



ASSESSMENT OF GRAHYAGRAHYATVA OF VANGA DHATU USING DATABASE AND STATISTICS.

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ABSTRACT:

Introduction- The ancient way of raw material standardization of Rasadravyas is through narration of Grahya i.e. acceptance and Agrahya i.e. rejection criteria. These criteria though may appear superficial to a casual observer, reveal much information about the constitution of Rasadravya. **Objectives-** To make efforts to study and enlist 'Grahyaagrahyatva'(acceptance & rejection) criteria of 'Vanga Dhatu' from important 'Rasashastra' texts. To prepare the database of 'Grahyaagrahyatva' on collected samples of 'Vanga Dhatu' with the help of well designed proforma and statistics. **Methodology-** Critical study of enlisted Grahya and Agrahya criteria were done and precise meaning put forth in the proforma. Well designed proforma and visual scales were developed to assess the data which appears to be subjective. But assessed methodically and thus converted into numerical data for applying statistics. In this short term project research attempts are made to assess Grahyaatva of collected 16 Vanga samples. This methodology shows application of statistics in the research of raw material standardization. **Conclusion-** Three extremely Grahya (sample no. 2, 3 and 12) and three extremely Agrahya (sample no. 13, 15 and 16) samples are assessed with the application of statistics, which inturn assessment will be objective and reproducible.

KEYWORDS: Vanga, Grahyaagrahyatva, Standardization, Assessment, Proforma, Statistics, Criteria.

INTRODUCTION:

Mineral medicines, however, are eyed cautiously by modern scientific world due to various reasons. These include inconsistent production practices and insufficient evidences of their standardization, safety and efficacy.

*"Jatimadbhirvishudhaishca Vidhina Parisadhitai: /
Rasoparasalohadyai: Soota: Sidhyati Naanyatha //"*
- Rasaratnasamuccaya 5/216

The reference from Rasaratnasamuccaya indicates the significance of the authentic and unadulterated raw material and appropriate techniques of processing it, in order to achieve the desired effects of a pharmaceutical product.⁽¹⁾ The word Grahyaagrahyatva is made up of two parts Grahya and Agrahya. The word Grahya means – to be selected or to be accepted. The word Agrahya

denotes exactly opposite meanings i.e. not to be accepted. These are the norms stated in Rasashastra texts, that should be fulfilled by the raw material in order to be used safely in medicines. Thus, they signify the quality control techniques. The methodology of selecting a drug before using it in medicine is clearly mentioned in Vimana Sthana of Caraka Samhita (8/87).⁽²⁾ It is termed as Bsheshaja Pariksha and Carakacharya describes every aspect of it beginning from identification of drug, collection, storage, creation of a dosage form and formulation upto dose and pharmacological action. Even Modern Pharmaceutical science emphasized the need of Standardization. According to Modern science, the process of standardization is divided into three categories viz. 1) Quality control of raw material 2)

In process quality control (Validation of the process)
3) Final product standardization.

As far as Rasashastra is concerned, mineral drugs are potentially toxic and hence the texts describe the Grahya-grahyatva i.e. quality control parameters for raw materials in detail. The classical Ayurvedic view teaches us to assess any Dravya on the basis of Pancabhautic theory. The standards of raw material acceptability i.e. Grahya-grahyatva are also explained on the same lines, in the form of adjectives. These classical textual norms, being in Sanskrit and in ancient terminology are difficult to understand, create problems while procuring raw material to be used in pharmaceuticals and leads to confusion. If one could elucidate these criteria with the help of exact knowledge of Sanskrit, word to word meaning, perhaps selection procedure of the raw material will become rational. Most of the characteristics mentioned for Grahya-grahyatva in the ancient texts can be assessed by physical examination. These characteristics may seem simple, but they signify much crucial aspects. Many a times there are minor variations in the composition of minerals that cause variation in their colour. May be, this minor variation in composition brings about major changes in trace element or structure of the material which inturn will change its pharmacological properties.

