



Review Article

USED PATTERN OF METALS AND MINERALS IN ASHTANG HRIDAYA: - THE BIRDS EYE VIEW

Dattatray Dighe^{1*}, Kshirod Kumar Ratha¹, Purnendu Panda¹, Aswani P S¹, M. M. Rao²

¹Research Officer (Ayurveda), ²Director, Central Ayurveda Research Institute of Hepatobiliary Disorders, Bharatpur, Bhubaneswar.

ABSTRACT

Human evolution and progress has count mainly on the discovery of metals. Primitive man used metals first time for making apparatuses and weaponries; as the information advances metals played a significant role in development of agriculture, transport arts, crafts and health care. Ayurveda have faith in the principle of 'Yat Pinde Tat Bramhande' and therefore all these naturally occurring metals and minerals have major role in restoration of human health and treatment of any kind of illness. Classical treatise Ashtanga Hridaya is a very popular book among the physicians among south India. In this classic, eight types of *Dhatu* (metals), varieties of *Ratna-Uparatna* (precious stones and minerals) are mentioned for different purposes. Here an attempt is made to collect all these information of metals and minerals in a collective form to analyse their used pattern in therapeutic, Diagnostic (*Nidana Panchaka*), Pharmaceutical Benefits, *Dincharya/ Pathya-Apathya*, *Panchakarma* and Surgical/Para Surgical Procedure. All these metals and minerals are used in different formulations like *Sneha* (Oil &Ghee), *Sandhana* (Fermentation), *Churna* (powder), *Vati* (tablet), *Lepa* (Coating powder) & *Anjana* (Collyrium). Human body is composed of almost every natural element found in nature and our civilization is completely reliant on metals and the science of metallurgy is now one of the most widely documented and researched material science.

KEYWORDS: Ashtang Hridaya, Dhatu, Metal, Mineral, *Shilajit*.

INTRODUCTION

The originator of Ayurveda, Lord Dhanvantari holds Conch cell (*Shankha*, *Jaluaka* (leech), *Amrit Kalash* (Pot filled with nectar) and *Chakra* in his hands implies he has three metals in his hands, which enlightens the intimacy of metals and minerals in Ayurveda. Human civilization and development have relied mainly on the discovery of metals. Prehistoric man used metals first time for making tools and weapons as the knowledge advances, metals played an important role in advancement of agriculture, transport and arts and crafts.¹ Ayurveda is life science and it is based on principle of *Panchamahabhuta*, *Dosha*, *Dhatu* & *Mala*. It reckons to heal the body on the principle of 'Yat Pinde Tat Bramhande' and therefore most of the metals and minerals play major role in Ayurveda for longevity of human being. Metal is a solid material which is characteristically hard, glittery, malleable, fusible and ductile with good electrical and thermal conductivity². It is a substance out of which a person or a thing is made³. Same definition is also quoted in Ayurveda, that the constituents which are the basic component in building of the human body is termed as *Dhatu* i.e. "Shareera Dharanat Dhatava Uchyate" (*Sushrta Sutrasthan*). There are seven types of *Dhatu*

mentioned in Ayurveda and they are also called as *Dushya* since they tends to be vitiated by imbalanced *Doshas*. Minerals are naturally occurring inorganic substances with certain and predictable chemical composition and physical properties (O Donoghue, 1990). It has been formed as result of geological processes⁴. Metals are not only useful for therapeutic purpose, but also used for diagnostic and pharmaceutical procedures. *Ashtanga Hridaya* is a very popular treatise among the practitioners, has cited various metals, precious stones and minerals in it for different purposes. The present review dealt with the use pattern of metals and minerals cited in *Ashtanga Hridaya* with special reference to their pattern and mode of used as therapeutic, diagnostic, pharmaceuticals and prognostic measures. Most of the *Yantras* (Pharmaceutical equipment) are prepared from metals preferably from Iron or any suitable one. (A.H.S 25/4-S.Su 7/7). They are useful for examination of the patients, like in *Bhagandara Eshani Yantra* used (A.H.U 28/25).

Etymology: *Vali Palit Khalitya Karshya Balya Jara Mayan, Nivarya Dadhate Deham Nrushnam Tad Dhatavo Matah (Ayurveda Prakash 3/2)*.

The word *Dhatu* derived from the word 'Luh'; and *Loha* which is generally used for all types of metals. In Vedas six types of metals are mentioned. In Ayurveda, among Brihat Trayees Charaka and Susruta mentioned eight types of metals in different sections of their respective texts; *Vagbhata* also mentioned eight types of metals in his text *Ashtang Hridaya*. In *Rasahridaya Tantra* nine types of metals are categorized under three categories i.e. *Saraloha*, *Sattvaloha* and *Putiloha*. *Vagbhata* in *Rasaratna Sammucchaya* categorized nine metals under three categories i.e. *Shuddha Loha*, *Puti Loha*, *Mishra Loha*⁵.

Metals and Minerals from history to current trend

Prehistoric man were using six metals i.e. Copper, Gold, silver, Iron, Tin, Lead and each with distinct properties⁶. The Egyptians have used copper to sterilize water in 3000 BC, the Chinese used gold in medicine in 2500 BC and Hippocrates was using many metals such as Cu, Fe, Zn, Na, K to cure diseases⁷. Today our civilization is completely reliant on metals and the science of metallurgy is now one of the most widely documented and researched material sciences⁸.

Human body is composed of almost every natural element found in nature. In astronomy, a metal is any element other than hydrogen and helium and they only contribute 2% of the atomic matter in the universe and 75% is hydrogen and 23% is helium. All these metals and elements have essential role in the body functioning such as formation of blood, bones, teeth, and other tissues; osmoregulation of body fluids, and the control of physicochemical process. Some of these elements are required in trace amounts. These metals are generally found in typical and diverse diet. If human body is low or high concentration in specific metals this can create different types of problems and disease⁹. The various uses of metals and minerals in today practices are: Iron, Zinc and Copper deficiency in body is responsible for anemia. Technetium in imaging purpose; Iron, Manganese in contrast imaging; Cobalt in tumor locations in diagnostic purpose; Platinum for tumor, Gold salts for rheumatoid arthritis, Lithium manic depression behavior, Zinc tropical in wound healing, Silver in burn cases, Gold, silver Copper ligand having anticancer properties; Bismuth in antacids; Lanthanum in Chronic kidney diseases.¹⁰

Classification of Metals and Minerals in Rasagranthas (Indian alchemy/Ayurvedic Pharmaceutics)¹¹

Classification of metals and minerals in Ayurveda is very vast and there are different opinions of different scholars in their classification

and enumeration. The wide and most acceptable classification in Ayurveda is;

Maharasa Dravya: 1) *Abhraka* (Mica) 2) *Vaikranta* (Tourmaline/ Flurospar) 3) *Makshika* (Copper pyrite/ Iron pyrite) 4) *Vimal* (Iron pyrite) 5) *Shilajatu* (black bitumen or mineral pitch) 6) *Sasyaka/Tutha* (Copper sulphate or blue vitriol) 7) *Chapal* (Bismuth) 8) *Rasak* (Zinc Carbonate).

