COMPARATIVE STUDY OF SOME COMMERCIAL SAMPLES OF NAGA BHASMA

Mrudula Wadekar*, Viswas Gogte+, Prasad Khandagale++ and Asmita Prabhune∗
∗Division of Biochemical Sciences, National Chemical Laboratory,
PUNE 411008
+Deccan College, Deemed University, Pune-411006++ Loctite, Jejuri-412303

Received : 10-12-2003                                     Accepted : 12.2.2004

ABSTRACT: Naga bhasma is one of those reputed ayurvedic bhasmas which are claimed to possess some extraordinary medical properties. However, identification of a genuine sample of naga bhasma is a challenging problem. Because at present naga bhasma is manufactured by different ayurvedic pharmacies, by following different methods, these products are not standardised either from chemical and structural point of view. Therefore, comparative study of these samples using modern analytical techniques is important and necessary to understand their current status. In this communication, such study of naga bhasma from chemical and structural point of view is reported by using XRD, IR and UV spectroscopy and thermogravimetry.

INTRODUCTION

Naga bhasma, which is obtained from metallic lead, is a miraculous ayurvedic drug[12]. Its significant medicinal properties[3,4] include (i) improvement of basic human metabolism (ii) excellent remedy against chronic hyperacidity due to stomach enlargement epilepsy and hysteria (iii) antidiabetic activity, and utility as a powerful tonic in diabetic weakness as well as diabetic coma (iv) recovery from chronic paralysis (v) acceleration of the process of bone formation and bone strengthening(vi) testicular regenerative potential.

According to the modern science, lead and lead compounds are toxic to human health. Therefore, manifestation of some extraordinary medicinal properties in naga bhasma indicates that, the ayurvedic processes performed during its preparation must be bringing about some radical changes in lead, which not only destroy its toxic nature but impart extraordinary medicinal properties ascribed to naga bhasma.

In spite of its reputation, naga bhasma is not accepted as an approved drug on international level. In India also, it is not as popular as it should be, most probably due to lack in advanced research to justify the claims regarding the merits of naga bhasma on experiment basis. Therefore, synthesis, characterization and biomedical investigation of naga bhasma using modern techniques is an exciting and promising area for advanced research. Accordingly we have undertaken detailed research investigations of naga bhasma. As a part of this, a comparative study of some representative samples of naga bhasma from chemical and structural point of view by using XRD, IR and UV spectroscopy and thermogravimetry is reported here.

MATERIALS AND METHODS

(a) Collection of Samples:-
Commercial samples of naga bhasma from the following representative pharmacies were obtained.
| Sr. No. | Name of Pharmacy | Code Number |
|---------|------------------|-------------|
| 1.      | Koral Pharmacy (Nasik) | NAG.01      |
| 2.      | Baidyanath (Nagapur) | NAG.02      |
| 3.      | Hariparashuram (Pune) | NAG.03      |
| 4.      | Dootpapeshwar (Mumbai) | NAG.04      |
| 5.      | Krishna Gopal (Ajamer) | NAG.05      |

Following lead oxides (E-merk) were also obtained for comparative purpose:

(i) PbO (Litharge)
(ii) PbO2 (Lead dioxide)
(iii) Pb3O4 (Red lead)

(b) Preliminary Investigations

Preliminary investigations of the sample under study, which include examination of solid state colour, solubility and quantitative estimation of lead by volumetry with EDTA5 were carried out before their detailed structural investigations.

(c) Structural Investigations

XRD patterns

The XRD patterns of the solid samples were recorded on Rigaku CD-MAX II VC model X-ray diffractometer using CuKα radiation filtered by nickel foil over the range of diffraction angle 3.0 to 50.0°. The readings of the diffraction angle were made up to the accuracy of 0.01°. The wave length of the radiation used was 1.5405 Å.

(d) Infrared spectra

Infrared spectra of all the samples along with the three lead oxides selected for comparative purpose were recorded in KBr pellets in the region 4000-450 cm⁻¹ on Perkin-Elmer FTIR spectrophotometer model 1600.