MATERIALS AND METHODS:

Material:

1. Procurement of Vanga samples
2. Literature study of Vanga

Methodology:

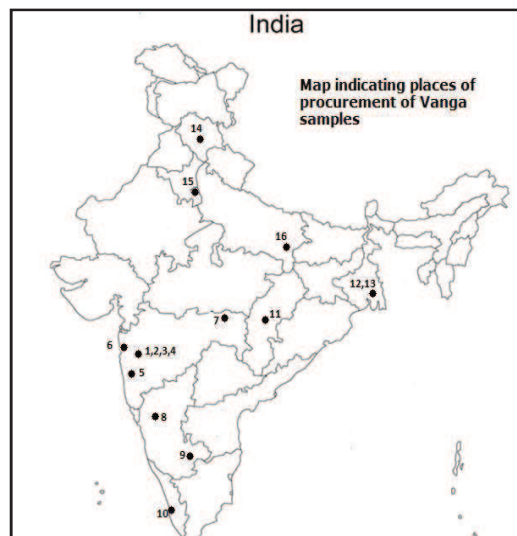
A. Procurement of Vanga samples:

Total 16 samples of Vanga were procured from various sources like local market, pharmacies and mines were labelled according to GPS – Global Positioning System.

Table No. 1, Places of procured Vanga samples

Sample Code	Name of city	Sample Code	Name of city
S-1	Pune	S-9	Bengalore
S-2	Pune	S-10	Ernakulam
S-3	Pune	S-11	Jagdarpur
S-4	Pune	S-12	Kolkata
S-5	Kolhapur	S-13	Kolkata
S-6	Mumbai	S-14	Paparola
S-7	Nagpur	S-15	Delhi
S-8	Hubli	S-16	Varanasi

Procured Vanga samples from various places of India shown in the following map.



B. Data base preparation:

List of 'Grahya' (Inclusion Criteria) Norms:

Various Rasashastra texts mentioned Grahya-grahyatva norms for Vanga were compiled from 30 Rasashastra texts. After scrutinizing the compiled data following criteria were mentioned. (Table No. 2, Table No. 3.)

Critical study of Grahya-grahyatva criteria of Vanga:

For proper assessment of Grahya-grahyatva, the primary step would be complete understanding of the meaning conveyed by the Sanskrit terms. For this purpose, the adjectives regarding the appearance of Vanga were enlisted and their meanings were searched and studied with the help of Sanskrit-English dictionary of Monnier-Williams, Shabdakalpadrum and Vachaspatyam.⁽¹²⁾

These Sanskrit terms were elaborated with the help of literature survey method by using Lexicons (Koshas) and dictionaries. (Table No. 4)

C. Proforma for the assessment of Vanga:

The proforma was prepared and validated. Further assessment of Grahya-grahyatva of the samples were carried out with the help of proforma. The proforma includes precise meanings of Grahya and Agrahya criteria were found to be placed in one group. The actual proforma sheet consists of one page for 1st to 4th samples for Grahya criteria and one page represents 1st to 4th samples for Agrahya criteria. Total 19 criteria of Grahya Vanga and 8 criteria of Agrahya Vanga were divided according to organoleptic assessment i.e. Shabda, Sparsha, Rupa, Rasa, Gandha Pariksha. In this segregation, some parameters were found to be placed commonly. e.g. Khurakara and Kshurakara criteria were placed in Rupa as well as Sparsha assessment category. Some of the Grahya-grahya criteria are given in the following table, representing the proforma. (Table No. 5)

List of 'Grahya' (Inclusion Criteria) Norms:

Table No. 2, List of Grahya criteria												
Sr. No.	Grahya Criterias	R. T.	R. R. S.	R. A.	A. P.	A. K.	B. R. R.	R. P. S.	R. C.	R. C. M.	R. K. D.	Y. R.
1.	Candrabham ^(1,3)				+							
2.	Candralohasamaprabha ⁽¹⁾	+										
3.	Dhavala ^(1,3,4)		+			+	+		+	+		+
4.	Drutadravam ^(1,3)	+	+			+	+		+	+	+	+
5.	Gaurava ^(1,3,5)		+			+	+		+	+		+
6.	Khurakara ^(1,3)				+							
7.	Ksurakara ^(1,5,6)											
8.	Laghu ^(5,7)			+								

List of 'Agrahya' (Exclusion Criteria) Norms:

