

Present Status Of Trace Elements And Heavy Metals In Ayurvedic Medicines

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Abstract

The therapeutic benefits of Ayurvedic medicines are historically well known. Sometimes the concentration of trace and heavy metals can vary depending on their geographical sources, which can cause extremely harmful effects. Thus, one of the most important topics nowadays is the assessment of toxicity and safety of these Ayurvedic medicines. The presence of these constituents in the soil of the study area can be linked to the formation of toxicants of these harmful elements. They should be used with caution in the field as their uncontrolled ingestion can have harmful dangerous consequences on their consumers. Analysis by atomic absorption spectrometry allowed the detection of trace and heavy metals. This paper discusses the current status of trace elements and heavy metals in Ayurvedic medicine. Along with this, the effects of trace elements and heavy metals on human health have also been explained. This research paper also contains about in what way to determination of Trace element and heavy metal from ayurvedic medicines specially "Ras".

Keywords- Ayurvedic medicine, trace element, heavy metals, human health.

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I. Introduction

Ayurvedic medicine was developed over 2000 years ago in India and mainly relies on Ayurvedic pharmaceutical goods. Ayurveda is used by almost 80% of India's population. With more than 500,000 Ayurveda physicians operating in 4,000–6,000 Ayurvedic Hospitals and another 20 Clinics. The acceptance of Ayurveda in western nations has grown recently. Ayurvedic remedies are now offered in the United States through South Asian marketplaces, ayurvedic doctors, health food stores, and the internet. Due to their marketing as dietary supplements, ayurvedic medicine products are governed under the Dietary Supplement Health and Education Act, which does not demand proof of their safety or efficacy. The earliest archaeological evidence on the relationship between people and plants dates back 1.2 million years. Recent chemical study of ancient human dental calculus has shown that 70–80% of daily calories were derived from plant items (Hardy et al., 2017). Despite the fact that historically, using plants for medicinal purposes in conventional treatment methods has lost some of its original value due to technical advancements, the need for medicinal plants has been rising in recent years, particularly due to the chemical side effects of pharmaceuticals. More than 80,000 plant species are utilised for therapeutic purposes, and it is known that 80% of the world's population benefits from medicinal plants against diseases (Karahan et al., 2020). Similar to other plants, medicinal plants require a variety of macroelements (such as Ca, Cl, N, Na, P, K, Mg, etc.) and trace elements (such as B, Fe, Cu, Mn, and Zn) for growth, development, and optimal life support.

Since the body cannot produce these components on its own, their reception from the environment is essential (Zeiner et al., 2017). The development of cell tissues, the formation of roots and flowers, the structural and physiological stability of plant tissue, cell division, cell wall formation, cell expansion, and the activation of enzymes in plant metabolism are just a few of the metabolic processes that these trace elements play a significant role in (Jones et al., 2001). They also play important roles in pollen health, fertilization, protein synthesis, the formation and transport of carbohydrates, the transport of calcium, and the formation of hormones. Necrosis in young leaves, vegetative and reproductive growth, blossom-end rot of fruits, significant losses in crop yield and quality, cell breakdown, decreased plant fertility, loss of membrane integrity, and inhibition of the cell expansion in plant functions are all symptoms of essential nutrient deficiency (Olle et al., 2009).

But a wide range of anthropogenic activities, including industry, the burning of fossil fuels, mining, smelting, forest fires, traffic, municipal waste, sewage disposal, chemical fertilizers, and pesticides, have significantly increased pollution since the Industrial Revolution (Erdogan et al., 2022). As a result, many naturally occurring aquatic and terrestrial ecosystems have become contaminated by heavy metals such as

aluminium (Al), arsenic (As), cadmium (Cd), chromium (Cr), cobalt (Co), iron (Fe), lead (Pb), nickel (Ni), silver (Ag), and zinc (Zn) elements (Turan et al., 2020).

