

## VITAL TRACE ELEMENTS DEFICIENCY AND ITS FULFILLMENT THROUGH AYURVEDA

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### ABSTRACT

Early in 20<sup>th</sup> century, scientists were able to qualitatively detect small amounts of several elements in living organism. They were found in a very little amount so the name was given as “**trace elements.**”<sup>1</sup> These take part in vital functions of the body especially related to metabolic activities so the name was given as vital trace elements. Only eight trace elements are generally accepted as being essential for health and wellbeing in higher animals through the consumption of food and beverages. These are cobalt, copper, iodine, iron, manganese, molybdenum, selenium, and zinc<sup>1</sup>. Elements such as cobalt, iron, manganese etc and many others are found to be essential part of the food. Any disturbance quantitatively leads to different medical conditions which can be handled through *Ayurveda. Rasashastra* and *BhaishajyaKalpana* is such branch which answers to the catering deficiency of vital trace elements. An attempt is made in this article to identify and use different elements explained in *Ayurveda* in catering vital trace elements and analyzing them in different selected diseases.

**Keywords:** Trace elements, Calcium, Iron, Copper, *Rasashastra & Bhaishjyakalpana*

### INTRODUCTION

In tracing the chemical knowledge among the civilized nations of old one always finds it intimately associated with medicinal preparation and metallurgical operations<sup>2</sup>. Gold, silver, copper and bronze are mentioned in *Rigveda. Rigveda* also mentions a metal based *Ayasa* which is recognised as iron by most of the scholars.

Evidences are found that the people used drugs from all the 3 resources animal, vegetable and mineral resources. Stag horn and cuttle fish bones are found in excavation of Harappa and Mohenjodaro<sup>3</sup>. Indus valley metallurgists used metals such as copper, lead, gold, bronze and silver. Several crucibles of copper slag are discov-

ered which marks the beginning of metallurgy. Most of the beads found are coated with copper glaze which must have been melted in a 1000 degree temperature kiln (Mcintosh) and perforated with thin copper wires<sup>4</sup>. The Indus valley people knew the use of copper, bronze, silver, gold but not iron. Many of the elements were known and named by our *Acharya* some 1000years back and were practically used for the treatment of various diseases. It is well illuminated through *RasaShashtra* and *BhaishajyaKalpana* branch. We find references of usage of drugs especially vital trace elements like *Kanaka* (gold), *Rajata* (silver), *Tamra* (Cooper), *Pravala* etc. And this indicates that the practice of metallic medicine was in vogue during that period itself. We mainly come across the toxicity or scarcity of vital elements. And how do we handle these clinical presentations through *Ayurveda* is the main idea behind this article.

It is estimated that 98% of the body mass of a man made up of 9nm metallic elements. The 4 main electrolytes namely Na, Mg, K and Ca constituting about 1.89%. However, this tiny fraction executes a tremendous influence on all body functions. Most of them mediate vital biochemical reactions by acting as catalyst for many enzymes and proteins.<sup>5</sup>

These trace elements can be classified under *DhatuVarga* and different qualities have been explained. Purification methods, *Bhasmikiranana*, dosage and usage in different *vyadhi* have been explained. Most of them come under *DhatuVarga* and others under *SudhaVargaDravyas*. And we use these to cater the deficiency and sometimes to take out accumulating metals in the body. Few examples for physiological roles of trace elements:

- Iron as a trace element is involved in binding, transporting and releasing oxygen in higher animals.
- Calcium as trace elements is involved in coagulation of blood in bleeding disorders and also imparts structural stability to important biological molecules.

- Sodium and potassium salts are very important to balance electrolytes in the fluids of the body to avoid dehydration and hypotension etc.

Explanation of few vital trace elements in our daily practice:

➤ **Copper (Cu cuprum- Latin name)**

Copper plays a very important role in our metabolism largely because it allows many critical enzymes to function properly. In *Sanskrit* it is called as *Tamra*. It is a famous red colored shining metal. Usually copper is obtained from Copper Sulphate (*tutta*) may be used for preparing *bhasma.Tamra* is *Lavana varjita pancha rasa* mainly *Tikta rasa pradhana*, *gunabeing laghu*, *Sara*, *ushnaveerya* and *Madhuravipaka*. And its main *karma* are *lekhana*, *brihmana*, *Ropana*, *netrya* etc.<sup>6,7</sup>

When we observe copper deficiency we have 2 areas to be concentrate on, those are- Anemia and hypo pigmentation of skin and hair. When anemia is concerned Copper has a selected biochemical function in hemoglobin synthesis, connective tissue metabolism and bond development.