Table No. 3, List of Agrahya criteria												
Sr. No.	Agrahya Criterias	R. T.	R. R. S.	R. A.	A. P.	A. K.	B. R. R.	R. P. S.	R. C.	R. C. M.	R. K. D.	Y. R.
1.	Shyamshubhraka ^(1,3,8)		+			+	+		+	+		+
2.	Dhusara ^(3,9)	+						+				
3.	Anyadhatuvimishrita ^(1,6,10)	+										
4.	Mishraka ^(1,7)	+								+		
5.	Krishna ^(1,11)	+										
6.	Kathina ⁽⁸⁾	+										
7.	Ruksha ^(1,8)	+									+	
8.	Drave Atikaṭhina ^(3,8)	+										

(R.T.- Rasatarangini, R.R.S.- Rasaratnasamucchaya, R.A.- Rasarnav, A.P.- AyurvedPrakash, A.K.- Anandkand, B.R.R.- Bruhat Rasaraj Sundar, R.P.S.- RasaprakashSudhakar, R.C.- Rasa Chintamani, R.C.M.- Rasendrachudamani, Y.R.- Yogaratnakar)

Table No. 4, Critical study of Grahya and Agrahya criteria	
Grahya criteria	Agrahya criteria
Drutadrāvam: Drut – Vi. Crutabhutam, Dru.-Srutau, Gatau. - Vi. – SheeghraDravanasheelam - Quick, speedy, swift, rapidly, without delay. - Quickly or indistinctly spoken - Flown, run away - Dissolved, melted, fluid Dru. – Dru. Drunoti, to hurt, injure. ⁽¹²⁾	Mishraka: - Mishra- Yuti: Samyojanam -Mixed, Not pure, adulterated. ⁽¹²⁾

Sample Assessment Criteria

GRAHYA CRITERIA ↓ GRADES→	Sample 1				Sample 2				Sample 3				Sample 4				Total
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
RUPA PARIKSHA																	
Khurakar																	
Kshurakar																	
Dhaval																	
Shubhra																	
Shveta																	
Sita																	
Candrabham																	
Candraloha Samaprabham																	
Rupyabham																	
Snigdha																	
Nirmal																	
Shuddha																	
Svachha																	
Sarala																	
Sutrapatrakaram																	
SPARSHA PARIKSHA																	
Khurakar																	
Kshurakar																	
Snigdh																	
Mrudu																	
Sarala																	
Gaurav																	
Laghu																	
Shitam																	
SHABDA PARIKSHA																	
Nishabda																	
GANDH PARIKSHA																	
Putigandha																	
Metallic																	

Table No. 6, Agrahya sample proforma

AGRAHYA CRITERIA GRADES	Sample 1				Sample 2				Sample 3				Sample 4				Total
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
RUPA PARIKSHA																	
Shyamashubhraka																	
Dhusara																	
Mishraka																	
Anyadhatu Vimishritam																	
Krushna																	
Ruksha																	
SPARSHA PARIKSHA																	
Ruksha																	
Kathina																	

Inclusion and exclusion of Grahya criteria:

The Grahya and Agrahya criteria incorporated in proforma were assessed organoleptically. The criterion Ushnasaham and Drutadravam need heating treatment for their assessment. Hence, 'Ushnasaham' and 'Drutadravam' from Grahya criteria and 'Drave Atikathina' from Agrahya criteria were excluded from the proforma.

Total 19 experts were consulted and they were divided in three groups as follows.

Experts Group of Ex ,7 .Table No		
Sr. No.	Name of group	No. Of experts
1	Ayurvedic Academicians/ Teachers/ Practitioners	6
2	Ayurvedic Pharmacists and Research scholars in Rasashastra	7
3	Metallurgists and Geologists	6

Though the data received from experts in various fields was subjective, it is converted into numerical, measurable, reproducible and worldwide acceptable form with the help of proper scoring to Grahya criteria. Thus application of statistical methods to the data is also possible.