Trace metal

Some metallic ions, including iron and copper, take part in oxidation-reduction reactions in the metabolism of energy. Trace elements primarily serve as catalysts in enzyme systems. Additionally essential to the transfer of oxygen is iron, which is a component of haemoglobin and myoglobin. Instrumental neutron activation analysis (INAA) has been used to analyse specific plant parts for the presence of 20 elements, including As, Ba, Br, Ca, Cl, Co, Cr, Cu, Fe, K, Mn, Mo, Na, P, Rb, Sb, Sc, Se, Sr, and Zn, which are frequently used as medicines in the Indian Ayurvedic system. It has been discovered that the majority of medicinal herbs are abundant in one or more of the components being researched.

Minerals known as trace elements or trace metals are minor levels of which are found in living tissues. Some of them are known to be nutritionally necessary, some might be (but the evidence is merely speculative or sparse), and the rest are regarded as nonessential. (Eskin et al., 2019).

Heavy metal

The buildup of hazardous industrial wastes in soil, air, and water is constantly growing as a result of rapid urbanisation and extensive environmental degradation. Heavy metals, which are abundant in nature and have an atomic weight range of 63.5 to 200.6 g/mol and a specific gravity larger than 5 g/cm³ have a major negative impact on all living things, but particularly on people. Plants absorb these heavy metals in their harvestable parts (through root uptake, foliar sorption, and concentration of specific elements in leaves), and the intensity of this uptake process is correlated with the plant's overall elemental concentration. Plants are sensitive to environmental conditions, structure is modifiable. Certain heavy metals, including arsenic, lead, cadmium, and mercury, are poisonous and not necessary for plants. Traditional and Ayurvedic medicine are very concerned about the risk of dangerous heavy metals being transferred to people and animals through the usage of plants cultivated in contaminated areas. If heavy metal buildup is discovered to exceed the

allowable limit, it may have major repercussions for the trade in medicinal plants in India, which is estimated to be worth Rs 5000 crore annually with an annual growth rate of 7-15%. Consequently, testing for these dangerous metals in both finished goods and raw Ayurvedic constituents should be required. Prioritizing heavy metal testing on raw herbs will prevent contamination from spreading to finished goods. It can be viewed as a strategy for raw material quality assurance (Ozyigit et al., 2018).

Ayurvedic Medicines

Using Ayurvedic items made from medicinal plants cultivated in polluted areas might have negative health effects on people. The quality of these raw herbs should be ensured in terms of heavy metal contamination in order to acquire desired therapeutic advantages. WHO advises against using herbs and herbal as well as Ayurvedic products unless their heavy metal concentration has been evaluated qualitatively and quantitatively.

To determine the quantity of heavy metal pollutants in Ayurvedic raw materials, it is therefore necessary to estimate the presence of these heavy metals in medicinal plants. The selection of medicinal plants was based on their recognised medical qualities, relevance in Ayurveda, the traditional system of Indian medicine, and widespread use in both traditional and modern pharmaceutical, nutritional, and cosmetic preparations around the world.

In Ayurveda Philosophy, majority of metal poisoning is unintentional. Metals like arsenic, mercury, lead, and others are commonly found in several Ayurveda medications like rasaushadhis. Ayurvedic standards should be used to standardise ayurvedic medications such that metals are never present in free form and never lead to toxicity. The shodhana purification of these metals prior to the production of medications is crucial. Otherwise, using medications for which the shodhan treatment has not been performed results in a number of problems. Many systemic diseases can also be caused by a rasaushadhis overdose.

A few ayurvedic medications with metal content (Vd. Jaiprakash et al.,2020).

Nag (Lead)	Tralokyachintamaniras, jwarariras, manikyaras, yogeshwarras, mahaniikantharas
Tamra (copper)	Arogyavardhinivati, laxmivilasras, aamvateshwarras, kanchanabharas, tamreshwarras
Gauripashaan (Arsenic)	Mallasindur, vadvanalras, ardhavabhedharyog, sameerpanagras, suchikabharanras
Manshila	Tralokyachintamaniras, manshiladighrut, mrutsanjivani, shwaskutharras, manshiladyavarti
Hartal (Yellow arsenic)	Rasmanikya, sameerpannag, kasturibhairav ras, talsindur, talakbhasma, nityanandaras