Copper is mainly involved in formation of RBC's, in absorption and utilization of iron. There was also a demonstration carried out that rats fed with copper deficient milk were unable to produce sufficient RBC's. Anemia was corrected by addition of copper- containing ash from vegetables or animal sources. Various factors influence copper absorption and it is enhanced and more easily absorbed in the form of copper salts.<sup>7</sup> Here in *Ayurveda* we have *rasa dhatu* which undergoes *rajana karma* by *ranjaka pitta*. When *ranjaka pitta* not functioning properly then *pandu* that is hypochromic microcytic RBC's are produced because of hampering in *ranjana karma*. *Tamra* may act on this specific *ranjaka pitta* stimulating it for *rasa ranjana karma*.

To cater this deficiency *Vaidya* can use directly *Tamrabhasma*, *Tamra Parpati* and other *Tamrayogas* along with *madhu*, *gruta* etc.

Apart from the skin manifestation especially *shvitra* (vitiligo) where there is melanin depigmentation or loss. Melanin is a natural pigment found in most of the organisms. Tyrosine is a copper containing enzyme which is present in the plants and animal tissues that catalyze the production of melanin. So, deficiency of copper leads to no any catalytic action during production of melanin thus leading to its deficiency. In *Ayurveda* it can be said as reduced *bhrajaka pitta* which has role of *varnya* or gives *varna* to *twacha* which is reduced. So to cater it again we can use, *Tamrabhasma*<sup>6</sup>, *ArogyardhiniVati* which contains *Tamrabhasma* and aids in the synthesis of melanin pigments of the skin. It stimulates the *bhrajaka pitta* and facilitates *varnya karma*. It can be given in the form of *Lepaa* long with *bakuchi* or with normal *gruta* mixed with *Tamrabhasma*. Especially in *shvitraroga Tamra-Parpati* with *vachachurna* is indicated.

#### **Iron: (Fe : latin name ferrum)**

In *Ayurveda* iron is referred as *loha* and many types of *Loha* are found with lots of therapeutic uses. *Tikshna*, *ayas*, *krishna loha* are other synonyms of *Loha*. Iron is present in huge quantities all over the earth crust and also available to a greater extent in the plant kingdom. The total body content of iron is about 3-5gms of which 75% is in blood while rest is in liver, bone marrow and muscles. Heme is the major iron containing substance. It is found in Hb, myoglobin, cytochrome C etc. In our classics it has been stated that *rakta* is *loha* *gandhi* it is synonymously called as *lohita*. This shows the presence of iron in blood and without any investigations this was established by our Acharyas many years back. An average daily requirement of IRON is 1-2gms which has to provide as 20mg of iron in food. Iron is absorbed from food in the form of heme (meat, poultry etc) and non heme (plant based, iron fortified foods) when there is a need and transport form of iron known as ferritin. Metabolism of iron is very unique because it maintains hemostasis by regulating the absorption of iron but not excretion.

When iron stores in body are depleted, absorption is enhanced.<sup>5</sup>

Deficiency of such an important trace element Iron, it causes severe disorders and most important among them is iron deficiency Anemia, Microcytic hypochromic RBC's. Anemia is the second most important cause for the mortality in India. Iron deficiency also includes impaired thermoregulation, immune functions and mental functions such as impaired attention, irritability, lowered memory etc. In olden days around 17th century, a recognised treatment for chlorosis or iron deficiency anemia, was drinking wine containing iron fillings. There may be other conditions also secondary to which there is depletion of iron such as, menstruation in women, diarrhea, IBS and enteritis which account half of Iron deficiency Anemia globally.<sup>5</sup>

Such a deficiency of Iron, an important trace element can be catered through many *loha kalpas* which have 100% benefits and no side effects if it is properly prepared. *Loha bhasma*<sup>6</sup> along with *madhu* or *ksheera* in one *gunja pramana* (125mg) is 1st among them. This has a direct and wonderful effect in increasing Iron content in the body and is claimed as *poshaka*, *balya* and *vrushya* in nature. The very next rich Iron source is *Manduram*<sup>5</sup>/*loha kitta* (Iron oxide/ rusted iron) which is 100 years old. It is *sheeta* in *guna* and *veerya*, *vrushya*, *parama rakta vrudhi kara*. All *mandura kalpanas* such as *Punarnava mandura*, *Mandura vataka*, *Mandura bhasma* along with *purana guda* are the top and rich source of Iron mainly used in *Panduroga prakarna*, *shotha* etc. *Lohasava* is also one of the popular preparation used in reduced Hb% in patients. *Yoga* such as *Dhatri loha*<sup>4</sup>, *darvyadi leha*, *Ayorajadi yoga*, *Ayaskruti rasayana* etc contain *loha* along with herbs which can bring most efficacy to the preparations. In this way by different permutation and combinations of herbs with *loha bhasma* can also be used in daily clinical practice. *Loha* is called "*Rasayanavaram*" by *Rasa Ratna Samuchaya kara* which means the best *rasayana*.