Uparasa: 1) *Gandhak* (Sulphur) 2) *Gairika* (Ochre-Fe₂O₃) 3) *Kasia* (Ferrous Suphate- FeSO₄ & H₂O) 4) *Sphatika* (Potash Alum- K₂SO₄Al₂(SO₄)₃24H₂O) 5) *Haratal* (Yellow Arsenic -As₂S₃) 6) *Makshila* (Realgar-As₂S₂) 7) *Anjana* (Collyrium) 8) *Kankushtha* (Gambose tree extracts).

Sadharana Rasa: 1) *Kampillaka* (*Kamila*-Mallotus Philoppinesis) 2) *Gauripashan* (Arsenic-As₂O₃) 3) *Nausadar* (Ammonium Chloride-NH₄Cl) 4) *Kaparda* (Coweries-CaCO₃) 5) *Agnijar* (Amber) 6) *Hingul* (Cinnebar-HgS) 7) *Mriddarshringa* (Litharge-PbO) 8) *Girisindoora* (*Sandigdha*).

Metals (Dhatu): 1) *Svarna* (Gold), 2) *Rajat* (Silver), 3) *Tamra* (Copper), 4) *Kantaloha* (Iron), 5) *Naga* (Lead), 6) *Vanga* (Tin) 7) *Pittal* (Brass) 8) *Kansya* (White Copper) 9) *Varta/Panchaloha* (Bronze) 10) *Yashad* (Zinc).

Ratna (Precious Stones): 1) *Manikya* (Ruby) 2) *Mukta* (Pearl) 3) *Vidruma* (Coral) 4) *Tarkshya* (Emerald) 5) *Pushkaraj* (Topaz) 6) *Bhidura* (Diamond) 7) *Neelam* (Sapphire) 8) *Gomeda* (Zircorn) 9) *Vaidurya* (Cats Eye).

Uparatna: 1) *Suryakant* (Sun Stone) 2) *Chandrakant* (Moon Stone-KAlSi₃O₈) 3) *Rajavarta* (Lapis Lazuli-Na₄(S₃AlOAl₂(SiO₃)₃) 4) *Spahatik* (Rock Crystal-SiO₂) 5) *Pairojaka* (Turquoise-H₅{Al(OH)₂}₆Cu(OH)(PO₄)₄) 6) *Vyomashma* (Jade) 7) *Nagapashan* (serpentine-H₄Mg₃Si₂O₉) 8) *Kousheyashma* (Silicate Magnesium) 9) *Dugdhapashan* (Magnesium Silicate) 10) *Trinakanta* (Succinum) 11) *Akeeka* (Agate-SiO₂).

Shukla Varga/Sudha varga: - 1) *Godanti* (Gypsum-CaSO₄2H₂O) 2) *Badarashma* (Silicate of Lime) 3) *Mrugashringa* (Harts Hurn) 4) *Shankha* (Conch Shell) 5) *Shukti* (Peral Oyster) 6) *Khatika* (Chalk) 7) *Tankan* (Borax) 8) *Varatika* 9) *Kukutanda Tvaka* (Egg Shells).

Importance of Ashtang Hridaya and History

Ashtang Hridaya has earned its right place among the great treatises of Ayurveda because it covered all eight branches and topics arranged in chronological order, precepts and practice of Ayurvedic sciences are narrated clearly. Greater portion and focus is devoted to internal medicine and only brief reference to surgery. It is not just compilation of Charaka, Sushruta and Ashtang Sangraha but is ideal ancient treatise based on eternal fundamentals and basic principles¹². It also

incorporates the opinion of other prominent scholars of that era apart from the Charaka and Susruta and presented them in a very systematic way. It is more popular and practiced in South India¹³. Charaka and Sushruta described the things in general, Vagbhata give stress on some important facts like *Raktamokshana* in *Raktaja* diseases; *Basti* treatment in *Vatavyadhi*; *Shilajatu* use for long duration for *Rsayana*; *Agrya Dravyas* description etc.

Metals and Minerals Mentioned In *Nidana panchaka*¹⁴

Vata Pittaj Bhagandara Pitika (boil) is Copper (Tamra) in color (A.H.U 28/9). If the *Svarna Kalasha* (gold vessel) seen by physician either on the way or at the time of entering the house of the patient is the signals of good health. (A.H.Sha 6/30). Dreaming of acquiring Gold or Iron is considered injurious to health (A.H.Sha 6/53). Feeling of Iron Clenching smell is a symptom of forthcoming disease (Prodrome) of *Raktapitta*. (A.H.N 3/5). Trauma due to metallic weapon caused by cutting, splitting, hitting, etc. may be responsible for formation of *Shotha* (inflammation) and *Visarapa* (cellulitis); known as *Abhigataj* (traumatic) *Shotha* and *Abhigataj Visarpa* respectively. (A.H.N 13/38 & 65). Lesion at perianal lesions due to vitiation of *Rakta* and *Kapha dosha* are copper (*Tamra Varna*) in colour and named as *Ahiputana* or *Matrukadosha*. (A.H.U 2/69-70). The child/adult seized by the *Graha* is found of pleasant intimacy to wear ornament and this condition is difficult to cure (A.H.U 3/37). *Anjananamika Pidika* either in the middle or at the ends of the eye lids due to *Rakta Dushti* looks like copper in color. (A.H.U 8/14). Generally, *Timira* resulted from *Kapha dosha*, the afflicted person sees the object as unctuous, white, as that of a Conch shell (A.H.U 12/17).