Tutha (Blue vitriol)	Kanaksundarras, agnikumarloha, jatyadihrut, jatyadiail, tralokyachintamaniras, mahajwarankushras, mhamrutunjayras
Vanga (Tin)	Induvati, kanchanabhraras, talkeshwarras, nityanandaras, laxmivilasras, mehakesariras, aamvatgajsinha modak, mohadadhiras
Parad (mercury)	Makardhwaj, sameerpannag, mallasindur, lohaparpati, rasaparpati

Effect of trace elements in human health

Exposure to non-essential trace elements can be harmful or have no effect depending on the dose. Essential trace elements are a matter for concern since too little or too much exposure to them in the diet can be harmful to people and other living things. Specific trace element shortages have been linked to a variety of disorders. For instance, a lack of iron can lead to anemia, and a lack of iodine might result in goitre.

Because it is necessary for mammals but not for plants, selenium (Se) is a special element. Children should consume 20 g daily, while adults should consume 50–70 g daily. Se is necessary for life and health, but if consumed in excess (45 g for children and 400 g for adults daily), it can be harmful. Since different plants accumulate different amounts of Se, the amount consumed is dependent on the plants consumed as well as the region in which they were cultivated.

Zinc intakes that are too high prevent animals from properly absorbing and using copper and iron. Increases in dietary zinc cause copper insufficiency in sheep, which is shown by lower plasma concentrations of copper, ceruloplasmin, and amine oxidase. In pregnant rats fed diets with varied levels of copper and zinc, a negative relationship between dietary zinc and copper concentrations in maternal and foetal tissues was found (Yalcin et al., 2020).

The food chain includes fluoride in some capacity. In communities with fluoridated water compared to those without, the measured fluoride level of the food is three times higher. The fluoride content of the water in which dry cereals were processed, according to study, has a significant impact on the fluoride content of those foods. They also claimed that there is a lot of fluoride in infant foods. Additionally, fluoride is ingested unintentionally from two main sources: foods that contain meat that has been mechanically deboned and fluoridated toothpaste. Children under the age of five have been found to consume the most fluoride on average each day (0.3 mg).

Trace elements can and do have an impact on human health, either due to toxicity when levels are too high or because of insufficient intake of the elements needed to maintain health. Problems with trace elements are frequently site-specific. Site-specific approaches can be used to lessen unwanted effects. (KG Das Sen et al.,).

Effect of Elements and heavy metals on human body

Due to residential or occupational exposure, 35 metals are of concern to us, 23 of which are heavy metals. These metals include antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese, mercury, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium, and zinc. Environmental and dietary exposure to certain heavy metals is widespread. While they are necessary in modest doses to maintain good health, high quantities of them can be poisonous or hazardous. Energy levels can be lowered by heavy metal toxicity, which can also harm other important organs like the liver, kidneys, lungs, brain, and lungs. Long-term exposure can cause gradually advancing physical, muscular, and neurological degenerative processes that mirror illnesses including multiple sclerosis, Parkinson's disease, Alzheimer's disease, and muscular dystrophy. Cancer can also be brought on by continuous exposure to certain metals and their derivatives. Certain heavy metals may be far more harmful than the background amounts that are already present in the environment. Hence, in order to protect against excessive exposure to heavy metals, it is essential to have a full understanding of these substances.

There are numerous health dangers connected to heavy metal toxicity, which has established itself as a serious threat. Even though these metals have no biological function, they are poisonous in some way that is damaging to the human body and its normal functioning. They can occasionally operate as the body's own pseudocatalysts while also having the ability to disrupt metabolic processes. Via the skin, respiratory system, or digestive tract, heavy metals can enter the human body. Because of their capacity to harm DNA and membranes, as well as to interfere with the activity of enzymes and proteins, toxic metals have established themselves as a serious threat to human health. These metals disrupt the functionality of native proteins by releasing thiols or other functional groups, accelerating the oxidation of amino acid side chains, interfering with protein folding, and/or substituting necessary metal ions in enzymes. (S Mishra et al.,).