### **Zinc : (Zn latin name: Zincum)**

This trace element is the only one that is found as an essential component in enzymes from all six enzyme classes. A primary homeostatic mechanism for zinc is absorption from the small intestine. In *Ayurveda* zinc is called as *Yashada*<sup>3</sup> or *kharpara* satwa and so called as *kharparaja*. *Naga*, *vanga* and *yashada* are together called as *trivanga*. An average of 15-20mg/ day of zinc is needed by the body and average body content of zinc is 2-3gms in adults. About 99% is intracellular while rest is in plasma. Zinc is essential for normal spermatogenesis and maturation of genomic integrity of sperms, for normal oogenesis, proper functioning of neurotransmitters, for proper epithelialization in wound healing and secretion of pancrease and gastric enzymes<sup>5</sup>. Zinc plays an important role in the cell proliferation, differentiation and metabolic activity of the cell. These take place in the presence of many zinc binding proteins.

Plasma zinc levels are decreased in pregnancy, fluid loss, oral contraceptive usage, blood loss, infections and malignancies. The deficiency symptoms also includes growth retardation, alopecia, dermatitis, anorexia, immunological dysfunction, psychological disturbances, faulty spermatogenesis, increased susceptibility to infectious diseases and delayed wound healing<sup>6</sup>.

In the zinc deficiency, *yashada* supplementation can be done successfully. *Yashada* is *kashaya* and *tikta rasa*, *katu vipaka* and *sheeta virya*. It can be mainly used for the treatment *kapha pitta* disorders especially in suppurative wounds, fatigue, *pratishyaya*, *pandu*, all the *netra vikaras*, parkinsonism, urinary incontinence, *prameha*<sup>9</sup> etc. *Trivanga bhasma* has lot to do with the wounds which don't heal, it enhances wound healing and most of the clinicians have got very good results and faster healing. Most popularly used is *Yashada bhasma* and can be done as *amayika pryoga* such as, *yashada bhasam* along with *swarna bhasma* is used in *yoshapasmara*, *yashada* along with *swarna vanga* its useful in nocturnal urination and urinary

incontinence, *yashada bhasama* along with *rasasindura* and *madhu* is good in depression etc<sup>10</sup>. Apart from these, formulations like *trivanga bhasma* (mentioned before), *swarna malini vasanta*, *yashada bhasma* etc can also be used at the clinical practice to cater zinc deficiency. Some experimental work was also done on *yashada bhasam* against hyperglycemia in animals and its response was found highly encouraging. *Trivanga bhasma*<sup>4</sup> was also proved best against testicular degeneration.

### **Iodine: (iodum)**

Iodine is a vital micronutrient/ trace element required in all stages of life. Iodine is an essential constituent of the thyroid hormones thyroxine  $t_3$ ,  $t_4$  hormones<sup>5</sup>. It also plays an important role in the functioning of parathyroid glands. Iodine promotes general growth and development within the body and as well as aiding the metabolism. Because of its role in metabolism the symptoms of an iodine deficiency can be far reaching. Recognition that iodine was nutritionally important began in 1920 when it was found that iodine prevented goiter.

The deficiency of iodine may cause many effects such as extreme fatigue, slowing of both physical and mental process, weight gain, facial puffiness, constipation and lethargy. Severe iodine deficiency often occurs in the individuals who have thyroid diseases and are hyper thyroid or those who have goiter from thyroid malfunction.<sup>5</sup> It is said that intake of iodine from sea weeds is safe because iodine is organically bound and is not accumulated in the body. In this context *Samudra lavana* is more relevant to discuss. This salt is prepared from sea water by evaporating it through the sunrays. Apart from that all *pancha lavana* can be taken into context.

*Samudra lavana*<sup>6</sup> is slightly *madhura* in *rasa* and *madhura vipaka*, *anushna virya* and *snigdha*, *laghu guna*. It is *hrudya*, *shoolaghna*, *bhedana*, *ruchikara*, *dipana*, *avidahi*<sup>10</sup>. This can be used as the dietary source and can be used in pinches along with the food. In severe fatigue patient it can be

given along with the various panaka kalpana and narikela jala. Different lavana kalpana like *Lavanaashtaka choorna*, *Dadimashtaka choorna*, *Pancha Lavana choorna*, *Sauvarchaladi choorna*, *Bhaskara lavana choorna*, *Narikela lavana* etc *kalpanas* can be made use of clinically in this case especially patients with iodine deficiency induced thyroid disorders.

