

**RASOUSADHI AS MICRONUTRIENT SUPPLEMENT: AN INTEGRATIVE APPROACH
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ABSTRACT

Micronutrient deficiency remains a major global health challenge, with a significant proportion of the population lacking essential nutrients such as iron, zinc, vitamin D, and vitamin B12, despite widespread use of fortified foods and synthetic supplements. Organically derived nutrients are often considered superior to inorganic mineral salts and synthetic compounds owing to their greater physiological compatibility and enhanced absorption by the body. In contrast, conventional supplementation with inorganic mineral salts and synthetic vitamins is frequently limited by poor bioavailability, resulting from gastrointestinal barriers, pH imbalance, and interactions with dietary fibres. In this context, *Rasousadhi* (herbo-mineral formulations) described in *Ayurveda* offer an alternative, characterized by enhanced bioavailability and tissue-specific action. Classical pharmaceutical processes such as *Shodhana* and *Marana* convert metals and minerals into nano-particals I.e *Bhasma* form, which may bypass conventional absorption limitations and target specific *Dhatu* (tissues). The use of media such as *Triphala*, *Maricha*, *Ksheera*, *Nimbu Swarasa* and *Amalaki Swarasa* during processing further enhances bioavailability by imparting chelating, potentiating, and organotropic properties. This review explores micronutrient physiology through the lens of *Dhatu Siddhanta* and discusses how *Rasousadhi* may serve as a rational, integrative approach to correcting micronutrient deficiencies at the tissue level. As micronutrient deficiency is a modern nutritional construct not explicitly described in *Ayurveda*, the present work is an attempt to establish a conceptual bridge between contemporary nutrition science and *Ayurvedic* fundamentals. Further pharmacological, experimental, and clinical investigations are required to substantiate these correlations and evaluate their therapeutic applicability.

KEYWORDS: Micronutrient Supplements, Bioavailability, *Dhatvagni*, *Rasousadhi*.**INTRODUCTION**

Nutrition is fundamental for maintaining health and preventing disease. Micronutrients, including vitamins and minerals, play crucial roles in energy production, growth, tissue repair, immune regulation, and neuroendocrine function. Traditionally, when diets were composed predominantly of fresh, whole, and minimally processed foods grown in nutrient-rich soils, additional supplementation was rarely necessary, as daily intake generally met physiological requirements.

In recent decades, however, dietary patterns have shifted towards refined, energy-dense, and nutrient-poor foods. Along with soil depletion, food processing, and lifestyle changes, this has contributed to a rise in micronutrient deficiencies. These deficiencies may arise from inadequate intake, impaired absorption, increased requirements, or chronic health conditions such as inflammatory bowel disease, malabsorption syndromes, and chronic anemia. In severe cases, supplementation

under medical supervision becomes necessary to prevent complications.

Despite widespread use of synthetic vitamin and mineral supplements, clinical outcomes are often suboptimal due to issues such as poor bioavailability, competitive inhibition between minerals, pH-dependent absorption, and poor gastrointestinal function.^[1] In this context, *Rasousadhi* (herbo-mineral formulations) described in *Ayurvedic* classics provide an alternative approach. When processed through *Shodhana* and *Marana*, these formulations yield nano-particulate *Bhasma* with potentially higher bioavailability and tissue-specific (*Dhatu*-specific) action.^[2] This article reviews micronutrient physiology through *Dhatu Siddhanta* and examines the potential of *Rasousadhi* as integrative micronutrient supplements.

METHODS AND MATERIALS

Nutrients are broadly divided into two categories.

MACRONUTRIENTS AND MICRONUTRIENTS^[3]

Macronutrients (carbohydrates, proteins, fats, and dietary fibre) are required in large quantities and primarily provide energy and structural components.

Micronutrients are required in smaller amounts but are essential because the body cannot synthesize them. These include **vitamins and minerals**.

Vitamins

Fat-soluble vitamins: A, D, E, K.

Water-soluble vitamins: B-complex and vitamin C.

Minerals are further classified based on daily requirements.

Macrominerals (required in amounts >100 mg/day): calcium, magnesium, phosphorus, sulphur, sodium, potassium, and chloride.

Microminerals / Trace elements (required in amounts <100 mg/day): iron, zinc, copper, selenium, iodine, and manganese. These micronutrients play specific roles in supporting the formation, nourishment, and function of various *Dhatus* as described in *Ayurveda*.

The word *Dhatu* is derived from the root “*Dha*”, meaning “to support” (*Dharana*) and “to nourish” (*Poshana*). *Dhatus* are the fundamental structural and functional units of the body. Vitamins and minerals act as essential biochemical factors for the proper formation, nourishment, and functioning of these *Dhatus*.

Rasadhatu

Primary function: *Prennana* (nourishment) of the body.

