JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

CARCINOGENIC PROPERTIES OF ARSENIC WITH DRINKABLE WATER AND ITS PROTECTION BY HERBS, NEAR CHHOIYA RIVER, DISTRICT BIJNOR, UP.

Shoma Devi, Adeeba Shariq, Nishu Chaudhary, Ilma Nasir, Ifra Khan
Krishna College of Science and I.T., Bijnor.

ABSTRACT

` In India, arsenic is a naturally occurring health-hazarding substance, and drinking contaminated water makes it human hazardous. In the current study, three sampling locations are identified for surface water quality to show the representative water quality of Chhoiya Nadi and in the same manner, three sampling sites i.e. Jalalpur, Navada, and Ravanpur are chosen to collect the groundwater sample in Bijnor district. Natural sources of arsenic include diverse minerals, soils, and water supplies. Arsenic is a carcinogen, and exposure to it, even through oral routes, can increase the risk of developing various types of cancer, including skin, lung, bladder, and kidney cancers. Curcuma longa and Ashwagandha show their anti-carcinogenic and anti -inflammatory property. Curcumin, a derivative of Curcuma longa plant, has gained attention for its potential as an anticancer agent due to its antioxidant, anti-inflammatory, and anticancer properties. Extracts from Withania somnifera leaves have also been used as a treatment in studies investigating its anti-cancerous properties. The acceptable threshold for arsenic stands at 0.01 mg/l, but it has surged to 0.05 mg/l. This poses a hazard to individuals who regularly consume it."

Keywords- Arsenic, Curcumin, Ashwagandha, Chhoiya- Nadi, Bijnor

INTRODUCTION

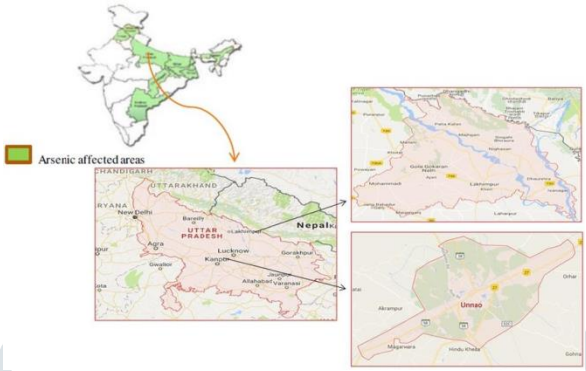
Arsenic (As) is a chemical element classified as a metalloid. The most common oxidation states in the environment are +3 (As^{III}, also known as arsenite) and +5 (As^{V} or arsenate), which exhibit different grades of toxicity. Arsenic compounds can be found in organic (when linked with carbon and hydrogen) and inorganic (when combined with oxygen, chlorine, and sulphur, among other elements) forms. Arsenic is naturally occurring and can be found in various minerals, soils and water sources. Its compounds have been known for their toxic properties for centuries. Ingesting high levels of arsenic can lead to serious health issues, including various cancers and neurological disorders. However, arsenic also has industrial applications, such as in the production of semiconductors and certain medications. Arsenic is a naturally occurring common health hazarding compound in India and the toxicity is in people by drinking of arsenic contaminated water. The safety limit of arsenic accepted by government is 0.05mg/ litre of drinking water (WHO) but World Health Organization (WHO) limits 0.01mg/litre in drinking water and 2mg/litre of foodstuffs on a fresh weight basis. Now chronic arsenic toxicity is a global health issue at present. The specific curative treatment against arsenicosis is not yet recommended. Stoppage of drinking arsenic contaminated water, improved diet , use of chelating agents etc. are usually suggested to mitigate arsenocosis. Spirulina, blue green algae, reduces mercury and other toxic metal accumulation in the tissue.