Method of assessment:

(Conversion of proforma in numerical values)

1. Collected samples were numerically coded from S-1 to S-16. Whereas, 19 experts who were to score the samples were coded from A to S.
2. Data was entered to spread sheet. Accuracy and validity of data was checked after data entry.
3. Data was rearranged according to 19 observations of a single sample with Grahya 20 and Agrahya 7 observations.
4. When inter observer variability was checked, it was more than expected as observer vary from expertise in different areas. Hence, mean of the observations were can not be calculated.
5. Candrabham, Candraloha Samaprabham, Rupyabham imply almost same meaning. When the observations recorded by the experts were analysed, it was observed that almost same score was given to above three criteria by some experts. Very few experts gave different scores for the above criteria. It is observed that normal distribution was followed by the data. Also, 'Kolmogorv-Smirnov' test was found to be positive for normality. Hence, to evaluate properly Grahya and Agrahya on the basis of above 3 Varna criteria, these criteria were consolidated under group 'GV1'. Likewise other groups were also categorised according to criteria.

Grahya criteria-

Table No. 8, Clumped Grahya criteria		
Criterion	Denoted as	Included criteria
Grahya Vanga-1	GV1	Candrabham, Candraloha Samaprabham, Rupyabham.
Grahya Vanga-2	GV2	Dhaval, Subhra, Sweta, Sita.
Grahya Vanga-3	GV3	Nirmala, Swachha, Suddha.
Grahya Vanga-4	GV4	Snigdha, Mrudu, Sutrapatrakaram, Guru, Sita, Nihsabda.
Grahya Vanga-5	GV5	Khurakara, Ksurakara, Putigandha, Laghu, Sarala.

(Here, G= Grahya, V= Vanga)

Likewise Agrahya criteria were also categorised and clumped as follows.

Table No. 9, Clumped Agrahya criteria		
Criterion	Denoted as	Included criteria
Agrahya Vanga-1	AV1	Syamasubhraka, Misraka.
Agrahya Vanga-2	AV2	Dhusara, Anyadhatuvasritam.
Agrahya Vanga-3	AV3	Ruksa, Kathina, Krusna.

(Here, A= Agrahya, V= Vanga)

6. Data for each Grahya criterion for 16 samples was fed to medical software and 'Kolmogorov-Smirnov Test' (K.S. Test) was applied to it. The highest value, lowest value, Mean, Standard Deviation and Normality were obtained from the data.
7. All Raw data of 16 samples was analysed and observations were put forth in the form of tables, graphs and charts.

Rupyabham:

Rupyabham means 'similar to silver'. This criterion is similar to 'Candraloha Samaprabham'.

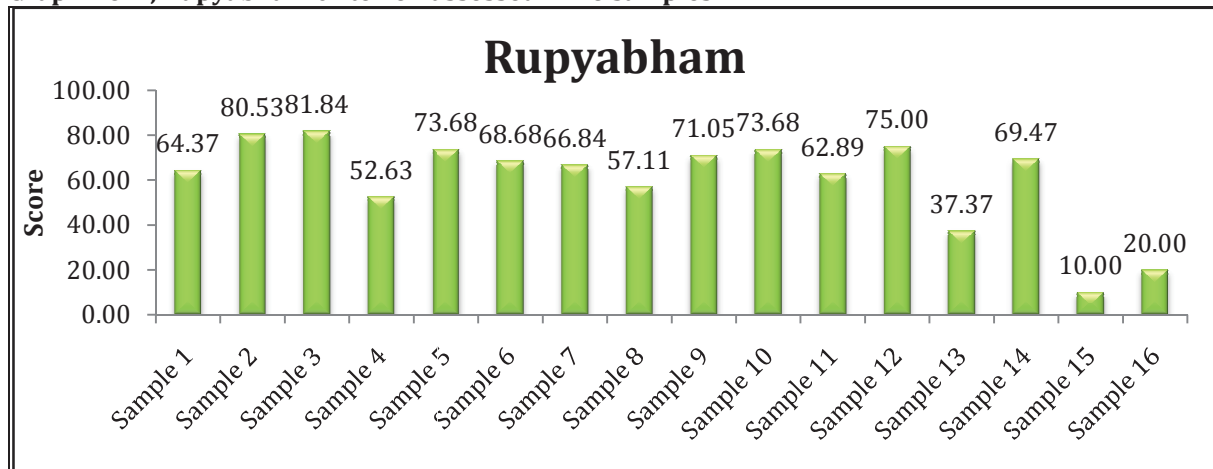
Most experts opined that same marks as that of Candraloha Samaprabham should be allotted to this criterion also. On comparing the graphs for both criteria, the marks for each sample are quite similar for both criteria. So, it can be considered that both these criteria compare the colour of Vanga with that of silver appearance. **(Graph 1)**

