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Preparation and Physicochemical Characterization of a Metal Based Traditional Medicine: *Suvarnarajvangeshwar* by Modern Analytical Tools

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ABSTRACT

The medicines used in the Ayurveda are prepared by using parts of plants, animals, minerals and metals. The present study involves a medicine prepared by using tin and mercury metals. In Ayurveda, the metal tin is termed as vanga and mercury as parada. Suvarnarajvangeshwar is a rasa prepared by kupipakwa method, described in Indian traditional books. In the modern scientific literature tin and mercury are known for their toxicity. In Ayurveda, this medicine is widely used against urinary tract infections and other abnormalities since thousands of years. In the present study an efforts are made to study the medicine by using modern analytical instruments. The study involves physicochemical characterization of the medicine prepared in the laboratory and two samples collected from local manufacturers. These samples were subjected for the analysis by modern analytical methods such as Scanning electron microscope, Electron dispersive X ray scanning and X-ray diffraction along with simple analysis such as pH, electrical conductance and solubility. The study shows variation in the physicochemical properties for the samples taken for the study. Which shows urgent need for the standardization of the preparation methods and materials used for the preparation of medicines?

Keywords: *Ayurveda*, Traditional Medicine, *Suvarnarajvangeshwar*, SEM, EDAX, XRD

INTRODUCTION

Ayurveda (science of life) is a traditional medicinal system of India, practiced since thousands of years. *Ayurveda* describes holistic approach in its traditional texts (*vedas, samhitas*) to treat the disease [1]. This holistic approach involves maintenance and restoration of many sided equilibrium of health through dietary regimen, procedures and medicines. The medicines used in *Ayurveda* are prepared from plants, animals, metals and minerals. The medicines prepared from plants are termed as *Kasthoushadhies* and medicines that involve metals or minerals are termed as *Rasaoushadhies* [2]. As reported in the ancient texts of *Ayurveda* such as *atharvaveda, charaka samhita*, medicines derived from plants/ herbs were used in earlier years. In these years, the metals in foil or powder form were used as medicines. *Siddha Nagarjuna,* the father of *bhasma* medicines developed methodologies for preparation of medicines derived from metals and minerals in 7th century AD. These methodologies were explained in *Rasashastra* involves extraction, purification of metals, minerals and conversion into digestible form known as *bhasma* (ash) [1,3]. The medicines derived from metals, minerals are termed as *Siddha* medicinal system at the southern part of India. These medicines are very effective and needs to be taken orally in very small quantities as a paste with honey, milk, ghee and butter. Several metals such as gold,

silver, copper, iron, zinc, tin, mercury etc. were used to prepare these medicines [4,5]. Physicochemical characterization of many metallic preparations such as iron [6,7], copper [8-10], zinc [3,11], gold [12], arsenic [13], many *bhasmas* [14] by classical and advanced analytical methods are reported. The *bhasmas* are also explored to study or verify medicinal properties [15-17] reported in *Rasashastra* books, antioxidant activity [10], antimicrobial activity [18], genotoxicity [19], blood compatibility [20], cell–particle interactions [21], lipid profile, kidney, liver functioning [22] etc. In the recent years, public interest in traditional health systems worldwide is increasing enormously [23]. Which in turn attracted many researchers regarding safety, efficacy and toxicity of these traditional medicinal systems across the world? The medicines available in market around the world have analyzed to study their clinical and toxicological aspect [24]. Some of the reports [25-27] have documented higher contents of toxic heavy metals such as lead, mercury, arsenic etc. in the medicines than regulatory standards and toxicities associated with it. These reports have forced researchers and practitioners working in the field of *Ayurveda* to think over the use of heavy metals and develop method for the standardization of the metals used in these medicines [28]. The several reports supporting *Ayurvedic* medicines and providing non toxicity of the metals [19,20,22,29,30] are available. The efforts are made for the standardization of heavy metal content in the medicines by the researchers of *Ayurveda* from industries [31], government agencies [32] and universities [4,33,34]. Indian government has also provided strict guidelines to control the heavy metal content in the *ayurvedic* medicine [35]. Most of the recent reports suggest that a single system of medicine will be obsolete in next two decades, so role of traditional health system has prime importance [28]. But the traditional health system has inadequate quality parameters for the standardization of drug. The standardized drugs of well-defined consistent quality are needed for reliable experimental studies, clinical trials and the therapeutic use [32]. The present work is an effort to highlight an urgent need of standardization of traditional medicines to meet global regulation of physicochemical parameters. In the present work, chemical evaluation of an *ayurvedic* medicine *Suvarnarajvangeshwar* is carried out by using traditional and advanced analytical parameters. *Suvarnarajvangeshwar* is *kupipakwa rasayana* used against urinary tract infections and other abnormalities. Earlier, it was explored for the in vitro anti-oxidant activity. This potent medicine was less evaluated for other studies [36]. The traditional medicines are used worldwide due to their efficacy and less toxicity, since thousands of years. But modern health systems require evidences for its efficacy and less toxicity by modern methods. Standardization of drug in *Ayurveda* means confirmation of its identity, quality and purity throughout all phases. It is a big challenge because no clear cut standardization procedures are available so far [31]. An *ayurvedic* medicine studied in the present work *Suvarnarajva,ngeshwar* is a metallic preparation of *vanga* and *parada* (tin and mercury). The analysis involves the study of regular physicochemical characterization such as pH measurement, electrical conductance and solubility of a metal compound as well as modern analytical tools such as SEM, EDAX and XRD. The study is an effort to bridge the gap between traditional medicinal system and modern scientific methods. The physicochemical characterization of such traditional medicines by modern analytical tools will be helpful to reveal the truth about the efficacy and low toxicity of these medicines.