Ancient civilization- arsenic compounds were used by ancient civilization as arsenic sulphide minerals were utilized as pigments in paints and cosmetic. Medicinal uses- in medieval times, arsenic compound were used in medicinal concoctions, often for their perceived therapeutic effects. However, due to their toxicity, these treatment could have harmful side effect. Poison – arsenic gained infamy as a poison during the renaissance and later periods. Due to its tasteless and odourless properties, making it hard to detect. Industrial uses- arsenic was used in various industries, including compounds were also used in wood preservation, glassmaking, and even in some medications. As scientific understanding of arsenic's toxicity improved, regulations were put in place to limit its use in consumer products and industrial applications. This was particularly important as prolonged exposure to arsenic was linked to various health issues, including cancers and neurological disorders. Environmental concerns-Arsenic contamination in groundwater became a significant issue in certain regions, leading to health crises. This contamination can occur naturally or as a result of human activities such as mining and industrial processes. Its constituents have long been recognized for their poisonous qualities. Arsenic poisoning can cause major health problems, such as malignancies and neurological impairments. Currently, persistent arsenic toxicity is a major global health concern. Arsenicosis does not currently have a specific suggested treatment. Arsenocosis is typically treated with a change in diet, chelating drugs, and stopping the Consumption of water contaminated with arsenic. Spirulina, a type of blue-green algae, lessens the buildup of harmful metals tissue. As arsenic sulfide minerals were employed as colors in paints and cosmetics, ancient civilizations used arsenic compounds. Arsenic compounds were frequently utilized in medicines during the Middle Ages due to their alleged healing benefits. However, these treatments could have negative side effects because of their toxicity. Arsenic is a carcinogen, and exposure to it, even through oral routes, can increase the risk of developing various types of cancer, including skin, lung, bladder, and kidney cancers. Prolonged Consumption of water or food contaminated with high levels of arsenic is particularly concerning. It is essential to minimize exposure to arsenic to reduce the risk of carcinogenesis. Oral exposure is one of the most important modes to investigate and establish rodent models. According to Budhauliya (2013), the Indo-Gangetic alluvium includes the Bijnor District and slopes from north to south. The district's drainage system supervises the Ramganga and Holy Ganga rivers and their tributaries. The Ganga and Ramganga Rivers have tributaries in the Bijnor district, including the Malin River, Chhoiya Nadi, Khoh River, Phika Nadi, Ban, and Gangan Nadi. According to Buddhauliya (2013), groundwater is one of the key sources for Meeting the needs of habitation and agriculture. The Chhoiya Nadi is a natural drainage system in the Indian state of Uttar Pradesh's Bijnor district. Chhoiya is a branch of the Ganges River. Many industries are situated along the bank of the Chhoiya drain and discharge their treated wastewater into it. Approximately 4575 square kilometers are occupied by the Bijnor district (Budhauliya, 2013). The Ganga and Ramganga are the two main rivers that flow through the Bijnor district; each has its watershed, although Ramganga is also a tributary of the Ganga River (Khan et al., 2017). The tributaries of the Ganga and Ramganga River in the Bijnor district are the Malin River, Chhoiya Nadi, Khoh River, Phika Nadi, Ban, and Gangan Nadi. According to the 2023 census, the Bijnor district has a total population of roughly 5,118,972 people. Most of the population in the Bijnor district is employed in agricultural and animal husbandry. However, a few sugar factories, distilleries, pulp and paper mills, and food processing units contribute to the region's economic well-being.The chronic arsenic exposure is a cause of immense health distress as it accounts for the increased risk of various disorders such as cardiovascular abnormalities, diabetes, neurotoxicity,and nephrotoxicity.In addition, the exposure to arsenic has been suggested to affect the liver function and to induce hepatotoxicity. Moreover, few studies demonstrated the induction of carcinogenicity especially cancer of the skin, bladder and lungs after the chronic exposure to arsenic.The present review addresses diverse mechanism involved in the pathogenesis of arsenic induced toxicity and end organ damage. Recent studies and the villagers said that, the water is extremely polluted and filthy. They cannot drink the water. They also keep their animals away from the River. More villagers are planning to relocate to other places, 12-15 villages of Bijnor district are in grave danger, including Agri, Jalalpur, Ravanpur, Hadarpur, Gadana etc. Pradeep Chaudhary, a resident of shikandri village said that, we have complained to the authorities concerned about the matter several times but to no avail.

