of phase II detoxification enzymes [26,27], catalase [28], superoxide dismutase [29] and glutathione peroxidase [30]. Curcumin also increases telomerase activity [31], enhances the activity of DNA repairing and reduces the death of neurons caused of arsenic overload. [32,33,34,35,36].

In addition, in laboratory conditions curcumin has demonstrated multiple pharmacological properties, including antioxidant, anti-inflammatory, anticarcinogenic, cardioprotective, hepatoprotective, antidepressant, immune-strengthening, and many others [37].

Unfortunately, these encouraging initial findings were not supported in human clinical trials due to the very low bioavailability of curcumin, averaging no more than 0.1% [38]. This low bioavailability prevents curcumin from showing its therapeutic potential while taking as a powder or extract.

It is worth noting that laboratory research with curcumin has greatly increased interest in it all over the world, and this was especially evident in the segment of dietary supplements. On almost every supplement site, you can purchase preparations made from powder or turmeric extract and find information on the pharmacological effect of curcumin on dozens of diseases.

This method of presenting information is a substitution of concepts, when laboratory findings are issued as clinical results. Neither turmeric extract, nor powder, is able to provide the pharmacological action that curcumin has shown in laboratory research.

Increasing the bioavailability of curcumin has been the topic of many research teams for several decades [39]. Nowadays, several technologies have already been developed to increase the bioavailability of curcumin. The most advanced technology for the delivery of active substances into the blood is liposomal [40].

Liposomal curcumin delivery technology allows to achieve the desired pharmacological effect in humans and animals, which has been demonstrated in thousands of laboratory studies [41,42].

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