In growth of worms in the head, (*Krimija Shiroroga*) coppery and thin nasal discharge seen as one of the symptom (A.H.U 23/12-14). Ulcer (*Raktaja Vrana*) caused by *Rakta* is looks red like the Coral. (A.H.U 25/10). and Iron smelling of the mouth is observed as one of the sign when organs of the trunk are wounded/injured (*Bhinna Vrana*) (A.H.U 26/32). According to Sushruta the anatomical structural shape of the vagina is like *Shankha Nabhi* (Conch shell) (A.H.U 33/27).

Metal and Minerals Advised in *Dincharya/ Pathya-Apathya*¹⁴

One should always wear precious stones (*Ratnadharan*) and potent hymns and herbs (*Mahaaoushadhi Dharan*) for prosperity (A.H.S 2/31). One should wear Pearl and beads of *Harichandana* in *Greeshma* season. (A.H.S 3/38). Use garlands of Pearl are advised in night time during autumn (A.H.S 3/53). The person who has consumed poisoned food

should be administered with purification therapies of upward and downward routes (emesis and purgation) and then made lick fine powder of Copper (*Tamra Bhasma*) with honey at the proper time, to purify the heart; after thus purifying the heart fine powder of Gold (*Svarna Bhasma*) one *Shana* in quantity should be administered to him. In the body which has partaken gold in this way the poison does not adhere just like water in lotus leaf. By this the life of person becomes long (A.H.S 7/27-28). Ghee kept for more than ten days in Bronze vessel, should be avoided and considered to be poisonous. (A.H.S 7/37). The person who takes alcohol ensuring the all suitable comforts should indulge in which mentioned alcohol taken into vessels made of rock crystal or oyster shells. (A.H.Chi.7/82). On completion of tenth day *Sutikothana* ceremony should be performed in accordance with customs of the family; anointing (*Lepa*) the baby with *Haratala*, *Manashila*, *Gorochan*, *Agaru*, *Chandana*. (A.H.U 1/22-23). In *Karnavedhana* procedure the piercing instruments which is used; is metallic and preferably a gold ring. (A.H.U1/29-31). Gold (*Hema*), *Shweta Vacha* & *Kushtha*; *Arkapushpi* & Gold (*Kanchan*); Gold (*Hema*), *Matsyakshi* & *Shankha*; Gold (*Kanak*), *Kayaphal* & *Vacha*; these four groups of drugs mentioned in each quarter verse, consumed mixed with honey and ghee, taken for a period of one year bestows good body growth, intelligence, strength, complexion and goodness (A.H.U 1/47-48). In general procedure of treatment in *Graha Avesha* for *Homa Bali Gems* (*Ratna*) and garlands are being advised to wear according to specific evil. (A.H.U 5/23). For the *Yaksha Graha*, Gold (*Hiranya*) should be offered as oblations along with other dugs mentioned in Bali procedure. (A.H.U 5/34). After the digestion of *Madira* with Garlic juice boiled rice made from old *Sali* (a type of paddy) which is white like Conch shell, jasmine, moon should be consumed with milk or juice of animal meat. (A.H.U39/123).

Metals and Minerals Used For Pharmaceutical Process¹⁴

In *Kshara* Preparation Iron Vessel is advised to use universally (A.H.S 30/15). *Maricha Tamalapatra*, *Kushtha*, *Manashila Kasisa* powder are mixed with oil and kept in Copper vessel for seven days. It is then applied to the skin and patient asked to bask in sun (A.H.Chi 19/73-740). For Therapeutic purpose *Bhringaraj* fried in oil in an Iron vessel should be consumed in *Shvitra* (Vitiligo) (A.H.Chi 20/8). In *Vatashonita* treatment, prepared paste of the drugs is advised to apply over Iron vessel in the morning and consumed in the midday (A.H.Chi 22/16-17). In *Pakshmathata* treatment powder of *Pushpakasisa* is soaked in the juice of *Tulasi* kept in a Copper vessel. After ten days it is used as a collyrium

in *Pakshmathat* (A.H.U 9/20). In preparation of *Mahanila Gutika*, *Tamra* Vessel is used for applying the prepared *Kalka* on it (A.H.U 11/41). In *Videhapati Nirmita Anjan* preparation it is advised to store the prepared *Kalka* in Conch Shell (*Shankha*) (A.H.U 13/27). A Lead (*Sisa*) rod is heated and immersed in the decoction of *Triphala*, juice of *Bhringaraja*, *Savisha*, ghee, goats milk, and decoction of *Yashti* separately in each; then the rod applied into the eyes with collyrium or without a collyrium, cures the eye diseases. (A.H.U 13/34-35). *Jivanti Taila* is advised to prepare in Iron vessel and also allowed to remain store in the Iron vessel itself for one month for the treatment of nasal medication (A.H.U 13/51-53). In wick perpetration, paste of drugs includes *Vaidurya*, *Mukta* is applied over thin Copper sheet and kept for 7 days. Next it is taken out and macerated with goat's milk then shade dried and used as collyrium (A.H.U 14/31). Collyrium made out of *Strotanjana*, *Vidruma*, *Manashila*, *Samudraphena* and *Maricha* is similar in action and mode of preparation as *Pindanjana Varti* (A.H.U 14/32). Silver sheets are used for wick preparation and it is used in *Vataja Adhimantha* (A.H.U 16/22). Iron vessel is used for collyrium storage (A.H.U 16/30). Iron, Copper and Bronze vessels are used in different formulations and preparatory procedures of Eye diseases. (A.H.U 34-38). In *Talisadi Gutika*, preparation Copper sheets are used to apply the paste of drugs over it (A.H.U 16/41). Paste of *Tutha* and other drugs with *Kanjika* (Sour gruel) is kept in Cooper vessel for some days and then used for *Seka* (compression) in eye care (A.H.U 16/48). Powder of *Pushpakasisa* soaked in the fresh juice of *Tulasi* and pasted on a Copper plate for ten days used as collyrium to cure *Pilla* and *Pakshmathat* (A.H.U 16/55). *Yavagu* fermented for 3 days with the addition of *Masha*, *Kodrava*, *Dhanyamla*, and made predominant with *Loha Shuklotkalta* imparts color even to the crane (A.H.U 24/43). Paste of *Pippali* should be smeared to the interior of an Iron vessel, which is filled with water and kept overnight. Next morning two Anjali of this water should be consumed. If it continued for one year, the person will be indulging in foods and drinks of his liking (A.H.U 39/103). In preparation of *Shunthi Rasayana and Shilajit Shodhana* Iron vessel is used for procedure (A.H.U 39/104-06, A.H.U 39/133). In *Narasimha Ghrita* preparation Iron vessel is recommended for use. (A.H.U 39/169)