Key micronutrients: sodium, potassium, chloride, B-complex vitamins, and vitamin C.

These nutrients help maintain osmotic balance, acid-base regulation, and circulation of water-soluble nutrients, supporting antioxidant defence and energy metabolism^[4], which aligns with the nourishing function of *Rasadhatu*.

Raktadhatu

Primary function: *Jeevana* (sustaining life through circulation and oxygen transport).

Key micronutrients: iron, copper, folate, and vitamin B12.

Iron forms haemoglobin; copper aids iron mobilization and utilization; folate and vitamin B12 are essential for DNA synthesis and red blood cell formation^[5], mirroring the haemopoietic function of *Raktadhatu*.

Mamsadhatu

Primary function: *Lepana* (covering, protection, and muscular strength).

Key micronutrients: magnesium, potassium, zinc, vitamin B6.

Magnesium and potassium are crucial for ATP production and neuromuscular function; zinc supports cell growth and repair; vitamin B6 is involved in amino acid metabolism and neurotransmitter synthesis, all essential for healthy muscle tissue.

Medadhatu

Primary function: *Snehana* (lubrication) and regulation of fat storage and utilisation.

Key micronutrients: chromium and fat-soluble vitamins (A, D, E, K).

These nutrients contribute to lipid metabolism, insulin sensitivity, antioxidant protection, and storage of fat-soluble vitamins.^[6] *Medo Dhatvagni Mandya* (impaired metabolic activity at the level of *Meda*) can lead to defective lipid utilisation and reduced bioavailability of fat-soluble vitamins.

Asthidhatu

Primary function: *Dharana* (support, structure, and stability).

Key micronutrients: calcium, phosphorus, vitamin D, vitamin K.

Calcium and phosphorus form the bone matrix; vitamin D facilitates calcium and phosphorus absorption and bone mineralisation; vitamin K regulates appropriate calcium deposition in bone, collectively maintaining structural integrity of *Asthidhatu*.

Majjadhatu

Primary function: *Poorana* (filling, particularly of bone cavities) and supporting nervous tissue and bone marrow.

Key micronutrients: phosphorus, iodine, B-complex vitamins, especially B12, and potassium.

Phosphorus and B12 are important for neural function and myelination; iodine supports neurodevelopment; potassium is essential for nerve conduction, corresponding to the neurological functions ascribed to *Majjadhatu*.

Sukradhatu

Primary function: *Garbhaposhana* and *Ojas* formation (reproductive health and vitality).

Key micronutrients: zinc, selenium, vitamin E, and folate.

Zinc is a critical cofactor in DNA synthesis and cell division; selenium and vitamin E have antioxidant roles in protecting reproductive cells^[7]; folate supports gametogenesis and embryo development, aligning with the role of *Sukradhatu* in fertility and *Ojas*.

Dhatvagni Mandya

In *Dhatvagni Mandya* (reduced metabolic activity at the level of a specific *Dhatu*), absorption at the gut level may remain normal, but the capacity of that *Dhatu* to assimilate and utilise vitamins and minerals is diminished. This concept parallels tissue-level metabolic defects, where nutrient intake is adequate but utilisation is impaired.

INTERPRETATION OF MICRONUTRIENTS THROUGH THE LENS OF DHATU SIDDHANTA

The interpretation of micronutrients through the lens of *Dhatu Siddhanta* reveals a striking parallel between *Ayurvedic* physiology and modern nutritional science. Each *Dhatu* from *Rasa* to *Sukra* is not merely a structural entity but a dynamic functional unit whose *Dharana* (support) and *Poshana* (nourishment) depend on the precise availability of specific vitamins and minerals.

Micronutrients act as subtle yet indispensable catalysts that regulate *Dhatvagni*, facilitate proper tissue formation, and ensure sequential nourishment (*Dhatu Parinama*) of all body tissues. Any imbalance or deficiency at this level disrupts *Dhatu* integrity, leading to impaired function, defective metabolism, and ultimately disease manifestation.

Thus, integrating micronutrient functions with *Dhatu Siddhanta* provides a holistic framework in which modern biochemical roles align with classical *Ayurvedic* concepts. This offers deeper insight into personalised nutrition, disease prevention, and the rational use of *Rasousadhi* for restoring *Dhatu Samyata* (tissue equilibrium).

DISCUSSION

Recent reports indicate increasing prevalence of vitamin and mineral deficiencies even among individuals who appear otherwise healthy. Contributing factors include altered dietary habits, reliance on highly processed foods, refined oils, reduced dietary diversity, and changes in agricultural and food-processing practices that may lower nutrient density. In addition, micronutrient status is influenced by multiple factors such as inadequate dietary intake, poor absorption, increased physiological demands, and specific health conditions like irritable bowel syndrome (IBS), Crohn's disease, and chronic anemia.