MATERIALS AND METHODS

In the present study material used is *Suvarnarajvangeshwar*. It can be prepared by different methods available in traditional texts. These methods are well established and practiced since thousands of years. In the present work the method used in ancient book *Rasamrut* [37] is used. The material obtained by this method is labeled as sample 1. The sample 2 and sample 3 were collected from local market.

The work is divided in two parts a) Preparation of *Suvarnarajvangeshwar* and b) Physicochemical characterization of the *Suvarnarajvangeshwar* samples 1, 2 and 3.

Preparation of *Suvarnarajvangeshwar*

One part (2 g) of pure *Vanga* was taken in an iron ladle and heated on burner. After melting *vanga,* half part (1 g) of purified *parada* was added and mixture was immediately transferred in a *khalva* (mortar) and grinded it well tills it turns into fine powder form. Then little quantity (50 to 100 mg) of *saindhava lavana* (salt) was added and triturated it with *nimbu* (Citrus Juice). The mixture was washed with water a black colour appeared in washed out water. The washing with fresh water continued till blackness ceases to appear. The mixture was dried and adds equal quantities (1 g) of *navasadara* (ammonium chloride) and *gandhaka* (sulphur) that of mercury. The mixture grinded well till it becomes fine smooth powder. This fine powder was filled up to half in *Kacakupi* (Glass bottle covered with cloth dipped in moist fine slurry of *multani* soil). The bottle was kept in a *Valuka Yantra* (sand bath) and heated in a furnace for twelve hours carefully. After that, the bottle was removed carefully along with *Valuka Yantra* from the furnace. Then it was allowed to cool to room temperature on earthen pot, after cooling *Kacakupi* was taken out from *Valuka Yantra*. The *Kacakupi* was cleaned and broken carefully at the middle. The lower part of the bottle contains golden mosaic coloured *swarnavanga*.

Physicochemical characterization of the *Suvarnarajvangeshwar* samples 1, 2 and 3

Three samples of *Suvarnarajvangeshwar* were taken for physicochemical evaluation. Sample 1 is *Suvarnarajvangeshwar* prepared in laboratory, Sample 2 and 3 were collected from local market prepared by reputed manufacturers.

pH and electrical conductance measurement

Sample 1, 2 and 3 were subjected for pH and Electrical Conductance measurement by using Equiptronics pH meter and Electrical Conductivity meter. The 1.00 g of *Suvarnarajvangeshwar* sample was stirred with 50 mL water in 250 mL beaker for 30 minutes and then filtered through Whatman no.1 filter paper. The filtrate obtained was subjected for pH and electrical conductance measurements.

Field emission gun

Scanning Electron Microscopic (FEG-SEM) imaging: The images of the *Suvarnarajvangeshwar* samples were taken at Sophisticated

Analytical Instrument Facility Center at Indian Institute of Technology, Powai, Mumbai, India (SAIF-IIT, Bombay) with the JEOL JSM–7600F model with 1.5 nm SEI resolution at 1kv in GB mode. It is applied with 0.1 to 30 kv accelerating voltage and 1 pA to 200 nA probe current.

Elemental analysis with energy dispersive X-ray analysis (EDAX)

Quantitative determination of bulk elemental composition in the *Suvarnarajvangeshwar* samples were carried out at Sophisticated Analytical Instrument Facility Center at Indian Institute of Technology, Powai, Mumbai, India (SAIF-IIT, Bombay) by EDAX (EDAX Inc., Mahwah, NJ, USA) which was attached with SEM.

