

PDF - INVESTIGATION INTO THE EFFECT OF THE TOXICANTS ARSENIC AND MANGANESE ON MALE REPRODUCTIVE SYSTEM OF WISTAR RAT. - researchcub.info

CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION.

In today's industrialized world, exposure to pollutants in which heavy metals like arsenic, lead, manganese are an example is of high risk. These metals are present even in drinking water. Arsenic is mostly present in underground water. These metals are highly distributed in our environment and are thus consumed in quantities greater than what by the body requires (Ferrer, 2003).

Increased levels of arsenic in the environment, is an attribute to industrial product and waste, agricultural pesticides and herbicides. Although manganese is an essential element, toxicity can be gotten from drinking water, food, occupation and so on. Exposure to these heavy metals can cause poison and damage to models (the human body. Effects of arsenic have been reported in both human and experimental ATSDR a, 2012; Kannan et al., 2001). Mn exposure can also cause neurotoxicity (ATSDR b, 2007). Manganism, a consequence of exposure to high Mn levels, is a known neurological syndrome with many symptomatic analogies to Parkinson's disease (Santamaria, 2008). Manganese and arsenic also target the same organ in the body, namely the brain (ATSDR, 2007a,b,c).

Given their co-existence in soil and atmosphere, exposure to toxicity does not occur in isolation (Kordaset *al*., 2010). Indeed, in the real world, exposures to complex mixtures are the rule, rather than exception (Scherer, 2005). Over the last several decades, the incidence of neurological diseases has increased (WHO, 2006). Mn poisoning results in an irreversible condition known as "manganism," a neurodegenerative disorder that resembles Parkinson disease in both symptomatology and the underlying cellular mechanisms (Ellingsen et al., 2008; Martinez-Finley et al., 2012).

Neurological disorders induced by chronic metal exposure can be progressive and manifest clinically decades after the initial exposure (Gil and Pla, 2001). The onset of neurotoxic effects is largely subtle, insidiously manifested and unidentifiable as a clearly defined disease (Shy, 1993).

Exposure to arsenic- and lead-contaminated drinking water has been associated with an increased occurrence of congenital heart defects (CHDs). Groundwater is a vital hidden natural resource (Tularam and Krishna 2009; Lashkaripour and Ghafouri 2011). Groundwater can be found in most environments and generally requires no prior treatment and can be found close to the points of demand often at low cost (MacDonald and Calow 2009). Arsenic poisoning or *arsenicosis* is a condition caused by the ingestion, absorption or inhalation of dangerous levels of arsenic, higher than the normal 10ppb which the body can tolerate.

The male reproductive system consists of two major parts: the testes, where sperm are produced, and the penis, according to Merck Manuals. The penis and urethra belong to both the urinary and reproductive systems in males. The testes are carried in an external pouch known as the scrotum, where they normally remain slightly cooler than body temperature to facilitate sperm production. Metals may cause a wide spectrum of reproductive and developmental adverse effects such as reduced fertility, abortions, retarded growth at the intrauterine cavity, skeletal deformities, malformations and retarded development especially of the nervous system.

Arsenic and manganese tend to decrease motility of sperm in the male reproductive system even though

the sperm are active.

The important mechanisms of action of arsenic are placental transfer, oxidative stress, direct binding with thiol group etc.

The toxicity of arsenic in male and female reproductive organs is also explained. It also throws some light on the therapeutic strategies for metal toxicity. Manganese is a suspected reproductive toxicant and exposure to it has the potential to negatively affect the human reproductive system. The severity and nature of the adverse effect is variable and can be influenced by factors such as level of exposure and individual sensitivity to the chemical. Effects on the male reproductive system can include such things as altered sexual behavior, altered fertility and problems with sperm shape or count.

Manganese also have some positive effects on the reproductive system, they include It helps to produce sex hormones and sperm. Manganese acts as a catalyst for breaking down fatty acids and cholesterol. Manganese has a positive effect on the male reproductive system, It also enhances the brain's aptitude for receiving and sending messages, Sex hormones are produced in the pituitary gland, where a considerable amount of manganese exists. Because of this, manganese is believed to assist in sexual health.

Studies have been carried out on the individual effect of manganese and arsenic on the male reproductive system, this research however concentrates on both their individual effect and also their combined effect on the reproductive system. Earlier studies have shown that both accumulate in the brain and affect production of hormones.

Apart from affecting the reproductive system of man, arsenic and manganese cause other side effect including cancer. Arsenic and manganese have been shown to induce oxidative damage in the membrane leading to production of free radicals that may induce cancer and apoptosis. On the other hand some studies have suggested that arsenic can aid cancer treatment as it assists blood thinning.

These studies however have not been confirmed. The effects of arsenic and manganese can be assessed in male induced rats using assays like H₂O₂, Lipid Peroxidation, GSH, GST, SOD etc.

Pollution of the environment by these heavy metals is indeed a cause for alarm and have caused adverse effect to the human body as stated by WHO, unsuspected sources like underground water have shown lack of awareness by individuals.

1.2 LITERATURE REVIEW

Any foreign substance that enters the body is called xenobiotics. These substances can undergo any of the following pathways;

- Excretion from the body unchanged

- Undergo spontaneous reaction of its own

- Undergo metabolism.

Most xenobiotics undergo the third pathway, however if the body is over exposed to a compound it will induce its own reaction and might likely undergo the above second pathway. Arsenic and manganese are foreign compounds which enter the body through various means.

1.2.1 ARSENIC

Arsenic is a chemical element with symbol **As** and atomic number 33. Arsenic occurs in many minerals, usually in conjunction with sulfur and metals, and also as a pure elemental crystal. Arsenic is a metalloid. It can exist in various allotropes, although only the gray form has important use in industry. A few species of bacteria are able to use arsenic compounds as respiratory metabolites. Trace quantities of arsenic are an

essential dietary element in rats, hamsters, goats, chickens, and presumably many other species, including humans. However, arsenic poisoning occurs in multicellular life if quantities are larger than needed. Arsenic contamination of groundwater is a problem that affects millions of people across the world (Mameli et al., 2001).

Arsenic and its compounds, especially the trioxide, are used in the production of pesticides, treated wood products, herbicides, and insecticides. However, these applications are declining. Arsenic can be found naturally on earth in small concentrations. It occurs in soil and minerals and it may enter air, water and land through wind-blown dust and water run-off (Martinez-Finley et al., 2012).

Despite its notoriety as a deadly poison, arsenic is an essential trace element for some animals, and maybe even for humans, although the necessary intake may be as low as 0.01 mg/day. Most arsenic is found in conjunction with sulfur in minerals such as arsenopyrite (AsFeS), realgar, orpiment and enargite. None is mined as such because it is produced as a by-product of refining the ores of other metals, such as copper and lead. A very high exposure to inorganic arsenic can cause infertility and miscarriages with women, and it can cause skin disturbances, declined resistance to infections, heart disruptions and brain damage with both men and women (Dhatrak and Nandi, 2009; Mejía et al., 1997).

Finally, inorganic arsenic can damage DNA. A lethal dose of arsenic oxide is generally regarded as 100mg. Organic arsenic can cause neither cancer, nor DNA damage. But exposure to high doses may cause certain effects to human health, such as nerve injury and stomachaches.

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