Mishraka:

means mixed. This is opposite to Grahya character like Shuddha, Svachha etc. in the Grahya character list. Sample no. 13, 15, 16 got a higher score for this character. These samples had unclean appearance and had scored low in Grahya criteria. Higher scores

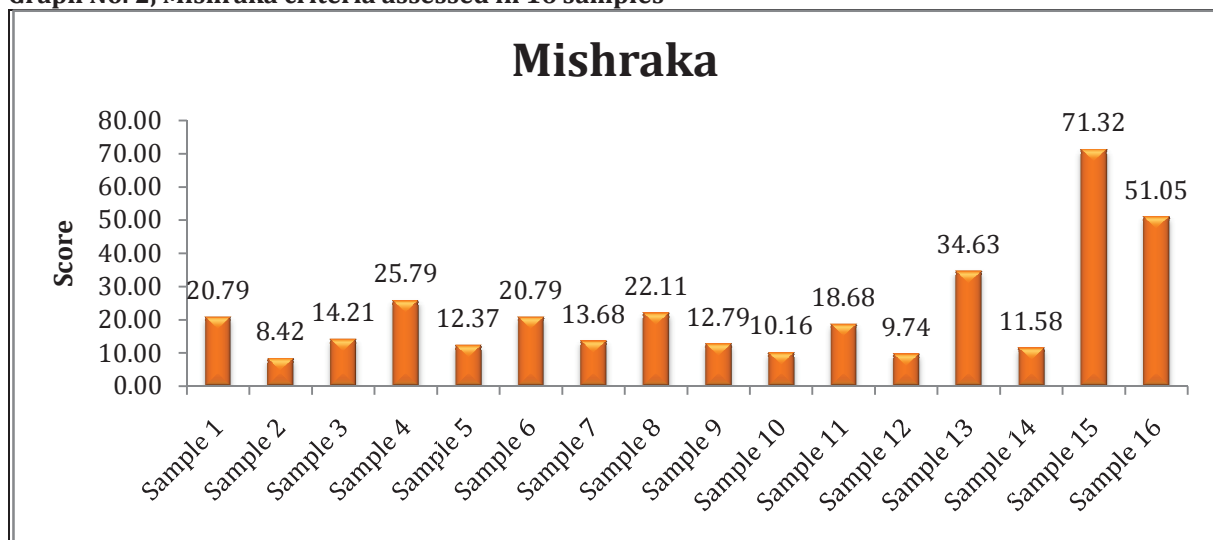
obtained by them in Agrahya criteria again confirm their inferior quality. (Graph 2)

Graph No. 1, Rupyabham criterion assessed in 16 samples



Rupyabham criterion Test to .S.Selective values from K ,10 .Table No					
Highest value	Lowest value	Mean	Standard Deviation	Standard error of the mean	Normality
81.85	10	60.3	20.87	5.22	Acceptable range

Graph No. 2, Mishraka criteria assessed in 16 samples



Method of assessment and Calculations:

1. Clumping of criteria:

For the final selection similar to assessment criteria, sample wise assessment was also done by taking 1 to 16 samples in a column and scores of the samples given by all experts as per following methodology. All the above criteria were clumped in respective group as they follow normal distribution.

2. Deciding weightage:

The scores given by experts to the samples were observed and ranked accordingly. But it was

difficult to extract deductive conclusion as some experts had given more focus on criteria in group 'GV1'. Some had given more importance to criteria in group 'GV2' or likewise any other group. Depending upon the hints in references of Grahyaagrahyatva of Vanga in Ayurvedic texts, as well as after keen interpretation of the data, order of priority was decided for the Grahya and Agrahya criteria. According to priorities, the weighted mean for above mentioned groups were calculated with weightage equivalents as per following table. (Table No. 11)

Name of group	Weightage of the group
Grahya criteria	
Grahya Vanga 1 (GV1)	5
Grahya Vanga 2 (GV2)	4
Grahya Vanga 3 (GV3)	3
Grahya Vanga 4 (GV4)	2
Grahya Vanga 5 (GV5)	1
Agrahya criteria	
Agrahya Vanga 1 (AV1)	3
Agrahya Vanga 2 (AV2)	2
Agrahya Vanga 3 (AV3)	1

Weightage represents the priority of the criteria belonging to the group which can statistically prove its importance by multiplying scores of criteria within the group. For e.g. score of group AV1 is calculated by multiplying scores of criteria with its weightage i.e. 3.