Health is more than just the absence of disease; it is a condition of complete physical and mental well-being. The idea of Ayurveda, which takes a holistic approach to healing the body as a whole as opposed to mainstream treatment, fits particularly well with this term. As old as humanity itself, numerous civilizations have used therapeutic herbs. According to WHO estimates, herbalism is used the most frequently throughout the world. A global trend for a resurgence of interest in conventional medical practises has emerged in recent

years. In phytochemical research, screening medicinal herbs has emerged as a possible source for biodynamic chemicals with therapeutic effect, but little is known about the impact of vital trace elements and the presence of heavy metals, which are crucial to enzymatic and physiological processes. The marketability, professionalism, effectiveness, and safety of Ayurvedic goods have also come under scrutiny due to the growing popularity of therapeutic plants. Public confidence in the safety of Ayurvedic and natural goods can only be achieved by enforcing regulatory requirements utilising good agricultural, laboratory, supply, and manufacturing practises. (D. Sinha et al.,).

Determination of Trace element and heavy metal from Ayurvedic Medicines

Therefore, trace element analysis and comprehensive screening of organic components are necessary. Instrumental neutron activation analysis (INAA) has been used as a multispectral technique for the determination of elements 23–31 in a variety of herbs and Ayurvedic formulations. AAS was especially used for the determination of toxic elements Ni, Cd and Pb. Furthermore, thin layer and column chromatography including preparative TLC was used for the separation of organic components, which were identified by IR, NMR spectral and GC-MS methods.(Al-Omari et al., 2011).

II. Discussion

Our research draws attention to the potential heavy metal toxicity of Ayurveda drugs. Mercury, arsenic, and zinc are typical harmful metal components found in Indian-made Ayurveda remedies, which frequently contain heavy metals. The components stated on the medicinal label cannot be used to determine the kind and amount of metals. These findings demand an assessment of the manufacturing procedures, environmental pollution (including heavy metal pollution), and hazardous metal concentration sources, as well as the legislation required to ensure the safety of Ayurveda medications.

The significant incidence of heavy metals in a random sample of widely used Ayurveda drugs in India is the subject of this investigation. heavy metal detection in all formulations According to an examination of the literature, metals were indicated on the labels of around 28% of ayurvedic medicines. With the exception of one formulation, metal concentrations exceeding the FAO/WHO and AYUSH-mandated limits for zinc, mercury, and/or arsenic are seen. Nearly all materials have detectable quantities of zinc, iron, copper, and chromium. Typically, none of the samples contain cadmium. In the rasa shastra, metals are considered medicinal after being purified and free of side effects.

The high frequency of heavy metals in a randomly selected It is possible that environmental contamination of the Ayurvedic as well as herbal plants (such as heavy metal pollution) or manufacturing methods with accidental or deliberate metal mixing caused the high prevalence and dangerous quantities of heavy metals in our report and related investigations. Moreover, Ayurveda medicines are not strictly regulated for safety, and enforcement of associated regulations is far laxer in LMIC than in the industrialised world. Lead, arsenic, and mercury are the top three hazardous substances on the US Agency for Toxic Substances and Disease Registry's list of substances (ATSDR). Our samples frequently contained detectable quantities of these metals, which supported the most recent global data.

III. Conclusion

The poisonous or harmful effects of metals in certain forms and quantities are known as heavy metal poisoning. Children are among those who are vulnerable to the hazardous effects of heavy metals. The environment is exposed to heavy metals both naturally and as a result of human activity. These heavy metals have a propensity to build up in the body, harming important organs like the kidneys, liver, brain, lungs, and blood composition. If certain Ayurveda formulations containing metals are not thoroughly cleansed before consumption, they may result in a number of illnesses. Some medications can have negative side effects if taken in excess. Individuals should be informed about the heavy metal poisoning prevention, control, and treatment options. For Ayurvedic treatment, Shodhana treatments should be combined with Prativisha. The heavy metals mercury, cadmium, aluminium, arsenic, and others are the topic of this review. These metals accumulate in the body as a result of exposure and induce a variety of side effects as well as systemic harm. While the treatment of these heavy metals has been mentioned in Ayurvedic scriptures as using a poisoning and cleansing procedure as well as an antidote. Shodan and Maran processes are used prior to preparation because many Ayurveda medications especially “Ras” are made with metals. Metals that have not been processed exhibit hazardous symptoms when utilized. Hence, the review's main topics include Ayurveda specially “Ras” perspectives on heavy metal poisoning, hazards, and treatments.

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