Oral Exposure and Arsenic Carcinogenesis-

Examining and establishing rodent models to investigate the significant impact of arsenic on carcinogenesis primarily focuses on understanding the consequences of prolonged oral exposure, as it is one of the most crucial modes of exposure to this carcinogenic substance. Arsenic is classified as a Group 1 human carcinogen by the international agency for Research on Cancer (IARC). Studies confirming the carcinogenesis of arsenic in human are identified, long term exposure to arsenic,

especially through drinking water, has been linked to an increased skin, lung , bladder, kidney , and liver cancer as well as vascular diseases and hepatotoxicity . Skin and several types of internal cancers, including bladder, kidney, liver, prostate, and lung have been associated with arsenic ingestion Arsenic is a well-known human carcinogen, and its carcinogenic effects have been extensively studied in relation to oral exposure.



Figure–Arsenic affected areas shown in map.

Because the water of choeyya river is highly toxic and several villagers used it as their drinking water,or food it causes several stomach and skin diseases to them. And it is prone to cancer,more than 100 victims in the last five years.And many of them already died because of cancer. Chronic exposure to arsenic in choeyya can lead to various health conditions and diseases-

Skin cancer-

The risk of skin cancer, notably squamous cell carcinoma and basal cell carcinoma, has been demonstrated to be greatly increased by long-term exposure to high levels of arsenic, frequently from drinking water contaminated with naturally occurring arsenic. Over the past few decades, a strong link between arsenic and skin cancer has been shown. The initial conclusions were drawn from observations of an increase in skin cancer cases following administration of Fowler's solution (1% potassium arsenite), a former treatment for a number of hematological and skin illnesses. While arsenic-related BCC typically develops in many foci and parts of the body exposed to sunlight, in contrast to cases arising from other skin carcinogens, arsenic-related skin SqCC can either form de novo or advance from Bowen's disease. Bowen's disease (carcinoma in situ), basal cell carcinoma (BCC), and squamous cell carcinoma (SCC) are the three skin cancers most frequently brought on by arsenic. As-BD, or arsenic-induced Bowen's disease, can develop into invasive BCC and SCC. As-BD patients are given consideration for more thorough lung and bladder cancer screenings. In addition to directly affecting the carcinogenic process, it has been demonstrated that arsenic toxicity can also be potentiated by other environmental carcinogens. For example, arsenic-exposed individuals with a history of smoking and chronic exposure to environments with high fertilizer use may be more susceptible to cancer-prone skin lesions than those without these risk factors, even at the same level of arsenic exposure . Arsenic can act as a cocarcinogen with UV light in a synergistic mode of action, leading to development of hyperkeratosis. Additionally, the same mode of action was observed between high levels of arsenic (over 100 μg/L) and tobacco smoking with respect to risk of skin lesions in men.

Lung cancer-

Arsenic in drinking water was determined as a cause for human lung cancer by the IARC in 2004. The risk of lung cancer and other malignancies increases significantly with arsenic concentration in water for both men and women. Following the therapeutic use of this metalloid in psoriasis patients receiving Fowler's solution treatment for their condition, the link between swallowed arsenic and lung cancer was discovered. Thereafter, multiple case-control and cohort-type studies

showed that there was an elevated risk of developing lung cancer after exposure to arsenic in drinking water. Lung cancer risk has been linked consistently, positively, and statistically significantly among people exposed to high levels of arsenic in drinking water. A 1999 report from the National Research Council (NRC, USA) based on sizable epidemiology research came to the conclusion that there was enough data to demonstrate that drinking water containing arsenic promotes lung cancer among other types of malignancy.

Sources of Arsenic contamination in groundwater and soil-

Beside irresponsible human activities, many natural phenomena can render groundwater unfit for human consumption. Such natural and anthropogenic causes can be identified and the people and policymakers can be advised to initiate and follow remedial measures. Several studies have emphasized the fact that over-extraction of groundwater hastens the process of leaching of Arsenic into the groundwater. This is favoured by the water-rock interactions, physical and geochemical conditions of aquifers.