Crystalline phase identification with X-ray diffraction (XRD)

The different crystalline phases present in the *Suvarnarajvangeshwar* samples were studied by using an X'Pert Pro (Phillips) X-ray powder diffractometer. *Suvarnarajvangeshwar* samples were studied by placing a thin layer of powder in conventional cavity mounts. The samples were scanned from (10–90) 2h. The Cu anode X-ray was operated at 40 kV and 30 mA to give monochromatic Cu Ka X-rays (k=1.54056 Å). To calculate mean crystallite size of *Suvarnarajvangeshwar* samples from its XRD graph Debye–Scherrer formula was used.

$D_{h,k,l} = (k \times \lambda)/(\beta_D \times \cos \theta_B)$

Where, $D_{h,k,l}$ is mean effective size of crystal; k=0.9 (constant); λ is X-ray wavelength; β_D is full width half maxima (FWHM) of peak, θ_B is Bragg scattering angle. The mean crystallite size was calculated after averaging the crystal size value from seven most intense reflection peaks of the XRD graph [38].

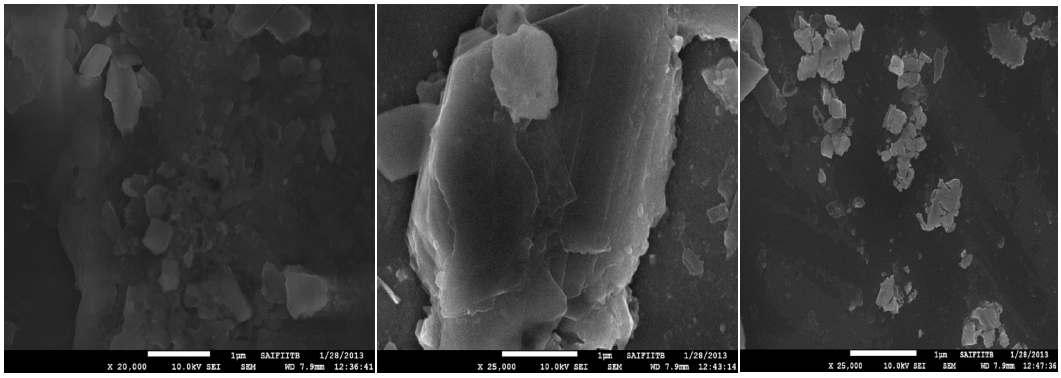
RESULTS AND DISCUSSION

1. pH and Electrical Conductance: There is variation in the pH and electrical conductance values of the samples as shown in Table 1.

Table 1: pH and electrical conductance of *Suvarnarajvangeshwar* samples

	pH	Electrical conductance (in mmho)
Sample 1	3.8	3.68
Sample 2	4.6	1.52
Sample 3	4.1	3.20

2. Field Emission Gun-Scanning Electron Microscopic (FEG-SEM) imaging: The SEM images of sample 1, 2 and 3 shows variation in size and agglomeration Figure 1.



(a) (b) (c)

Figure: 1 SEM of *Suvarnarajvangeshwar,* sample 1(a), sample 2(b), sample 3(c)

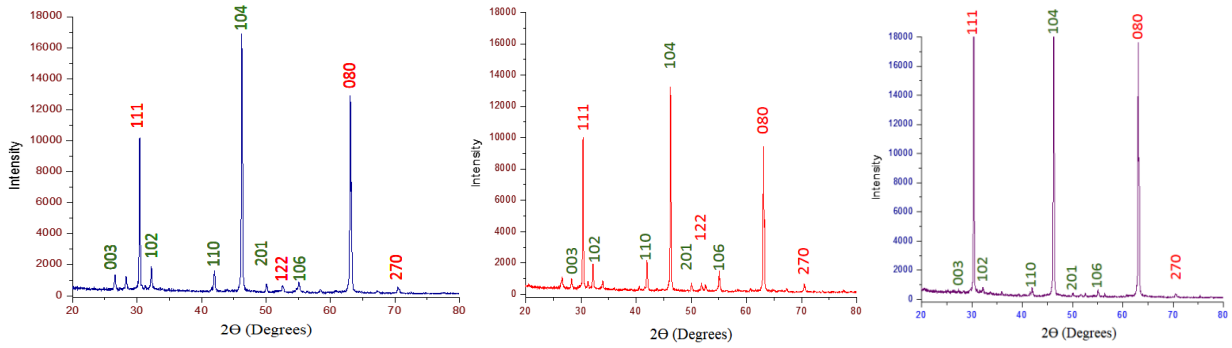
3. Elemental analysis with energy dispersive X-ray analysis (EDAX): The EDAX analysis of *Suvarnarajvangeshwar* samples shows variation in composition as well as atomic percentage of elements. Sample 1 shows presence of C, S, Cu, Zn, Sn elements, where S with highest (51.50%) followed by Sn (25.23%). Sample 2 contents C, S, Sn, Hg elements, where S with highest (38.59%) followed by Hg (31.37%). Sample 3 contents C, S, Cu, Zn, Sn elements, where S with highest (50.29%) followed by Sn (26.57%) (Table 2).