Metals and Minerals Used For *Panchakarma* Procedure¹⁴

Vasti netra (enema nozzle) should be made up of Gold (*Hemadi*) or other suitable metal according to the purpose and feasibility. (A.H.S 19/9). *Uttarbasti* nozzle should be twelve *Angula* in length

and its mouth (at the lower part of tip) should be capable of permitting a grain of mustard; smooth, made from Gold and or other metals (*Hemadisambhavam*). Gold and other metals should be used for preparation of external part of *Uttarbasti Netra yantra* (A.H.S 19/72). The smoke apparatus (*Dooma Yantra*) should be prepared from Gold (*Hemadi*) or any other suitable metal (*Bastinetra Sama Dravya*) (A.H.S 21/7). In *Teekshna Dhooma Dravya*, the useful drugs are *Jyotishmati*, *Nisha*, *Dashmoola*, *Manashila* (*Manovha*), *Haratal* (*Aal*), *Laksha*, *Apamarga*, *Triphala*, substances which have strong smell and drugs of *Murdhavirechan* properties (A.H.S 21/18). A metal rod, ten *Angula* in length thin in the middle, with tip resembling a flower of bud is best suited; made up of Copper (*Tamri*) for *Lekhana*, Iron (*Kal-Loha*) for *Ropana*, Gold (*Svarna*) & Silver (*Raupyaja*) for *Prasadana* (A.H.S 23/12). *Lekhana Putapaka* is by making use of *Mastu* (water of yogurt) macerated with paste of liver of animals and birds, Pearls (*Mukta*), Iron (*Ayas*), Copper (*Tamra*), *Saindhav*, Antimony Sulphide (*Strotanjan*), Conch shell (*Shankha*), Seafoam/cuttlefish (*Samudraphena*) and *Hartal* (*Aal*) (A.H.S 24/15). *Manashila* (*Manovha*), *Saindhava*, *Pippali* and oil are made into collyrium (eye salve) and applied in *Vishmajwara* (A.H. Chi. 1/161). Smoke of *Manashila*, *Aal*, *Madhuka*, *Mamsi*, *Musta* and bark of *Ingudi* together inhaled in a prescribed procedure as *Kasaghna Dhooma* (Anti cough inhalation) (A.H.Chi. 3/68). *Manashila* is used in *Dhoomapana* (Inhalation) Yoga along with *Palasha* leaves, *Tualsi* leaves, *Tvak* & *Sunthi* (A.H.Chi. 3/149). *Manashila* mentioned in *Dhoomapana* Yoga along with fresh sprouts of *Vata* and ghee (A.H.Chi. 3/150). Leaves of *Haridra*, root of *Eranda*, *Laksha*, *Manashila*, *Devadaru* and *Jatamansi* are made into paste and *Dhoomvarti* is prepared. It should be lubricated with ghee and smoked. (A.H.Chi.4/10-13). *Tutha* is one of the ingredient in *Arshanashak Lepa* along with other drugs in treatment of haemorrhoid (A.H.Chi. 8/22-23). In *Vamana Virechana Vyapada* for *Jivadan Chikitsa*, *Shvetanjana Bhasma* is one of the ingredients in *Vasti Dravyas*. (A.H.K 3/35-38). In *Matrukadosha* after *Vrana Parisechana*, paste of *Kasisa*, *Gorochan*, *Tutha*, *Manashila*, *Haratal* and *Rasanjana* macerated with any sour liquid should be applied; or the powder of *Yashti*, *Shankha*, *Souveeranjana*; or *Sariva* & *Sahankhanabhi*; may be sprinkled on *Vrana* (A.H.U 2/72-74). *Taila Paka* prepared from *Hingvadi Varga* containing *Haratal* (*Aal*) and *Manashila* (Nepali) is used for internal use as well as for *Nasya karma* and same drugs can be used for *Dhooopana*, *Lepana*, *Anjana*, *Parisechan* purpose in *Bhutonmada* and *Apasmar* treatment (A.H.U. 5/2-7). *Anjana* prepare with *Sita*, *Manashila*, *Elavaluka*, *Saindhav Nafara*, *Tarkshya* mixed with

honey useful in *Timira* (A.H.U 11/24). Any type of Gems, teeth, horns, Metals, drugs which cure ulcers, should be used as collyrium in *Shuklagata netra roga* (A.H.U 11/36). In *Shuklaharshan* treatment eye salve prepared from *Shankha*, *Kola*, *Kataka*, *Draksha*, *Madhuka*, *Makshuka*, *Sura*, *Danta* and *Shirish* flowers are used as *Anjana* (A.H.U 11/44). *Shankha* and *Samudraphena* are also used in *Anjana* formulation (A.H.U 11/46-47). *Lohabhasma* is used in *Anjan Varti* preparation (A.H.U 11/49-50). *Haratal* is mentioned in *AnjanaYoga* with other drugs. (A.H.U 11/34-54)

Tamra Bhasma, *Lohabhasma*, *Roupyabhasma*, *Svarnabhasma*, *Vaidurya*, *Mouktika*, *Shankha* are mentioned in context of *Churnajana* preparation and used in *Timira* treatment (A.H.U 13/20-22). *Tutha* cooked in fire and soaked into cow's urine, juice of fresh cow dung, fermented rice wash, breast milk, ghee, *Visha*, and honey are advised to use separately for many times as collyrium, to improve the eye sight of human being like that of eagle.(A.H.U 13/33). In *Anjana yoga Vidruma*, *Manashila*, *Samudraphena* are used along with other drugs and prepared Kalka is applied over copper sheet for 7 days (A.H.U 14/32). In *Vidalak* preparation *Svarna Gairika* mentioned as one among the ingredient (A.H.U 16/20). *Ghoshha* (*Trikatu*), *Abhaya*, *Tutha*, *Yashti*, and *Lodhra* are tied into bundle with a thin cloth and immersed in *Dhanyamla* (fermented wash of grains) and kept in a Copper vessel for overnight and it is useful to alleviate different kinds pain of the eyes (A.H.U 16/7). Buds of *Sumana*, *Shankha*, *Triphala*, *Madhuka*, and *Bala* made into a *Varti* (wick) macerating with rain water cures *Adhimantha* caused by *Pitta* and *Rakta* (A.H.U 16/23). *Varti* prepared with *Saindhava*, *Triphala*, *Trikatu*, *Shankhanabhi*, *Samudraphena*, *Aileyak* and *Sarja* cures the eye diseases caused by *Kapha*. (A.H.U 16/24). *Nadi Vrana* (Sinus ulcer) caused by *Kapha* is treated with application of the paste of *Tila*, *Saurashti*, *Dantimoola*, *Nimba* leaves, and *Saindhav* (A.H.U 30/34). Application of paste of *Mukta* is best to cure swelling, pricking pain, burning, and fever in insect bite (A.H.U 37/27). Pill prepared with *Hingu*, and *Haratal* along with the juice of *Matulunga*, used for application on the bite and collyrium is useful to remove the scorpion poison (A.H.U 37/35). In *Talupaka* which is unripe in nature the site should be rubbed with the paste of *Kasisa*, Honey and *Tarkshya* (A.H.U 22/51). In *Indralupta* the vein nearest to the site should be cut and the patch should be scratched well and then covered with the paste of *Kasisa*, *Manovha*, *Tutha*, *Maricha* (A.H.U 24/28). Paste of *Danti*, bark of *Chitramula*, *Snuhi* *Ksheer*, *Arka Ksheer*, *Jaggery*, *Bhallatakashthi* and *Kasisa* are used for external application in tumor which arising from *Kapha*. (A.H.Chi. 18/26)