Sources of human exposure to Arsenic-

People can be exposed to Arsenic through ingestion of water and food, through respiration of smoke particles and absorption from dermal contact with soil and bathing with arsenic-contaminated water. The most important route of exposure to humans is through the ingestion of food and drinking water contaminated with Arsenic. 2. Arsenic gets entry into the food chain through the use of water contaminated with arsenic for irrigation. The repeated use of water contaminated with arsenic for irrigation results in contamination of the top-soil of the area. The vegetables and food crops growing in the soil contaminated with arsenic take up arsenic from the soil along with other minerals. The rural populations primarily depend on foods produced locally. Thus, the exposure to Arsenic in rural population of the Arsenic affected areas is much higher. However, the urban population remains less affected as they receive their food supplies from different places

PREVENTION OF ARSENIC TOXICITY BY HERBS:-

Curcuma Longa-

For many years, herbal medicines have been used and are still employed in developing countries as the primary source of medical treatment. Turmeric reduces inflammation, which is at the root of many diseases, including cancer. Animal and lab studies show that turmeric can help prevent cancer growth and kill certain cancer cells, but we don't know if it has the same effect in humans. In another study, a mouthwash containing curcumin reduced mouth swelling. The main mechanisms of action by which curcumin exhibits its unique anticancer activity include inducing apoptosis and inhibiting the proliferation and invasion of tumours by suppressing a variety of cellular signalling pathways [Kunnumakkara A.B. et al. 2017].

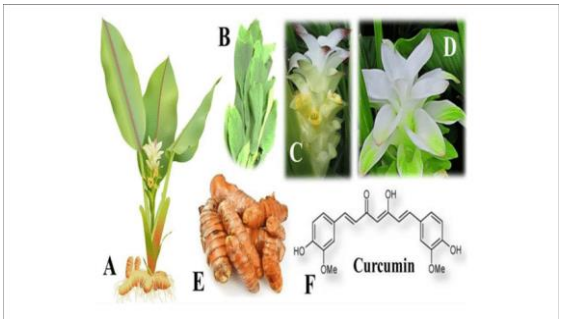


Figure 1

| Turmeric (*Curcuma longa L.*) plants are with the following features: (A) A highly branched standing C. longa plant with cylindrical rhizomes of yellowish to orange colour. (B) Broad long and simple leaves with long petioles (leaf stems) grow from branching rhizomes that lie just below the surface of the soil. (C) Inflorescence is terminal, spike-shaped, and cylindrical, having laterally green united bracts with reddish spots. (D) It produces very pretty, tall white flower spikes. (E) *Curcuma longa* rhizomes with yellowish to orange color. (F) The natural and major bioactive compound of the *Curcuma longa* plant.

Withania Somnifera-

Ashwagandha (*Withania somnifera*) is indeed a prominent herb in Ayurveda, which is the traditional system of medicine in India. It is also known by various other names; Natural therapies become an alternative of treatment. Ashwagandha, a tropical herb used in Indian Ayurvedic medicine, also has anticancer activity in the water extract of Ashwagandha leaves (ASH-WEX). WS roots are used in over 200 formulations in Ayurveda, Siddha and Unani medicine. Ashwagandha churna, powdered root of the WS plant is frequently used to treat a variety of ailments. Further, it is also used with other ingredients. WS is used as the major component in Saraswati churna, which is a herbal powder mixture utilized to treat neurological conditions. Ashwagandhadhi lehyam is another preparation that includes WS, primarily utilized as a rejuvenation

supplement, a treatment for male impotence and as an energy enhancer.