3. Scoring: Accordingly 19 observations received from experts for every single sample were collected. When the data was analyzed, it was seen to be following normal distribution. To minimize inter observer variability for each characteristic, mean was taken and used for further calculations. Such data generated for all 16 samples was taken for further calculations.

For e.g. score given to 1st sample by 19 experts, for clumped criteria GV1, GV2, GV3, GV4 and GV5 is presented in following table. (A, B, C, D... Represents Experts in the **table No. 12**)

Here, 'A1' represents score given by expert 'A' to the sample '1' for clumped groups GV1, GV2, GV3, GV4, GV5. In the bottom of the table, average of GV1, GV2 etc. groups was calculated. The sum total of these averages represents score of sample 1. The total '929' represents Grahya score of sample 1.

4. Ranking:

The scores of 20 Grahya criteria were added and all the 16 samples were ranked.

Similarly score of 7 Agrahya criteria were clumped in groups AV1, AV2 and AV3 and for sample no. 1 they were calculated as follows. The total score '140.55' represents Agrahya score of sample no. 1. Grahya and Agrahya scores for each sample were calculated by using the same methodology and tabulated. (**Table No. 13**)

Thus each sample got Grahya score and Agrahya score for its clumped group of criteria. Still, any substantial conclusions were difficult to draw, as Grahya and Agrahya criteria were being considered separately. Hence, it was decided to subtract scores of Agrahya criteria from the scores of Grahya criteria for each given sample.

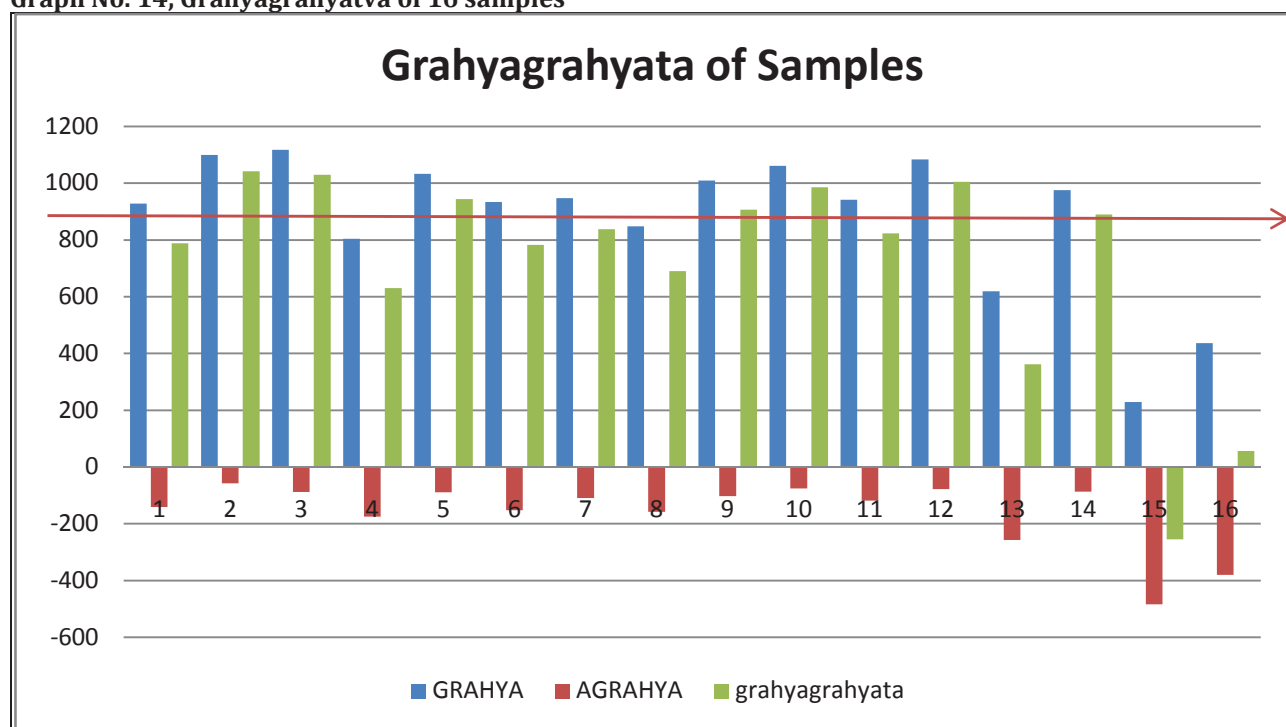
Graph below (**Graph No. 14**) represents Grahya, Agrahya as well as Grahya-Agrahya assessment of 16 samples. Positive bars are above X-axis in blue colour represents Grahya, negative bars below the X-axis in red colour represents Agrahya and Green bars represents Grahya-Agrahya of 16 samples. To compare the 16 samples statistically 'Annova Test' was performed for Grahya criteria Annova between the columns was seen to be statistically significant ($P < 0.005$) which indicated there was difference in 16 samples. Thereafter, total score for Grahya and Agrahya criteria for each sample was calculated by mean method and placed in front of the respective sample. The first 3 samples having highest score ranks (sample no. 2, 3 and 12) and last 3 samples having lowest score ranks (sample no.13, 15 and 16) were sent for physico-chemical analysis. The reason behind isolating these 6 samples is to ease comparison of chemical assessment and assessment by experts by statistical method.

