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# Ameliorative effect of two Ayurvedic herbs on experimentally induced arsenic toxicity in calves

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ABSTRACT

*Ethnopharmacological relevance:* Chronic arsenic poisoning due to contaminated subsoil water is a threat to society in West Bengal, India and in Bangladesh. The human being may also be affected by the exposed cattle from the affected area by consuming milk, egg, meat and others. In Ayurveda, several herbs like *Haridra* (turmeric), *Shunthi* (dried ginger root) and others are used for the management of arsenic poisoning.

*Aim of the study:* The study was conducted to find out the ameliorative effect of turmeric and ginger powder against experimentally induced arsenic toxicity in calves.

*Materials and methods:* Twenty four calves were divided into four groups (group I, II, III and IV) having six animals in each group. Animals of group I, II and III were orally administered with sodium arsenite at 1 mg/kg body weight for 90 days and in addition group II and group III animals were treated orally with turmeric and ginger powder respectively at 10 mg/kg body weight from 46th day onwards. Group IV animals were given food and water without drug and served as control. Arsenic content was estimated in faeces, hair, urine and plasma in every 15 days. Bio-chemical, haematological and anti-oxidant parameters were also assessed.

*Results:* Turmeric and ginger powder significantly ($P < 0.05$) reduced the plasma and hair arsenic levels through increased excretion via faeces and urine. Haemoglobin level, TEC and TLC were decreased in groups I, II and III, however these were improved significantly ($P < 0.05$) from 75th day onwards in turmeric and ginger treated groups. Increased activity of AST and ALT were significantly decreased ($P < 0.05$) from 75th day onwards in group II and III. Blood urea nitrogen and plasma creatinine were also significantly decreased ($P < 0.05$) in group II and III than group I from 60th day onwards. The SOD and catalase activity were significantly ($P < 0.05$) reduced in groups I, II and III, but these were restored at the end of the experiment in turmeric and ginger treated groups.

*Conclusion:* The test drugs are found significantly effective not only to eliminate arsenic from the body but also give protection from possible damage caused by arsenic exposure, it may be concluded from the present study that turmeric and ginger can be helpful in the therapy of chronic arsenic toxicity in calves.



## 1. Introduction

Arsenic poisoning from contaminated subsoil water is a threat to human health in West Bengal, Bihar, Uttar Pradesh, Assam states of India and in Bangladesh (Fazal et al., 2001; Ghosh et al., 2011; Khan and Ho, 2011; Tikenbala Devi et al., 2010). Apart from human, animals are also equally exposed to arsenic in the affected areas. Ruminants of arsenic present in faeces and urine contaminate the environment (Datta et al., 2010). Again arsenic enters into the food chain from the meat or milk of affected animals. Dullness, depression, with slightly reddish urine, oligourea, rough body coat, profound muscular weakness, increased inspiration rate, mild nervous depression and diarrhoea are associated features of arsenic exposure (Biswas et al., 2000). Therefore therapeutic measures are taken to reduce arsenic load and its toxicity

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in animals. This will benefit the human population in two ways; one by restriction of arsenic entry into food chain and the other by reduction of toxic effect and thereby increasing animal production. A previous study reported that treatment by some selective plants can successfully reduce the toxic effects of arsenic in chronic arsenic affected cattle in Nadia district, West Bengal, India (Hazarika et al., 2015).

Arsenic seems to be dangerous metalloid component to human health. Chronic exposure to arsenic is associated with a greater risk of cancer of the skin, lung and liver in human being (Banerjee et al., 2011). Within the body, arsenic causes toxicity by reacting with the free –SH group of the enzyme and cross linking of protein (Akhand et al., 2002). This cross linking of enzyme and protein activates multiple intracellular signaling pathway and generation of reactive oxygen species (ROS) which is responsible for arsenic induced pathogenesis (Hossain et al., 2000).

From the point of view of animal health, it is observed that most of the animals mainly ruminants rearing in arsenic prone area are not showing any specific clinical symptoms but from their faces and milk significant amount of arsenic was eliminated which further contaminate the pasture land and enter into food chain (Banerjee et al., 2011). Therefore, removal of arsenic is very essential to make animal origin foods safe for human being as well as to save animals from chronic carrier state. The popularly known technique such as chemical precipitation, chemical oxidation and reduction, ion exchange, filtration, reverse osmosis and others are mostly used to remove heavy metals from solution (Datta et al., 2010). But these removal techniques are inappropriate and expensive when heavy metals remain in very low concentration. So, there is need for alternative treatment to remove the arsenic from animals.

