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Effects of Arsenic (As) on Animal Health

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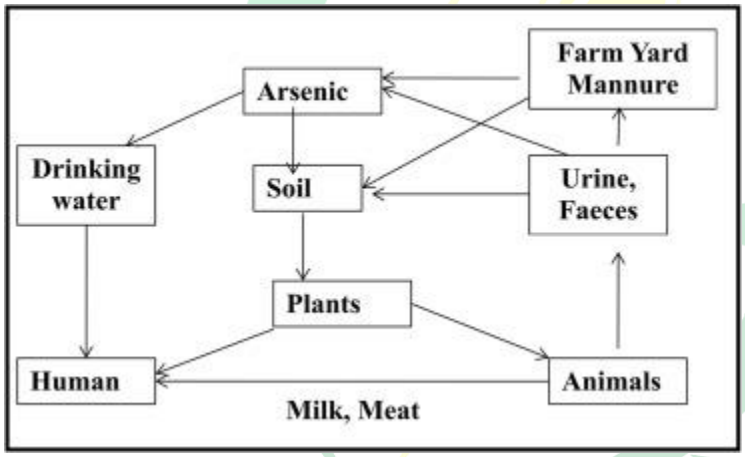
Arsenic (As) contamination has attracted international attention as a result of its devastating health consequences on humans and animals. As is one of the top seven most harmful compounds in the environment, according to the Agency for Toxic Substances and Disease Registry (2000). This classification is based on the substance's toxicity as well as the risk of pollution in the air, water, or soil. Insecticides, fungicides, wood preservatives, glass, alloys, synthetic paint, electroplating, and pharmaceuticals are just a few of the industries where arsenic is used. As is found in the earth's crust or bed rock in some geographical areas and is extremely soluble. Through leaching and erosion, it can contaminate nearby ground water, elevating its concentration in drinking water. When as polluted water is used for irrigation, it enters the food chain and spreads across the animal kingdom.



Increased levels of as (0.20-3.7 mg/lit) in ground water have posed major health risks to millions of people in numerous regions of the world, including India, China, Thailand, Bangladesh, and Taiwan, as well as other countries of Asia and Europe. According to Chakraborty and Das (1997) livestock raised in and around such areas are similarly prone to be victims of As pollution-related disasters. In some parts of the Indian subcontinent, ground water provides a significant risk of exposing animals and humans to dangerous levels of As. Higher levels of arsenic in ground water have been observed in 50 Bangladeshi districts and 9

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West Bengali districts, exceeding the WHO's recommended limit of 0.01 mg/L (WHO, 2004). According to Chakraborti (2004), the Ganga-Meghna-Brahmaputra (GMB) flood plain, which covers 5 lakh square kilometres in Uttar Pradesh, Bihar, Jharkhand, West Bengal, and Assam and is home to 450 million people, is prone to As poisoning. As content in several industrial sites in Panipat, Yamunanagar, and Sonepat was greater than WHO permitted limits (Mani et al., 2003), and some locations in Delhi (Lalwani *et al*.,). Recently, the Sangrur belt in Panjab was discovered to have a high As level in the water.

Arsenic is a cumulative poison with a long retention time inside the body, posing a threat to the body's different physiological systems. Abdominal pain, diarrhoea, salivation, vomiting, anorexia, weight loss, black urination, distinct skin eruptions, and other side effects of toxic levels of As can occur (Radostitis *et al*., 2000). However, acute haemorrhagic diarrhoea is the most common clinical indication of As poisoning in cattle (Riviere et al., 1981). As indicated by clinical manifestations and biochemical abnormalities, the liver and kidney are the principal target organs for toxic effects of As (Santra *et al*., 2000). As well as its organic metabolites, inorganic As is widely absorbed (about 80%) and eliminated in the urine (Underwood and Suttle, 1999). Intestinal bacteria that can methylate As and metabolise methylated As may influence As absorption and metabolism (Hall and Kohan, 1997). Methylation is the mechanism through which As is metabolised in the liver. Biomarkers of As exposure include levels of As or its metabolites in blood, hair, nails, and urine. Only in the case of acute As poisoning or sustained chronic high-level exposure is blood As a viable biomarker. As accumulates slowly in tissue, primarily in the liver, kidney, and skin. Arsenic has been linked to a lack of cell-mediated immunity and a decrease in the proportion of T helper cells in the body (Yu *et al*., 2002). Animals with lowered immunity are more prone to infections, making them less frugal and economically viable. In the case of chronic As exposure, haematological parameters are also affected. Its toxicity is also blamed in animals for stunted growth and infertility. Chronic intake of As polluted feed and water may have a harmful effect on animals, reducing output and posing a risk to human health through milk excretion (Bhattacharya *et al*., 2009). Milk has a significantly higher level of As.

According to studies on experimental animals, As is a metalloid that promotes oxidative stress by generating reactive oxygen species or inhibiting antioxidant enzymes (Ramos *et al*., 1995). Increased amounts of reactive oxygen species (ROS) in the body would have an impact

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on the steady-state level of nitric oxide (NO), which reacts quickly with reactive oxygen species like superoxide, resulting in a significant reduction in NO production. Furthermore, As has an effect on signalling cascades, activating (or inactivating) transcription factors that control downstream gene expression. At low concentrations, the build-up of reactive oxygen species (ROS) induces abnormal gene expression and lipid damages. Antioxidant substances, but more significantly, the stimulation of antioxidant enzymes (SOD and CAT), which are critical for the termination of the oxygen radical cascade and the lipid peroxidation chain reaction, can ameliorate the oxidative burden (Ahmad, 1995). Antioxidants have been proven to be effective in reducing chemical-induced oxidative damage in monogastric animals, according to reports (Ramanathan *et al*., 2002). The presence of antioxidants and thiols (-tocopherol, ascorbic acid, N-acetylcysteine, methionine, lipoic acid, S-adenosyl-methionine) that facilitate As methylation is required for As metabolism and excretion. Vitamin E is a powerful lipophilic radical scavenger and the first antioxidant discovered. Although there is literature on the negative effects of As on monogastric animals and humans, there is less evidence on its long-term consequences on ruminants. However, given the rising levels of pollution in the environment, it is critical to analyse the impact of feeding As on ruminants as well. Because of the probable function of As in inducing oxidative stress, antioxidants may improve the efficacy of As-induced adverse effects mitigation. In rabbits (Rabbani *et al.*, 2003), rats (Nandi *et al*., 2006), and rodents, feeding ascorbic acid as an antioxidant has been shown to be beneficial (Rana *et al.*, 2010). Vitamin E is a dietary need that acts as a first line of defence.