Metals and Minerals Used in Surgical/Para Surgical Procedure¹⁴

Sharp instruments should be prepared by a skilled metal smiths from a well blown strong steel like Iron (*Teekshna Varti Ayas*), in accordance with traditional method. (A.H.S 26/2). Rod made of Copper (*Tamri*), with two faces shaped like the bud of *Kurabaka*, meant for piercing the lens in Cataract couching (A.H.S 26/13). Those metallic weapons (*Ayaskanten*) without earlike projections, which have created a wide opening in the body and lodged straight, can be removed by making use of magnet (A.H.S 28/34). In diseases like black moles, weakness of body parts, headache, *Adhimantha*, warts, cysts etc. burning of the skin should be done either with lighted wick, tooth of cow, rock crystal (*Suryakant Mani*) arrow head or others {Iron rod, *Pippali*, excreta of goat etc.}(A.H.S 30/41). In case of *Samyaka Dagdha* a paste of *Tvakshiri*, *Plaksha*, *Chandana*, *Gairika* and *Amrita* is mixed with ghee and should be applied on the burn (A.H.S 30/51). In case Post-operative *Medoja Vridhi* oil prepared with *Manashila*, *Ela*, *Tulasi*, *Piipalimula*, *Bhallataka* is used for healing by *Snheha* and *Sweda* (A.H.Chi. 13/38). Administration of Black bitumen (*Shilajit*) or Iron pyrite (*Svarna Makshik*) with honey is advised internally and *Agnikarma* by Iron (*Aya*), Gold (*Hema*), salt, stone etc. for *Granthi Bhedana* purpose (A.H.Chi 18/28-31). Skin patches which are static, greatly insensitive, non-perspiring and itching should be rubbed first either with powder of dry cow dung, cattle fish/seafoam (*Phena*), or with sharp instruments and then warm paste applied over (A.H.Chi. 19/58). In *Vartma Roga* treatment, after scrapping procedure Cuttle fish (*Samudraphena*) is used to wash the excluding blood (A.H.U 9/6). In *Utsanga* and *Anjananamika*, followed by fomentation and pricking of the lesions and removal of its content powder of *Manashila* (*Shila*), *Saindhava*, and *Nata* with honey are applied. (A.H.U 9/24). In *Kaphotklishta* cases, after doing the scrapping, fine powder of *Sanidhava*, *Kasiasa*, *Manashila* (*Manovha*), *Pippali* and *Tarkshya* mixed with honey is applied (A.H.U 9/23). Overgrowth of soft muscle tissue should be reduced using paste of buds of *Jati*, *Kasisa*, *Manovha*, *Haratal* (*Aal*), *Guggulu* and *Chittrak Moola* (A.H.U 25/48). For fracture of the waist, forelegs and thighs, it is beneficial to lie on a hard-wooden box fitted with five pegs (may be of Iron peg) to support and immobilize the fractured portion (A.H.U 27/27). Fistula which opens into the interior should be explored by a probe (Metallic) and then cut with the knife (Metallic) (A.H.U 28/25). *Tilakalaka* and *Mashaka* should be burnt by either Sun stone (*Suryakant*), *Kshar* or fire (A.H.U 32/13). In poisonous weapon injury it should

be pulled out and the wound should be burnt with heated Iron rod (A.H.U 35/45). Except in the bite of *Mandali* snakes, in the all others, the site of the bite should be burnt with heated rods of Gold (*Hema*), Iron (*Loha*) (A.H.U 36/45).

Metals and Minerals Used For Therapeutic Purpose

Tamra, Suvrana:- *Vishajanya Vikara* treatment (A.H.S 7/27). Wearing of precious stones and garlands are advised in general treatment of aggravated *Pitta dosha* (A.H.S 13/5). *Shilajit*:- *Sthoulya* treatment (A.H.S 14/23). Gold, Silver or even Iron: - *Punsavana Vidhi* (A.H.Sh 1/38). *Manashila*:- *Chardi* Treatment (A.H.Chi 6/18-21); *Tarkasya, Shankha*:- *Atisara Chikitsa* (A.H.Chi 9/57-59, 9/91); *Pravala, Ushakadi Gana, Shilajit*: *Mutrighat* treatment (A.H.Chi 11/13, 11/25-26); *Shilajit, Ayaskriti*:- *Prameha Chikitsa* (A.H.Chi 12/29-35,43); *Shilajit*:- *Vidradhi Chikitsa* (A.H.Chi 13/25); *Shilajit*:- *Gulma Chikitsa* (A.H.Chi 14/51); *Ayaskriti*:-*Udara Chikitsa* (A.H.Chi. 15/74); *Shilajit, Suvarnamakshika*:- *Kumbha kamala Chikitsa* (A.H.Chi.16/52); *Loha, Shilajit*:- *Shotha Chikitsa* (A.H.Chi 17/1-3); *Shilajit*:- *Kushtha Chikitsa* (A.H.Chi 19/48); *Shilajit*:- *Vatavyadhi Chikitsa* (A.H.Chi 21/49); *Shilajit*:- *Vatashonit Chikitsa* (A.H.Chi 22/65); *Tamra, Loha*:- *Kukunak Chikitsa* (A.H.U 9/32); *Shankha, Samudraphena, Tamra*:- *Shukra Dosha Chikitsa* (A.H.U11/35); *Svarnamakshika, Loha, Svarna*:- *Timira Chikitsa* (A.H.U 13/36); *Manashila*:- (A.H.U 16/50); *Samudraphena*:- *Kaphaja Karnashoola Chikitsa* (A.H.U 18/14); *Manashila, Haratal*:- *Arsha Arbuda* treatment (A.H.U 20/24-25); *Tutha*:- *Dantachala Chikitsa* (A.H.U