Conventional synthetic supplements, while useful, frequently encounter limitations related to bioavailability, pH-dependent solubility, competitive mineral interactions, and underlying gut dysfunction. In contrast, *Rasousadhi* are described to act at the level of *Agni* (digestive and metabolic fire), promoting *Agnidipana*

and *Amapachana*, while delivering minerals in highly processed, nano-particulate *Bhasma* forms that may enhance absorption and tissue specificity.

Why Supplements Fail vs Rasousadhi

1. Wrong chemical form and mineral-mineral competition

Divalent minerals such as calcium and zinc are known to compete for intestinal absorption when administered together in inorganic salt forms. High intake of one may reduce the absorption of the other. Synthetic supplements often use such inorganic forms that depend heavily on optimal gastrointestinal pH and intact transporter function.^[8]

In *Rasousadhi*, minerals are processed into organometallic or nano-particulate *Bhasma* forms, often complexed with herbal constituents. These processed forms may reduce direct competition at intestinal transport sites and facilitate better cellular uptake. Thus, formulations containing both calcium and zinc in *Rasousadhi* tradition may exhibit less antagonism compared to unprocessed inorganic salts, although more experimental validation is needed.

2. Missing Cofactors

The absorption and utilisation of many micronutrients depend on the presence of specific cofactors. For example, iron absorption is enhanced by vitamin C. Conventional iron supplements are often given without consistently addressing such synergistic requirements.

In contrast, *Rasousadhi* such as *Loha Bhasma* and *Mandoora Bhasma* are traditionally prepared using *Amalaki Swarasa* or *Nimbu Swarasa* (both rich in vitamin C) during *Shodhana* and *Marana* processes. Many *Mandoora Kalpas* also incorporate vitamin C-rich ingredients in the final formulation, potentially providing an intrinsic source of cofactors and reducing the need for separate vitamin C supplementation.

3. Competitive inhibition in multivitamin formulations

In many multivitamin-multimineral preparations, multiple minerals compete for the same transport pathways, which may reduce individual bioavailability.^[9]

Rasousadhi formulations, though often containing two or more minerals, are processed with *Bhavana Dravya* such as *Nimbu Swarasa*, *Amalaki Swarasa*, *Triphala Kashaya*, etc. These may exert chelating and complexing actions, altering the chemical form of minerals and thereby modulating their absorption pathways. This could help partially bypass direct competitive inhibition, although this concept requires further scientific corroboration.

4. Gut dysfunction and Kshetrikarana

Gastrointestinal pH, mucosal integrity, and motility strongly influence mineral absorption. For example, calcium carbonate requires an acidic environment for

optimal solubility, and hypochlorhydria can significantly reduce its absorption.

Acharyas have described the concept of *Kshetrikarana* in texts like *Ayurveda Prakasha*, recommending preparation of the “field” (gut and tissues) before administering potent *Rasadravya*. This involves the use of *Deepana–Pachana* medicines to correct *Agnimandya*, clear *Ama*, and normalise internal milieu. By restoring gastric function and balancing pH, *Kshetrikarana* can conceptually enhance the absorption and utilisation of *Rasousadhi*-based micronutrients.

CONCLUSION

Micronutrient deficiency remains a significant global health concern despite extensive use of synthetic supplements and food fortification. Limitations such as poor bioavailability, pH - dependent absorption, competitive mineral interactions, and underlying gut dysfunction indicate that merely increasing quantitative intake is insufficient without ensuring proper assimilation and tissue-level utilisation.

Rasousadhi, processed through classical techniques like *Shodhana* and *Marana*, transform minerals into finely processed, potentially nano - particulate *Bhasma* forms with enhanced bioavailability and reduced gastrointestinal irritation. The incorporation of *Bhavana Dravya*—such as *Triphala*, *Nimbu Swarasa*, *Amalaki Swarasa*, or *Ksheera*—imparts specific properties including chelation, potentiation, and organotropism, facilitating targeted *Dhatu* nourishment. The principle of *Kshetrikarana* further emphasises correction of *Agnimandya* and optimisation of the internal environment before supplementation, effectively preparing the “absorption field”.

Interpreting micronutrient physiology through *Dhatu Siddhanta* highlights that effective therapy must address not only intake but also *Dhatvagni* and *Dhatu Poshana*. In this integrative framework, *Rasousadhi* may offer a holistic and potentially superior adjunct or alternative to conventional micronutrient supplementation, by combining *Deepana–Pachana*, improved bioavailability, and tissue - specific action. Nevertheless, further experimental, clinical, and pharmacokinetic studies are required to substantiate these traditional claims and to define their role alongside modern nutritional interventions.

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