### **Calcium: (Ca)**

The trace element Calcium is highly important in the development of healthy bones, particularly in young people and pregnant women. It is considered as the clotting Factor IV found abundantly in Bone and absorption from food and Works with many clotting factors for activation of the other clotting factors. It mediates the production of prothrombin again a clotting factor necessary for coagulation.

About 9-11mg of calcium present in Plasma about. It is also present as, 41% non ionized and bond to protein, not diffusible thorough capillary membrane and is not filtered by glomeruli, also 9% is combined with anionic substances like citrate and phosphate, is diffusible through capillary membrane and glomeruli and 50% is both ionized and diffusible through capillary membrane. Calcium apart from forming as essential constituent of bones plays important role is haemostasis. Recommended daily calcium in infants is 500mg and 1gm in adults.

Low levels of calcium in the body may be due to, congenital deficiency of calcium, Low level of calcium in blood due dietary deficiency, Malabsorption from gut, Kidney malfunction or Bone disorder. Deficiency of Calcium can cause demineralised bones in the body and Osteoporosis. This leads to frequent bone fractures and skeleton curvature, and is increasingly common as people live longer. It can also lead to different clotting disorders such as hemophilia scurvey and so on where there is increased clotting time.

In this context we can talk about *sudhavargeeya / shukla dravyas*. *Sudha* means –nectar, honey, comfort, beverage of Gods etc. In *Charaka* and *Sushruta Samhita*, *sudha* [lime] has been included in *parthiva dravya*<sup>11</sup>. Both *Rasaratnakara* and *Rasarnava* mentioned *Shukla varga*. *Rasamritam* mentioned *sudha vergyaneem* based on its chemical composition. *Sudha vargiya dravya* has chief compound CALCIUM in the form of calcium carbonate, calcium fluoride, calcium sulphate. Purification of these *sudhavargiya dravya* is of utmost importance because they are alkaline in nature. To reduce this alkalinity they made *shodhana* in *Amla rasa* (acidic medium) *dravyas* to reduce excessive alkalinity.

*Sudhavargiya dravyas* can be group of *shonita sthapana* *dravya* probably because of following reasons: these *dravyas* are more of *parthiva guna* and most of them are *sheeta virya*. In case of *raktapitta* (haemorrhage inside the body without any external impact) there is *sara guna vrudhi* of both rakta and pitta so here *sthambana chikitsa* is necessary. Opposite to *sara guna* there is *parthiva guna (sthira guna)* and *sheeta guna (sthambhane himaha)* which helps in *sthambana* of *shonita*. There are also *ushnaveerya dravyas* which are *sthambana* may be due to *prabhava* which are useful in *saama rakta* condition (conditions like thrombosis along with bleeding ex: infarcts) where both *pachana* and *sthambana* effect is needed like *karpardika bhasma* etc. In view of all these facts *sudhavargiya dravyas* are useful in management of coagulation disorders/bleeding disorders with calcium deficiency successfully in clinical practice.

Some of the *sudhavargeeya*<sup>6</sup> *dravya* are *kapardika*, *Shankha*, *Shukti*, *Mrigashringa*, *Kukkutanda twak*, *Samudraphena*, *Ajasthi*, *Pravala*, *Moutika*, *hastidanta Aja dughda* which are animal source, *bhasma* of all these can be used as the source of calcium in the clinical practice and are found very effective as natural calcium preparations like *bhasma* are more effective than synthetic calcium. Plant source such as *Vamsalochana*, *Vasa*, *Na-*

gakesara, Arjuna, Plaksha, Bilwa, lodhra etc. Apart from these mineral source *godani bhasma*<sup>4</sup>, *khatika*, *sudha* are rich in calcium can be used as the calcium supplements for calcium deficiency. Commonly used preparations for the *sthambhana* of jeeva rakta like *Bolabadha rasa*, *Chandrakala rasa*, *Pravala panchamruta rasa*, *Vasanta kusumakara rasa*, *laghumalini vasanta* etc.

We have extra added effects by practicing bhasma as it helps in correcting the *agni* (by clearing indigestion), having properties like an antacid, can aid in healing ulcers, soothen the environment in the stomach and so on.

## CONCLUSION

Trace elements also known as trace minerals, are the chemical components that naturally occur in soil, plant, and wildlife in minute concentrations. They are necessary for the optimal development and metabolic functioning such as proper cell metabolism, effective immune function, and healthy reproduction of humans. Deficiency of such trace elements can be certainly catered through *Ayurveda* and wonderful results can be obtained through permutation and combination of *kashtoushadhi* and *rasoushadhi*. Here only selected few trace elements and their deficiencies have been mentioned but the same concept can be applied for all the other trace elements and we can make an effort to find out more and more in our classics. Ultimately its all about treating the disease with out any hindrance and side effects.

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