22/15); *Kasisa*:- *Krimidanta Chikitsa* (A.H.U 22/21); *Loha*:- *Palitya Chikitsa* (A.H.U 24); *Loha*:- (A.H.U 34/54); *Suvarana Makshika, Suvarna Bhasma*:- *Visha Chikitsa* (A.H.U 35/56); *Manashila*:- (A.H.U 36/82); *Ratnapushpa Dharana*:- A.H.U 36/91-92).

Metals and Minerals Under The Classification¹⁴

While describing the *RasaSkandha* A.H mentioned Gold (*Hema*) in *Madhura Skandha*, Silver (*Rajata*) in *Amlaskandha*, Bronze (*Kansya*)& Iron (*Ayas*) in *Tikta Skandha*, Pearl (*Mukta*), Coral (*Pravala*), *Anjana, Gairika* in *Kashaya Skandha* (A.H.S 10/23-33).

Ushakadi Gana:-*Ushaka, Tuttha, Kasisa, Shilajit, Saindhava*. (A.H.S 15/23)

Priyngvadi Gana:-*Pushpanjana (Jasta) and Anjan Yugma (Yugmapadya)*. (A.H.S 15/37)

In *Rasayana Vidhi* chapter *Triphala* is advised to be used along with *Rajat, Tamra, Sheesak, Vanga, Loha*, and *Svarana Bhasmas* as *Rasayana* with honey and ghee as *Anupana*. (A.H.U 39/42-43) *Shilajit* is used as *Rasayana Dravya* and its detailed description for consumption and benefits are described in *Rasayana Vidhi* chapter (A.H.U 39/139-142).

In *Vajikarana* chapter *Grathakar* has described the following *Dravyas* as an *Agrya*.

Bastijeshu-Girijam (In Urinary Disorder *Shilajit*); *Pandou Sreshtham Ayo* (In Anemia *Loha Bhasma*); *Gareshu- Hem* (In Poisoning *Svarna Bhasma*); *Sarveshu Rogeshu- Shilajit* (in all disease *Shilajit*) (A.H.U 40/48-50).

Metal and Mineral Containing Formulations and Route Of Administration¹⁴

Name	Context	Ingredient
Sneha Kalpana (Oil & Ghee)		
<i>Kasisadi Taila</i>	A.H.Chi 8/14-16 External	<i>Kasisa, Manashila, Abhraka, Haratal,</i>
<i>Mutrighata Nashak Yoga</i>	A.H.Chi 11/25-26 Internal	<i>Ushakadi Gana</i>
<i>Vyoshadi Ghrita</i>	A.H.Chi 16/36-37 Internal	<i>Loha Bhasma (Ayoraj)</i>
<i>Guggulyadi Gharshana Taila</i>	A.H.Chi 19/71-72 External	<i>Kasisa, Manshila, Haratal (Shriveshtak), Gandhaka</i>
<i>Jivantyadi Ghrita Taila</i>	A.H.Chi 19/77-78 External	<i>Tutha</i>
<i>Mahavajraka Taila</i>	A.H.Chi 19/81-82 External	<i>Manshila, Haratal</i>
<i>Sikthakadi Taila</i>	A.H.Chi 19/84 External	<i>Sindura, Tutha, Rasanjan,</i>
<i>Bhutarava Ghrita</i>	A.H.U 5/19 Internal	<i>Manashila</i>
<i>Narasimha Ghrita</i>	A.H.U 39/169-73 Internal	<i>Loha Churna</i>
<i>Pancharvinda Ghrita</i>	A.H.U 39/48 Internal	<i>Svarna (Hemashakalam)</i>
<i>Chatushkavalay Ghrita</i>	A.H.U 39/49 Internal	<i>Suvarana (Hiranyapatra)</i>
<i>Jatyadi Ghrita</i>	A.H.U. 25/67 External	<i>Tutha</i>
<i>Ropana Chikitsa (Taila)</i>	A.H.U. 26/26 External	<i>Amrutatutha(Mriddarshringa)</i>
<i>Manjishthadi Sneha</i>	A.H.U 32/31-32 Nasya & Abhyanga	<i>Phitakari, Manashila, Haratal, Gorochan, Gairika, Tutha, Padmakadi Gana</i>
<i>Dhatakyadi Taila</i>	A.H.U 34/51-53 Abhyanga,	<i>Kasisa, Phitakari</i>