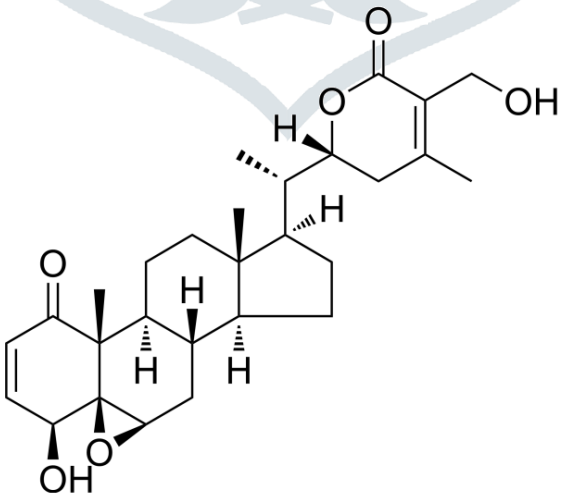


Figure 2

Withania Somnifera - Roots , A Chemical Structure

It exhibits toxicity towards specific cancer cells, increases bioavailability, or enhances stability. The plant family Solanaceae includes W. somnifera, sometimes referred to as Ashwagandha, Indian ginseng, asgandh, and winter cherry. It grows in Spain, some regions of Middle-East Africa, India, Pakistan, Afghanistan, the Canary Islands, and Pakistan. The plant is a 1.5-foot-tall erect undershrub.metres high. For more than three thousand years, it has played a significant role in the Ayurvedic and traditional medical systems.1-2 different plant parts are traditionally used to treat various ailments. Root has been used for centuries as an aphrodisiac, liver tonic, anti-inflammatory, astringent, and antidepressant as well as for fever, poor memory, neurasthenic, and weak muscle tone. The glycowithanolides extracted from the roots of *W. somnifera* were tested on rats for their anxiolytic and depressive properties.*W. somnifera* prevented stress-related stomach ulcers more successfully than compared to the medication ranitidine .It considerably reduced the effects of reserpine or haloperidol on optimism for the treatment of Parkinson's disease and catalepsy. It additionally had antivenom as well as anti-inflammatory actions. Additionally, it had an antiangiogenic effect. It starts with a possibility of obtaining hypoglycemic, diuretic, and hypocholesterolemic medications eleven. Methanol and Leaf and root hexane extracts exhibited strong antibacterial activity. It's heart-protective Additionally, an experimental report of the effect. Animals respond to W. somnifera as an anticonvulsant in models of both acute and ongoing seizures. The glycoprotein of W. Somnifera possesses antifungal performance. Additionally, it has cardiotropic, adaptogenic, and anticoagulant properties.

Sampling Sites –

The main sampling site for the study of this work is the villages near the chhoyyia river. This tributary passes through around 50 villages in the district, including Sundarpur, Ravanpur, Navada, Gadana, Hadarpur, Sihora, Salmabad, Bhairera, Agri, Jalalpur and sikamdari is the main villages. In the current study, three sampling locations is identified for surface water quality to show the representative water quality of Choyyia Nadi and in same manner three sampling site i.e. Jalalpur, Navada and Ravanpur are chosen to collect the groundwater sample on monthly basis throughout the full year.

Figure 3: Shows the sampling sites- (chhoyia nadi bridge.) This pictures clearly shown the contamination of water due to dumpings of chemicals.

Collection of samples-

Results and Conclusion-

In the present study, the three surface and three ground water sampling sites were selected to evaluate the surface as well as ground water quality of Chhoyyia Nadi and its catchment area. The first surface water sampling site was chosen near Chhoyia bridge on bijnor to Nagina road, apart this the first ground water sampling site was

selected at village Fareedpur chandan which located near the upstream of Chhoyia nadi from first surface water sample site. The first surfacewater sample point is that where the treated effluent of Mohit Paper join the Chhoyia. The second one sampling sites is Aagri village for surface as well as ground water. This is village which is located on the bank of Chhoyia Nadi. The elevation of this village is 236 meter from sea level. The third and last sampling site is Chhachri mode.In down stream of this sampling site there is no industry is situated whose effluent join the Chhoyia nadi.

To study the variations in surface and groundwater quality within the Choyyia Nadi river and its surrounding catchment area, a total of three samples were collected from the surface water source. Additionally, another set of three samples were obtained from Indian Mark government hand pumps using the grab sampling technique as outlined in Trivedy and Goel's guidelines from 1986. These samples were carefully gathered in sterilized acid-washed polyethylene Terephthalate (PET) containers. Upon collection, immediate on-site analysis using a portable water testing device (TOSHCON TMULTI 27) was conducted to measure parameters such as pH, dissolved oxygen (DO), and total dissolved solids (TDS). Following on-site measurements, all collected samples were promptly transported to the laboratory for further comprehensive analysis. The analysis covered various physico-chemical parameters including total suspended solids (TSS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and turbidity.

Several studies have reported curcumin's antitumor activity on breast cancer, lung cancer, head and neck squamous cell carcinoma, prostate cancer, and brain tumours [Anand P. et al. 2008], demonstrating its capability to target multiple cancer cell lines. Despite all the above-mentioned advantages, curcumin's applications are limited due to its low water solubility, resulting in poor oral bioavailability and chemical stability. Another obstacle is the low cellular uptake of curcumin. Due to its hydrophobicity, the curcumin molecule tends to penetrate the cell membrane and bind to the fatty acyl chains of membrane lipids through hydrogen binding and hydrophobic interactions, resulting in low availability of curcumin inside the cytoplasm.