GRAHYA CRITERIA	GV1	GV2	GV3	GV4	GV5	
A1	391.7	310	210	163.3	50	
B1	350	280	200	66.67	26	
C1	400	320	240	120	43.33	
D1	400	260	180	128	20	
E1	125	100	75	96.67	46	
F1	200	275	200	110	41.25	
G1	366.7	180	200	116.7	48.33	
H1	175	170	225	108	45	
...	
Q1	40	70	110	51.67	36	
R1	300	215	180	95	46	
S1	91.67	80	30	91.67	27	Total
Average	315	256	199	117	42	929

Sample No.	Grahya Score	Agrahya Score	Final Score	Rank	Sample No.	Grahya Score	Agrahya Score	Final Score	Rank
1	929	141	788	10	9	1009	103	906	6
2	1100	58	1042	1	10	1062	76	986	4
3	1118	88	1030	2	11	941	118	823	9
4	805	174	631	13	12	1083	78	1005	3
5	1033	90	943	5	13	619	257	362	14
6	934	152	782	11	14	976	87	889	7
7	948	109	839	8	15	229	483	-254	16
8	448	158	290	12	16	437	380	57	15

Graphical presentation of Grahyagrahya samples:

Graph No. 14, Grahyagrahyatva of 16 samples



Above graph represents Grahya, Agrahya as well as Grahyagrahya assessment of 16 samples. Positive bars are above X-axis in blue colour represents Grahyatva, negative bars below the X-axis in red colour represents Agrahyata and Green bars represents Grahyagrahyatva of 16 samples. To compare the 16 samples statistically 'Annova Test' was performed for Grahya criteria Annova between the columns was seen to be statistically significant ($P < 0.005$) which indicated there was difference in 16 samples. Thereafter, total score for Grahya and Agrahya criteria for each sample was calculated by mean method and placed in front of the respective sample. The first 3 samples having highest score ranks (sample no. 2, 3 and 12) and last 3 samples

having lowest score ranks (sample no.13, 15 and 16) were sent for physico-chemical analysis. The reason behind isolating these 6 samples is to ease comparison of chemical assessment and assessment by experts by statistical method.

DISCUSSION:

Texts have mentioned two types of Vanga Dhatu – Mishraka and Khurakara as well as Shveta and Krushna. Among these, Khuraka from Grahya category is associated with shape, whereas, Mishraka depicts its mixed nature. These two types are also taken as standards for Grahya and Agrahyatva. Shveta and Krishna types depict colour and these are useful to ascertain Grahyagrahyatva.