	<i>Pichu Basti</i>	
Sandhana Kalpana (Asava & Arishta)		
<i>Ayaskriti</i>	A.H.Chi 12/29-32 Internal	<i>Lohapatra</i>
Leha Kalpana (Semisolid-Linctus)		
<i>Vijayavaleha</i>	A.H.Chi 3/168 Internal	<i>Manashila</i>
<i>Atisara Nashak Yoga</i>	A.H.Chi 9/91 Internal	<i>Krishna Mrittika, Shankha Bhasma or Pishti</i>
<i>Shashanka Lekhadi Leha</i>	A.H.Chi 19/46 Internal	<i>Mandoora Bhasma</i>
<i>Sitadi Avaleha</i>	A.H.Chi 19/49 Internal	<i>Mandoora Bhasma</i>
<i>Dviksharadi Rasakriya</i>	A.H.U 22/101 External	<i>Gairika</i>
Churna Kalpana (Powder/Granules)		
<i>Mutraghata Nashak Yoga</i>	A.H.Chi 11/10-13 Internal	<i>Pravala Pishti</i>
<i>Mutraghaat Nashak Yoga</i>	A.H.Chi 11/37-38 Internal	<i>Shilajit</i>
<i>Navayasa Churna</i>	A.H.Chi 16/14 Internal	<i>Lohabhasma</i>
<i>Tapyadi Churna</i>	A.H.Chi 16/20-22 Internal	<i>Svarna Makshika Bhasma, Sjlajit, Rajata Mandura, Loha Mandura,</i>
<i>Mustadi Avachurnan</i>	A.H.Chi 19/67-68 Udvartan	<i>Mridarshinga, Kasisa, Tutha, Kampillak, Gandhaka, Sarjarasa, Manashila, Haratal</i>
<i>Kalaka Churna</i>	A.H.U 22/99 Kaval	<i>Lohabhasma</i>
<i>Peetaka Churna</i>	A.H.U 22/100 Gandusha	<i>Manashila, Haratal</i>
<i>Khadiradi Gandusha</i>	A.H.U 22/107 Gandusha	<i>Lohabhasma</i>
<i>Brahmyadi Rasayana</i>	A.H.U 39/50-53 Internal	<i>Svarna</i>
<i>Chandrodaya Agad</i>	A.H.U 35/24-32 Internal	<i>Haratal, Manashila, Gorochan</i>
<i>Dushivishari Agad</i>	A.H.U 35/39 Internal	<i>Gairika</i>
<i>Mandara Agad</i>	A.H.U 37/74 Internal	<i>Manashila, Haratal, Gairika</i>
<i>Somaraji Rasayana</i>	A.H.U 39/107 Internal	<i>Lohabhasma</i>
<i>Shilajatvadi Rasayan</i>	A.H.U 39/161 Internal	<i>Shilajit, Lohabhasma, Svarna makshik Bhasma</i>
<i>Pushyanuga Churna</i>	A.H.U 34/49 Internal	<i>Shilajit, Gairika</i>
Guti/Vati Kalpna (Tablet)		
<i>Mandoora Vatak</i>	A.H.Chi 16/16-19 Internal	<i>Svarna Makshika Bhasma, Mandur Bhasma</i>
<i>Shilajit Vatak</i>	A.H.Chi 16/23-28 Internal	<i>Shilajit</i>
<i>Langalyadi Gutika</i>	A.H.U 39/165-68 Internal	<i>Lohabhasma</i>
Lepa Kalpana (Coating Powder Preparations)		
<i>Arshanashaka Lepa</i>	A.H.chi 8/22-23 External	<i>Tutha</i>
<i>Manashiladi Lepa</i>	A.H.Chi 19/70 External	<i>Manashila, Haratal</i>
<i>Marichyadi Lepa</i>	A.H.Chi 19/73-74 External	<i>Kasisa, Manashila</i>
<i>Savarnakara Lepa</i>	A.H.Chi 20/13 External	<i>Haratal Churna</i>
<i>Bhallatakadi Lepa</i>	A.H.Chi 20/16-17 External	<i>Shankha Churna, Tutha</i>
<i>Vranaropana Lepa</i>	A.H.U. 25/58 External	<i>Sindoora, Sheta anjana, Tutha</i>
<i>Tvacha shodhan Lepa</i>	A.H.U. 25/60 External	<i>Manashila, Haratal</i>
<i>Upadanshahara Lepa</i>	A.H.U 34/4 External Lepa	<i>Manashila, Haratal, Pushpakasisa, Phitakari</i>
<i>Kasisadi Churna</i>	A.H.U 34/55 External	<i>Kasisa, Phitakari</i>
<i>Nagaradi Agada</i>	A.H.U 37/40 External	<i>Haratal</i>
<i>Sankratkari Agada</i>	A.H.U 37/44 External	<i>Manashila</i>
Anjana/Varti Kalpna (Collyrium Preparation)		
<i>Mahanila Gutika</i>	A.H.U 11/40-41 External	<i>Tamra</i>
<i>Dantadi Varti</i>	A.H.U 11/34 External	<i>Shankha, Mouktika, Samudraphena</i>
<i>Mansyadi Anjana</i>	A.H.U 13/23-24 External	<i>Lohabhasma, Tutha, Shweta Sheesha,</i>

		<i>Shankha, Samudraphena</i>
<i>Marichadi Anjana</i>	A.H.U 13/25 External	<i>Manashila, Tutha, Samudraphena</i>
<i>Churnanajana</i>	A.H.U 13/25 External	<i>Samudraphena, Manashila, Tutha</i>
<i>Bhaskara Anjana</i>	A.H.U 13/28-29 External	<i>Svarnamakshika, Manashila, Shweta Anjana, Samudraphena</i>
<i>Tutha Anjana</i>	A.H.U 13/33 External	<i>Tutha</i>
<i>Rasendra Anjana</i>	A.H.U 13/36 External	<i>Parad, Shesa, Krishna Anjana</i>
<i>Sarpavasa Anjana</i>	A.H.U 13/41 External	<i>Shankhanabhi</i>
<i>Apratisara Anjan</i>	A.H.U 13/42 External	<i>Svarnamakshika, Tutha</i>
<i>Akshbeejadi Gutika</i>	A.H.U 13/43 External	<i>Tutha</i>
<i>Churnanajana</i>	A.H.U 13/45 External	<i>Heeraka, Neelam, Puskaraj and other Ratna, Roupya, Sphatika, Svarna, Krishna Anjana, Tamra, Shankha, Gairik</i>
<i>Souveeradi Anjana</i>	A.H.U 13/66 External	<i>Sphatika Mani</i>
<i>Vimala Varti</i>	A.H.U 13/70 External	<i>Shankha, Manashila</i>
<i>Kokila Varti</i>	A.H.U 13/71 External	<i>Loha Bhasma</i>
<i>Shashadantadi Varti</i>	A.H.U 13/72 External	<i>Shankha, Samudraphena</i>
<i>Varti Anjana</i>	A.H.U 13/74 External	<i>Shankha, Tamra</i>
<i>Kachayapana Anjana</i>	A.H.U 13/82 External	<i>Samudraphena</i>
<i>Nisha Andhya Nashak Varti</i>	A.H.U 13/87 External	<i>Haratal. Manashila, Samudraphena</i>
<i>Varti Anjana</i>	A.H.U 14/30 External	<i>Haratal</i>
<i>Pindanjan</i>	A.H.U 14/31 External	<i>Vaidurya, Mouktika</i>
<i>Pashupata Yoga</i>	A.H.U 16/25-27 External	<i>Pushpanjana</i>
<i>Talisadi Gutika</i>	A.H.U 16/40-42 External	<i>Loha Bhasma, Kasisa</i>
<i>Vyagradi Sandhav</i>	A.H.U 16/43 External	<i>Tamrabhasma</i>
<i>Rasanjanadi Anjana</i>	A.H.U 16/52 External	<i>Pushpanjana (Ritipushpa), Manashila, Samudraphena, Gairika</i>
<i>Pillanashak Anjana</i>	A.H.U 16/54 External	<i>Shankanabhi, Tamra Raja</i>
<i>Pushpakasisadi Anjana</i>	A.H.U 16/55 External	<i>Pushpakasisa churna</i>
<i>Aladi Churnajana</i>	A.H.U 16/56 External	<i>Haratal, Tamra Raja</i>