The worst affected are those who live close to industrial areas in every way. They lack access to clean water to drink, clean air to breathe, and clean water to irrigate their fields with water. They obtain drinking water from sources drilled at higher ground level that has a pale yellow color. All water samples had extremely high water hardness, with the level near the sugar mill being the highest and making the water unfit for consumption. Near a paper factory, excessive levels of conductivity, alkalinity, and TDS were detected in the water. This shows the need for adjacent residents to only drink water that has been properly treated and the requirement for authorities to properly monitor the effluent quality released by the industries. In addition to this, industries must make a small reduction.

References

1. Anand P., Sundaram C., Jhurani S., Kunnumakkara A.B., Aggarwal B.B. Curcumin and cancer: An“old-age” disease with an “age-old” solution. Cancer Lett. 2008;267:133–164.

2. Agency for Toxic Substances and Disease Registry (ATSDR) *Toxicological Profile for Arsenic*. Washington, DC, USA: U.S. Department of Health and Human Services; 2007

3. Aggarwal B.B., Kumar A., Bharti A.C. Anticancer potential of curcumin: Preclinical and clinical studies. Anticancer Res. 2003;23:363–398

4. Agarwal, A. and Deswal, S. 2017. Assessment of Ground Water Quality in Vicinity of Industries in Bijnor, U.P, India. International Journal on Emerging Technologies. 8 (1) : 745-750

5. Kunnumakkara A.B., Bordoloi D., Padmavathi G., Monisha J., Roy N.K., Prasad S., Aggarwal B.B.Curcumin, the golden nutraceutical: Multitargeting for multiple chronic diseases. Br. J.Pharm. 2017;174:1325–1348. doi: 10.1111/bph.13621.

6 Budhauliya, A.K. 2013. Ground water Brochure of Bijnor District, U.P. CGWB

7. Baliga MS, Meera S, Vaishnav LK, Rao S, Palatty PL. Rasayana drugs from the Ayurvedic system of medicine as possible radioprotective agents in cancer treatment. *Integr Cancer Ther.* 2013;12:455–463

8. Gagan A. And , Rajput A : Assessment of water quality of Choyyia Nadi (River) Catchment area in Bijnor District, Uttar Pradesh, India ,., 8, (2020).

9. Khan M.Y.A., Gani, K.M. and Chakrapani, G.J. 2017. Spatial and temporal variations of physicochemical and heavy metal pollution in Ramganga River- a tributary of River Ganges, India.Environ Earth Sci. 76:231

10 Lestari M.L., Indrayanto G. Curcumin. Profiles Drug Subst. Excip. Relat. Methodol. 2014;39:113–204.

11. Mahady G.B., Pendland S.L., Yun G., Lu Z.Z. Turmeric (Curcuma longa) and curcumin inhibit the growth of Helicobacter pylori, a group 1 carcinogen. Anticancer Res. 2002;22:4179–4181.

12. Mirjalili MH, Moyano E, Bonfill M, Cusido RM, Palazon J. Steroidal lactones from Withania somnifera, an ancient plant for novel medicine. Molecules. 2009;14:2373–2393.

9. Matta, Gagan; Lu, Xi Xi and Kumar, Avinash (2020a): Hydrological Assessment of River Henwal Using Water Quality Indices with Reference to Planktonic Composition. Advances in Water Pollution Monitoring and Control. Springer Publication. (ISBN: 978-981-32- 9955-9).

10. Reddy R.C., Vatsala P.G., Keshamouni V.G., Padmanaban G., Rangarajan P.N. Curcumin for malaria therapy. Biochem. Biophys. Res. Commun. 2005;326:472–474. doi: 10.1016/j.bbrc.2004.11.051

11. Srivastava, A., Kumar, A., Gupta, V., Agarwal, G., Srivastava, S. and Singh, I. 2011. Water Quality Assessment of Ramganga River at Moradabad by Physico-Chemical Parameters Analysis VSRD

12. Trivedy, R. K. and Goel, P. K. (1986) Chemical and Biological method for water pollution studies. Environmental publication (Karad, India), 6: 10-12.;

13. Vahter M. Mechanisms of arsenic biotransformation. *Toxicology*. 2002;181-182:211–217.