(e) Electronic Spectra

These are recorded in solid state in KBr discs in the region 200-1100 nm against pure KBr disc as the reference. About 1.0 mg of the sample was mixed with 100mg of spectroscopic KBr and transparent pallets of about 0.1 mm thickness were obtained for recording the spectra. The spectra were recorded on a Shimadzu spectrophotometer model UV-300.

(f) Thermogravimetry

Thermogravimetry of all the samples were recorded in air atmosphere on a NETZSCH simultaneous thermoanalyzer STA 409 model with platinum thermo cups and pt/pt/10% Rh thermocouples. For each run about 20-25 mg samples were taken and the heating rate was maintained at 10°C per minute.

RESULTS AND CONCLUSIONS

(a) Colour, Solubility and Lead content

The results of colour examination, solubility in water and 2N HO₃, and quantitative estimation of lead content are given in TABLE 1.

The variation in colour (from yellow-red-brown) as well as % Pb are most probably due to the difference in the method of preparation of naga bhasma. This is a general observation for most of the ayurvedic bhasmas, because of each bhasma of mineral origin; a large number of diverse methods for its preparation are reported in ancient ayurvedic literature. These are
individually followed by different ayurvedic pharmacies, the end products of which are likely to be different as indicated by differences in their general physical and chemical properties.

(b) XRD Investigations

The XRD patterns of the samples are shown in figure 1 and the results of their analysis using search March programme are summarized in Table II.

The XRD investigation leads to following general conclusions:
(i) All the samples are predominantly crystalline in nature as indicated by the line structure of XRD patterns. (ii) All samples are complex mixtures of PbO, PbO$_2$, and other lead compounds; the sample NAG.05 being the most complex in nature (iii) from the composition observed through XRD, the first four samples seemed to be prepared using plant materials alone for bhasmikarana (i.e. they are vanaspaty marit). The fifth sample (NAG.05) seems to be prepared by using arsenic sulfide for bhasmikarana as indicated by the presence of (AsO$_4$)$_3^-$ in the sample (i.e. this is manashila As$_2$S$_3$ marit)

Thus XRD investigation gives some guide lines useful for further detailed structure analysis.

c) Infra red spectra

The IR spectra are shown in Figure 2 and the significant IR peaks along with their probable assignments are given in TABLE III.

These spectra are interpreted in the light of the data provided by XRD (TABLE II). This data shows that samples of naga bhasma contain (i) hydroxy group (OH) and carbonate group (CO$_3$)$^2$ in all samples (ii) The sample NAG.05 contain sulfate (SO$_4$)$^2$ and (ASO$_4$)$^3$ as the important constituents also. When the IR spectra are carefully analysed, it was found that there is clear evidence in favour of the presence of the above referred four groups as indicated by the peaks corresponding to these groups. Thus carbonate, lead sulfate and lead arsenate. Apart from these, other minor constituents and trace constituents may be also present which are presently under estimation.

(b) The composition and structure of individual samples are different, which depend on the method of their preparation. Therefore, none of these samples can be selected as a standard sample of naga bhasma.

(c) For deciding merits and demerits of the commercial sample, each sample should be individually studied in detail. This study should include (i) knowledge about the method of its preparation and its reproducibility. (ii) Elemental analysis, which includes percentage of all major, minor and trace constituents (iii) chemical and structural aspects of the components (iv) biomedical investigations which should include pharmacological studies and clinical trials.

(d) Such detailed study of selected samples of nagabhasma is in progress under this project.

ACKNOWLEDGEMENTS

Our sincere thanks, are due to Council of Scientific and Industrial Research (CSIR) for awarding Research Associate ship to Dr. (Mrs) Mrudula Wadekar for this work. Thanks are also due to Director, National Chemical Laboratory, Pune and Dr. G. T.
Panse, Retired Scientist NCL for providing the necessary facilities and to Prof. B.A. Kulkarni for his guidance throughout the work.