4. Crystalline phase identification with X-ray diffraction (XRD): XRD technique was used to identify presence of the crystalline phases in the sample. XRD pattern of *Suvarnarajvangeshwar* samples are shown in Figure 2, sample 1 as Figure 2a, sample 2 as Figure 2b and sample 3 as Figure 2c.

While analyzing XRD pattern, it is observed that there are slight differences between the relative intensities and width of the reflexes, which indicates differences of crystallite size. The sharp peaks represents that all the samples are crystalline in nature. The XRD study also shows the presence of tin sulphide and mercury sulphide crystals in the samples. The size of crystallite was

Table 2: Elemental composition of *Suvarnarajvangeshwar* samples detected by EDAX

	Sample 1		Sample 2		Sample 3	
Element	**Weight%**	**Atomic%**	**Weight%**	**Atomic%**	**Weight%**	**Atomic%**
C K	4.69	19.92	3.98	27.18	5.17	21.99
N K	0.00	0.00	0.00	0.00	0.00	0.00
S K	32.37	51.50	15.10	38.59	31.60	50.29
Cu K	1.79	1.43	0.00	0.00	1.44	1.16
Zn K	2.46	1.92	0.00	0.00	0.00	0.00
Sn L	58.70	25.23	4.14	2.86	61.79	26.57
Hg M	0.00	0.00	76.78	31.37	0.00	0.00



(a) (b) (c)

Figure 2: XRD Pattern of *Suvarnarajvangeshwar*, sample 1(a), sample 2(b), sample 3(c)

evaluated by measuring the FWHM of the most intense peak. Using the Debye Scherrer's formula the mean crystalline size of the samples was calculated as for sample 1-49.06 nm, sample 2-54.26 nm and sample 3-52.14 nm.

CONCLUSION

The metal based *ayurvedic* medicines are complex material to analyze. The physicochemical characterization by SEM, EDAX, XRD etc. can give typical fingerprint of such medicines. Thus, modern analytical tools are helpful to analyze and useful to standardize complex herbo–mineral medicines. These characterizations can explain difference and similarity among the samples and therefore useful tool for quality control of *ayurvedic* medicines.

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REFERENCES

[1] B. Prakash, *I. J. History Sci.,* **1997,** 32(1), 1.

[2] A. Chaudhari, N. Singh, *Ancient Sci. Life.,* **2010,** 30(1), 18.

[3] T.K. Bhowmick, A.K. Suresh, S.G. Kane, A.C. Joshi, J.R. Bellare, *J. Nanopart Res.,* **2009,** 11, 655.

[4] A. Sudha, V.S. Murty, T.S. Chandra, *Am. J. Infect. Dis.,* **2009,** 5(3), 193.

[5] I.G. Shibi, G. Shalu, K. Jagannathan, *Int. J. Res. Ayurv. Pharm.,* **2012,** 3(3), 433.

[6] P.K. Sarkar, P.K. Prajapati, A.K. Chaudhary, S. De, *Indian Drugs.,* **2007,** 44(1), 21.

[7] S. Pandit, T.K. Biswas, P.K. Debnath, A.V. Saha, U. Chowdhury, B.P. Shaw, S. Sen, B. Mukherjee, *J. Ethnopharmacol.,* **1999,** 65(2), 149.

[8] K.S. Chitnis, A. Stanley, *Int. J. Pharm. Biosci.*, **2011,** 2(2), 160.

[9] M.P. Wadekar, C.V. Rode, Y.N. Bendale, K.R. Patil, A.B. Gaikwad, A.A. Prabhune, *J. Pharmaceut. Biomed. Analysis.,* **2005,** 39(5), 951.

[10] N. Pattanaik, A.V. Singh, R.S. Pandey, B.K. Singh, M. Kumar, S.K. Dixit, Y.B. Tripathi, *Indian J. Clin. Biochem.,* **2003,** 18(2), 181.