Ayurveda, the ancient Indian system of medicine is well known for its treasures like herbal and herbo-mineral medicines to treat human beings. Some of the arsenicals are used as medicine in Ayurveda viz. orpiment ($As_2S_3$), realgar ($As_2S_2$) and white arsenic ($As_2O_3$). These are used in various formulations after proper purification treatment, and are prescribed for the treatment of skin diseases, arthritis and others. These medicines produce various adverse effects if, not processed properly, prescribed in greater dose, or used long duration. The adverse effects include skin disorders, constipation, worm infestation, renal calculi, nephritis, deformities, to mention but just few, and even death. Many plant drugs are mentioned for purification treatment of the arsenicals and for management of these adverse effects (Kulkarni, 1998; Chaube, 2000).

The present study was planned to observe the ameliorative effect of two such plant drugs mentioned in the Ayurvedic texts for the management of adverse effects caused by arsenic compounds on sodium arsenite ($NaAsO_2$) induced chronic arsenicosis in calves. *Haridra* [dried root of turmeric (*Curcuma longa* Linn.; Zingiberaceae)] and *Shunthi* [dried root of ginger (*Zingiber officinale* Rosc.; Zingiberaceae)] were selected from the Ayurvedic texts as test drugs. The study confirms to the guidelines laid by the Institutional Animals Ethics Committee.

## 2. Materials and methods

### 2.1. Plant materials, chemicals and reagents

The test drugs (dried roots of *C. longa* and *Z. officinale*) were collected from the local market in Kolkata, West Bengal, India. These were identified by the Botanist of the West Bengal State Medicinal Plants Board, Kolkata. The voucher specimens of turmeric and ginger (PI/DR/06/14 and PI/DR/07/14) were deposited to the board. The drugs were dried in shade and made into fine powder form (mesh size 44). The therapeutic dose of turmeric and ginger powder mentioned in classics of Ayurveda is 1 g/d (Pandey and Chunekar, 2009). In the present study, the dose for experimental study of the test drugs was 10 mg/kg, calculated by extrapolating the human dose to animal dose based on the body surface area ratio (Sharma and McNeill, 2009). All chemicals and reagents used in this work were purchased from Sigma Chemical Co. and were prepared in all glass-distilled water. Estimation of different biochemical parameters were done by diagnostic kits from Cogent India.

### 2.2. Animals

Twenty four apparently clinically healthy male calves of 8-9 months age and having 52–60 kg weight were selected for this experiment. They were reared at individual room in the animal house of West Bengal University of Animal and Fishery Sciences provided with artificial lighting facilities and favourable temperature ($27 \pm 2$ °C). The animals were kept stall feeding with adequate supplementation of paddy straw and concentrates. The composition of concentrate feed mixture was 2 part wheat husk, 1 part crushed maize, 1 part crushed Bengal gram and mineral mixture. Before starting the experiment, the animals were dewormed with a mixture of levamisole and oxyclozanide at 7.5 mg/kg body weight dose ones. The animals were acclimatized in this experimental environment for 30 days. Institution Animal Ethics Committee approved experimental protocol before starting the experiment (WBUAFS/IEC/56/13).

### 2.3. Experimental design

Total twenty four calves were selected for the experiment and they were divided in four groups with six calves in each group. Calves of groups I were administered sodium arsenite ($NaAsO_2$) at daily dose of 1 mg/kg body weight orally for 90 days (Flora, 1999). Group II and group III animals were given sodium arsenite ($NaAsO_2$) at 1 mg/kg body weight dose for 90 days. From 46th day onwards, group II animals were given turmeric powder and group III animals were given ginger powder at 10 mg/kg body weight dose orally for next 45 days. Group IV animals were supplied food and water daily without any treatment for 90 days and were served as control.

At every 15 days interval of treatment, faeces, urine and hair samples were collected from all the animals for estimation of total arsenic concentration. On the same days, 10 ml blood were collected and divided into two aliquots (5 ml each). One aliquot without anticoagulant was used for serum aspertate amino transaminase (AST) and alanine amino transaminase (ALT) activity. Another aliquot with anticoagulant was used for estimation of haemoglobin content, total erythrocyte count, total leucocyte count, blood urea nitrogen (BUN), plasma creatinine, superoxide dismutase (SOD) and catalase activity.

### 2.4. Estimation of arsenic

Total arsenic was estimated in atomic absorption spectrometer (AAS) equipped with vapor generation accessories. AA240 model AAS equipped with vapor generation was used (model no. VGA77). A Varian arsenic cathode lamp with slit 0.5 nm and wave length 193.7 nm was used as light source. Aqueous solution of 0.6% sodium borohydrate in 0.4% sodium hydroxide and hydrochloric acid was used as a carrier solution to reduce the analyte to hydride form. To determine total arsenic in different type of samples, 10 ml aliquot was taken in a 50 ml volumetric flask. Then 5 ml concentrated hydrochloric acid and 1 ml freshly prepared 5% solution of potassium iodide and ascorbic acid were added and kept for