This explains the importance of Grahyagrahyatva of Vanga Dhatu according to its types. Grahyatva of a sample is mostly dependent on its purity and quality. Grahya and Agrahya Lakshana of Maharasa, Uparasa, Sadharana Rasa and Dhatu have been mentioned in their respective contexts. These criteria have been mentioned on the basis of available sources in the olden days. Similarly, they have been mentioned with relevance to nature, so as to ease their identification. Critical study of Grahyagrahyatva criteria reveals its proper meaning. These Grahyagrahyatva criteria were subjective and interpreted differently with individual observations. To standardize these criteria correlation with the modern parameters should be searched. In Grahya Lakshana of Dhatu, criteria like specific Varna (Colour), Gurutva (Specific gravity), Mridutva (Softness), Snigdhatva (Metallic luster) and Nirmalatva (purity) have been mentioned. The importance of Grahya assessment of Grahyatva is constant even today because their primary role in identity, purity and quality. Chemical assessment of samples is not possible every time as it is time consuming and costly. Easy assessment in less time, using available sensory resources was the speciality of ancient method. Though subjective, this method was adequate and safe as well as cost effective for that period.

Table No. 15, Correlation of Grahyagrahyatva criteria with modern standards

Sr. No.	Criteria	Indicating Standards
1	Dhavala	Purity, Quality
2	Shubhra	Purity, Quality
3	Candrabham	Identity, Purity, Quality
4	Nirmal	Purity

Sample collection of Vanga from various sources and from various parts of India gives varied range of samples with special characteristics. Every criterion applied on each sample and individual observations of the experts were filled numerically in the proforma. Proforma is basic tool in which subjective observations were converted into numerical values. Assessment of criteria was done by clumping the Grahya and Agrahya norms according to similarity and weightage i.e. importance among all criteria. This method helps the expert for easier assessment of criteria. Clumped group GV1 represents slimily criteria and posses weightage of five, GV2 represents silvery white colour of Vanga having weightage of four. Both these groups represent Grahya Varna of Vanga. Group GV3 represents Shuddhata (purity) of the Vanga. Group GV4 shows different criteria having weightage of two. GV5 includes criteria which are difficult to understand and difficult to assess.

Finally all the criteria were not scored individually but clumped under single group e.g. GV1, GV2 etc., due to similarities in the criteria. The criteria within the groups possess its importance at the different levels, so that group scores were multiplied by 5,4,3,2. This statistical calculation is called as weightage, which is applied to Grahya and Agrahya criteria.

While setting rules for standardization of a certain substance, both the criteria i.e. what should be in it and what should not, are equally important. A substance does not remain pure if impurities in it go beyond their minimal limits and hence becomes of no use.

AV1 includes Agrahya criteria Shyamasubhraka and Mishraka which indicates mixed colour or mixed Dhatu in Vanga. As both were important criteria for assessment, posses weightage of three. Group AV2 contains criteria Dhusara and

Anyadhatuvimishritam, having weightage of two.

Ruksha, Kathina, Krusna were included in the group AV3. These criteria were rarely seen in the samples so weightage given was one.

This statistical assessment helps in the selection of Grahya and Agrahya samples more accurately. The criteria applied to Vanga samples were subjective and difficult to compare with one another. The score given during the assessment gives proper valuation of criteria. The application of statistical assessment is definitely useful.

CONCLUSION:

Present study is aimed and designed to study the Grahyagrahyatva of Vanga. Database of Grahyagrahya parameters of Vanga from Rasashastra texts is prepared and assessed statistically. This study reveals following conclusions.

1. Despite extensive use of metals in Ayurvedic medicines, the aspect of their standardization is seen relatively unexplored.
2. Conceptual study of Vanga Grahyagrahyatva reveals importance of synonyms in standardization.
3. The Grahya and Agrahya criteria of Vanga were studied critically to derive their exact meaning and standard database was created which is crucial aspect of this study. For e.g. Text quotes name Vanga as it is obtained from 'Vanga Desha'.
4. Proforma is the basic tool with the help of which subjective observations were converted into numerical values.
5. Statistical tests 'Kolmogorv-Smirnov' and 'Anova' were applied to the data generated through the subjective assessment of samples by proforma, three extremely Grahya, 2, 3, 12 and three extremely Agrahya, 13,15,16 samples were selected.
6. Grahyagrahyatva criteria can be made easily understandable. Numerical value gives more precise and standard results according to research methods.

Important note:

It will be interesting to note the results of the further extension of present study. Modern parameters (Physical, Chemical, Metallurgical etc.) applied to assess these six final samples confirmed there standards in the same manner and in the same order of quality which was obtained using above cited statistics.

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