[11] M. Bhgawat, R.V. Kashalkar, A.S. Bhave, S.S. Vaidya, V. Ramaswamy, **2003,** *Indian. Drugs.*, 41(1), 12.

[12] A. Mitra, S. Chakraborty, B. Auddy, P. Tripathi, S. Sen, A.V. Saha, B. Mukherjee *J. Ethnopharmacol.,* **2002,** 80(2), 147.
[13] A.K. Panda, J. Hazra, *Int. J. Res. Ayurved. Pharma.,* **2012,** 3(6), 773.
[14] A. Kumar, A.G.C. Nair, A.V.R. Reddy, A.N. Garg, *Biol. Trace. Elem. Res.,* **2006,** 109, 231.
[15] P. Nigam, S. Kirti, S. Saxena, S. Sriwastava, L.D. Joshi, *Journal of the Diabetic Association of India.*, **1979,** 19(3), 159.
[16] C.E. Lagad, R. Ingole, *Ayurvedic.*, **2009,** 30(4), 443.
[17] S. Jain, P.N. Tandon, *Neurol. Asia.,* **2004,** 9(1), 57.
[18] D.H. Tambekar, S.B. Dahikar, *Recent Res. Sci. Technol.,* **2010,** 2(10), 59.
[19] N.V. Vardhini, T.N. Sathya, P.B. Murthy, *Curr. Sci.,* **2010,** 99(8), 25.
[20] W. Paul, C.P. Sharma, *Int. J. Ayur. Res.,* **2011**, 2(1), 14.
[21] G. Pyrgiotakis, T.K. Bhowmick, K. Finton, A.K. Suresh, S.G. Kane, J.R. Bellare, B.M. Moudgil, *Biopolymers,* **2008,** 89(6), 555.
[22] I.J. Bulbul, M.O. Ullah, M.A. Rahman, K.A. Rahman, A.K. Paul, M.S.K. Choudhuri, *Eur. J. Sci. Res.,* **2009,** 32, 1, 25.
[23] R.C. Kapoor, *Indian J. Tradit. Knowledge.,* **2010**, 9(3), 562.
[24] E. Lynch, R. Braithwaite, *Expert Opin. Drug Saf.,* **2005**, 4(4), 769.
[25] R.C. Ekeanyanwu, J.O. Njoku, P.O. Nwodu, A.E. Njokuobi, *J. App. Pharm. Sci.,* **2013**, 3(4), 88.
[26] R.B Saper, S.N Kales, J. Paquin, M.J Burns, D.M Eisenberg, R.B Davis, R.S Phillips, *The J. Am. Med. Ass.*, **2004,** 292, 2868.
[27] P.I. Dargan, I.B. Gawarammana, J.R.H. Archer, I.M. House, D. Shaw, D.M. Wood, *Int. J. Environ. Health.,* **2008,** 2, 3/4, 463.
[28] D. Shankar, P.M. Unnikrishnan, P. Venkatasubramanian, *Curr. Sci.,* **2007,** 92(11), 1499.
[29] P.K. Sarkar, P.K. Prajapati, V.J. Shukla, B. Ravishankar, A.K. Chaudhary, *Indian. J. Exp. Biol.,* **2009,** 47, 987.
[30] D. Mishra, M. Sinha, M. Kumar, V. Kumar, *J. Herbal. Medi. Toxicol.,* **2009,** 3(1), 13.
[31] R. Kurele, *Int. J. Ayurv. Pharm.*, **2015,** 6(2), 192.
[32] N. Tandon, S.S. Yadav, *J. Ethnopharmacol.,* **2016,** accepted for publication.
[33] R. Devnathan, P. Rajalakshmi, P. Brindha, *Int. J. Curr. Pharmaceut. Res.,* **2010,** 2(4), 12.
[34] S. Mohaptra, C.B. Jha, *Int. J. Ayurv. Res.,* **2010,** 1(2), 87.
[35] S. Basant, *Legal Status of Ayurvedic, Siddha and Unani Medicines.,* **2005,** 92.
[36] A.A. Naik, A.M. Kulkarni, P.V. Ansulakar, S.S. Savrikar, A.S. Chowdhary, *Int. Ayurv. Med. J.,* **2013,** 1(6), 98.
[37] Y. Trikamji, *Rasamruta,* Chowkhamba Sanskrit Bhavan, Varanasi, **1998,** 1, 95.
[38] S. Suresh, *Int. J. Physics.,* **2014,** 9(17), 380.