Analysis of Time of Measurement and Modes of Administration of Some Medicinal Plants Additives on Mercury Accumulation in the Liver

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ABSTRACT

Mercury toxicity leads to cell damage in many organs of the body. The authors comparatively examined the ability of different food additives with medicinal properties to protect against mercury (Hg) accumulation in the liver following different treatment interventions and modes of administration. Rats were fed on either 7% w/w Zingiber officinale, 7% w/w Garlic, 10% w/w Lycopersicon esculentum, or 5%, w/w Garcinia kola (all in rat chow), while Hg (10 ppm) was given in drinking water. The additives were administered together with the metals (group 2), a week after (group 3) or a week before metal exposure (group 4) for a period of six weeks. The metal accumulations in the liver were determined using an Atomic Absorption Spectrophotometer (AAS). All the additives significantly (p<0.05) reduced the accumulation of mercury in the liver, percentage protection being lowest for ginger as an additive and highest for garlic. Percentage protection was significantly higher at weeks 4 (P<0.01) and 6 (P<0.001), compared to week 2. The mode of administration did not interact significantly with either time or additive in their relationship to percentage protection. Each additive provided significant protection from mercury and protection generally varied with time, but variations were not modified by mode of administration.

Keywords: Accumulation Pattern, Allium Sativum, Garcinia Kola, Liver, Lycopersicon Esculentum, Mercury, Mode of Administration, Time of Measurement, Zingiber Officinale

1. INTRODUCTION

Mercury (Hg) is a toxic, global pollutant biomagnified through the food chain (UNEP, 2002). Humans are exposed to organic forms of mercury like methyl mercury (CH$_3$Hg$^+$) - produced through biomethylation of the inorganic mercury present in aquatic organisms - through consumption of contaminated food and water (Klaassen, 1996); and ethyl mercury (CH$_3$CH$_2$Hg$^+$) through vaccines, (Fitzgerald & Clarkson, 1991; Clackson et al., 2003).

Mercurous and mercuric ions impart their toxicological effects mainly through molecular interactions with sulphydryl groups on various molecules like GSH, metallothionein and albumin (McGoldrick et al, 2003; Yoshida et al., 2006); or induction of stress proteins like heat shock proteins (HSPs) and glucose regulated proteins - GRPs (Goering et al., 2000; Papaconstantinou et al., 2003), leading to oxidative stress and cellular damage. Health effects of these exposures include reduced growth and development, cancer, organ damage, kidney damage, nervous system damage, development of autoimmunity and in extreme cases, death (Houston, 2007; Yoshida et al., 2006).

The management and treatment of metal poisoning has been with the use of chelators which mobilize and enhance excretion of these metals from the body and sometimes form stable complex with the metal, thus shielding the biological targets from it. The use of these chelators has been reported to reduce the tissue metal burden in many cases (Anderson, 1999; Nwokocha et al., 2011, 2012). However, various side effects of the chelators, their high toxicity, their chemistry with regards to mercury toxicokinetics and toxicodynamics, and the fact that they are not able to reverse damages already done, makes them not very effective for use (Cory-Slechta et al., 1987; Flora et al., 2008).

Growing awareness of the use of nutritional and medicinal plants to maintain optimum health emphasizes the relevance of considering the way that nutritional factors may affect metal toxicity (Zorn & Smith, 1990; Nwokocha et al., 2011a, b). There are reports that nutrients interact with the metabolism of heavy metals at the physiologic level (Nwokocha et al., 2012a, b). Medicinal plants and nutrients can affect bioavailability, toxico-dynamics, and transport to target organs, and influence the immunologic, biochemical, or cytologic functional responses.

Allium sativum (garlic) is claimed to have both prophylactic and curative effect (Pittler & Ernst, 2007; Nwokocha et al., 2012a) through its antioxidant properties. It contains many sulfur
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