DISCUSSION & CONCLUSION

Ashtanaga Hridaya is one of the prominent treatise of Samhita period to mentioned the use of various minerals and metals formulations apart from the drugs of plant origin. Use of Metallic and herbo-mineral preparation is practiced since *Samhita* period and *Ashtang Hridaya* also used eight types of metals, varieties of precious stones and minerals for different kind of purposes. Minerals and metals are cited as monotherapy or as ploytherapy or compound formulations along with their prescribed dosage form, method of uses etc. The exact duration of uses, purification procedure of them are not properly mentioned. Besides the internal and external therapeutic uses, they are mentioned in context of diagnostic tool for diseases and pharmaceutical procedures. In the classic according to the requirement of the rhythm and rhymes, the synonyms of the metals and minerals are used; like *Manovha* for *Haratal*, *Hema* for *Svarana*, *Aal* for

Haratal etc. In most of the formulations, where only *Vagbhata* mentioned the name of metal or mineral without mentioning their respective *Bhasmas*. In such situations, fine *Bhasmas* should be used for safety and effectiveness because all these metals and minerals when given in elemental form may produce toxic effect but in compound or Nano particle form it proved to be safe and very effective in nature. *Hridayakar* used *Bhasma* word in some chapters that clearly indicates that, *Bhasma* preparation procedure is well known during Samhita period. Metals and minerals were not only used for therapeutic purposes at that period, but they had also major useful role in diagnostic as well as Pharmaceutical procedures. Further it is observed that, metal and mineral containing formulations cost more in compare to herbal preparations. Their manufacturing process is also time consuming and any kind of short cut methods may be hazardous and not safe and

effective as expected. So, proper care should be taken during *Shodhana Marana*, and *Amritikarana* process of these metals and minerals to prevent any kind of toxic effect and to get optimal benefit. Prolonged use of metallic and herbo-mineral preparations is safe or toxic in nature is debatable; and pharmac-epidemiological studies of both prospective and retrospective nature are the need of the hour to generate the evidence in support of their use.

ACKNOWLEDGEMENT

The authors are very thankful to the Director General and Deputy Director (Tech.) CCRAS, AYUSH, New Delhi, for their encouragement and support.

REFERENCES

1. Infographic: History of Metals Timeline, [Cited on 18/1/18] available from <http://www.makin-metals.com/about/history-of-metals-infographic>
2. Definition of Metal, English oxford Living dictionary, [cited on 18/1/18] available from, <https://en.oxforddictionaries.com/definition/metal>
3. Definition of Metal, "Metal." Merriam-Webster.com. Merriam-Webster, n.d. Web. 18 Jan. 2018. [cited on 18/1/18] available from <https://www.merriam-webster.com/dictionary/metal>
4. Mineral definitions, what is Mineral? [Cited on 18/1/18] available from http://webmineral.com/Mineral_Definition.shtml#.WmC0fqiWYdU
5. Prof. Siddhinandan Mishra; Ayurvedeeya Rasashastra; Chaukhsmba Orietalia, Varanai, Reprint edition;2011, p:409-11
6. The Discovery of Metals, [Cited on 18/01/2018] available from <https://www.azom.com/article.aspx?ArticleID=6101>
7. Anastassopoulou J., Theophanides T. (1995) The Role of Metal Ions in Biological Systems and Medicine. In: Kessissoglou D.P. (eds) Bioinorganic Chemistry. Nato Asi Series (Series C: Mathematical and Physical Sciences), vol 459. Springer, Dordrecht available from https://link.springer.com/chapter/10.1007/978-94-011-0255-1_17
8. What is Metal, [Cited on 18/01/2018] available from, <https://www.mendability.com/articles/our-brain-and-metals/>
9. Wikipedia, The free encyclopaedia, Metals in Medicine, [Cited on 18/01/2018] available from, https://en.wikipedia.org/wiki/Metals_in_medicine
10. Metals in Medicine Stephen J Lipprd Department of Chemistry Massachusetts Institute of Technology, [Cited on 18/01/2018] available from, https://authors.library.caltech.edu/25052/10/BioinCh_chapter9.pdf
11. Prof. Siddhinandan Mishra; Ayurvedeeya Rasashastra; Chaukhsmba Orietalia, Varanai, Reprint edition; 2011.
12. Sudama Singh Yadav, Goswami PK; A review on sutrasthana of vagbhata's samhita is best among Ayurvedic classics (Sutrasthane tu Vagbhate). Ayurpharm Int J Ayur Alli Sci. 2014;3(9):248-253.
13. Byadgi P.S et al/ Glimpse on Roganidan by Vagbhata: a bird's eye view; IJRAP 2011,2(5) 1402-1404.
14. Vrajjivan Ayurvijnan Granthamala; Ashtag Hridayam, Edited with Nirmala Hindi commentary by Dr Bramhananda Tripathi; Chaukshambha Sanskrit Pratishthan; Delhi; Reprint 2007.

Cite this article as:

Dattatray Dighe, Kshirod Kumar Ratha, Purnendu Panda, Aswani P S, M. M. Rao. Used Pattern of Metals and Minerals in Ashtang Hridaya: - The Birds Eye View. International Journal of Ayurveda and Pharma Research. 2018;6(2):1-9.

Source of support: Nil, Conflict of interest: None Declared

*Address for correspondence

Dr Dattatray Dighe

Research Officer (Ayurveda),
Central Ayurveda Research Institute of
Hepatobiliary Disorders, Bharatpur,
Bhubaneswar -751029.

Email: manav_dighe@yahoo.co.in,
dattatray85dighe@gmail.com

Mobile No.: 9763443137

Disclaimer: IJAPR is solely owned by Mahadev Publications - A non-profit publications, dedicated to publish quality research, while every effort has been taken to verify the accuracy of the content published in our Journal. IJAPR cannot accept any responsibility or liability for the articles content which are published. The views expressed in articles by our contributing authors are not necessarily those of IJAPR editor or editorial board members.