REFERENCES

1. Brokar D.B., Rasaratnakar Shri. Gajanan Book Depot, Pune (1986)

2. Kulkarni S.B.- Dudhgavkar, Rasaratnasumuccaya Shivaji University, Kolahpur (1970)

3. Singh M., Joshi D and Arya N.C. Ancient science of life vol IX, 95-98 (1989)

4. Chaube A, Nagaraja T.N., Dixit S.K., Agarwal J.K., Kumar M. and Prakash B. Ancient science of life vol XV 153-155 (1995)

5. A.I. Vogel A text book of Quantitative inorganic Analysis’ ELBS 4th ed (1978)

6. Clive Whiston, X-ray Methods chapter 3. ACOL series, John Wiely and sons, New York (1987)

7. Kazuo Nakamoto Infrared spectra of Inorganic and Coordination Compounds, 2nd ed. Wiley Inter science.

8. Nyguist R.A. and Kargal R.D. Infrared spectra of Inorganic Compounds, New York (1963).

9. Rao C.N.R., Ultra-Violet and Visible Spectroscopy, Chemical Applications. 3rd ed. London; Butter Worths (1975)

10. Wendlandt W.W; Thermal method of analysis, 2nd ed., New York, Wiley (1974).

TABLE 1
Colour, Solubility and Lead content of Naga Bhasma

| Sr.No. | Sample Code No. | Colour       | Solubility     | % Lead |
|--------|-----------------|--------------|----------------|--------|
|        |                 |              | Water          | 2NHNO3 |
| 1.     | NGA.01          | Red          | Partly Soluble | 99%    | 76.48  |
| 2.     | NGA.02          | Orange       | Partly Soluble | 100%   | 72.28  |
| 3.     | NGA.03          | Yellowish    | Partly Soluble | 97%    | 85.16  |
| 4.     | NGA.04          | Yellow       | Partly Soluble | 95%    | 61.62  |
| 5.     | NGA.05          | Brown        | Partly Soluble | 96%    | 60.54  |
### TABLE II
**XRD Investigation of Naga Bhasma**

| Sr.No. | Sample Code No. | Constituents Identified                                                                 |
|--------|-----------------|----------------------------------------------------------------------------------------|
| 1.     | NGA.01          | PbO+Pb_3O_4+Pb (CO_3)_2(OH)_2                                                            |
| 2.     | NGA.02          | PbO+Pb_3O_4+Pb (CO_3)_2(OH)_2H_2O+Pb_10(CO_3)_6(OH)_6O                                   |
| 3.     | NGA.03          | PbO+Pb (CO_3)_2(OH)_2+Pb_10(CO_3)_6(OH)_6O                                              |
| 4.     | NGA.04          | PbO+Pb (CO_3)_2(OH)_2+Pb_10(CO_3)_6(OH)_6O                                              |
| 5.     | NGA.05          | [KNaPb_8 (AsO_4)_6]+[Pb_4(SO_4)(CO_3)_2(OH)_2]+[NaPb_4(AsO_4)_3] +[K_2Pb(SO_4)_2]+[Pb_2(SO_4)_4] |

### TABLE III
**Infrared spectra of Naga Bhasma**

| Sr. No. | Sample Code Number | Significant Absorption peaks in cm\(^{-1}\) and Assignments | \(\delta(OCO)\) | \((CO_3)^+\) | \((OH)^-\) | \((OH^+)\) | \((CO_3)^-\) | \((CO_3)^-\) | \((SO_4)^2-\) | \((ASO_4)^2-\) |
|---------|--------------------|-------------------------------------------------------------|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1.      | NGA.01             | 3529 2363 1406 1044 - - 890 682 668                          | 841 -          | 870 683 668 |
| 2.      | NGA.02             | 3466 2361 1406 1040 - - 880 682 668                          |                | 874 682 668 |
| 3.      | NGA.03             | 3466 2361 1404 1020 - - 870 683 668                          |                | 874 682 668 |
| 4.      | NGA.04             | 3445 2360 1417 1020 - - 874 682 668                          |                | 874 682 668 |
| 5.      | NGA.05             | 3447 2361 1400 1020 1090 841 - 681 668                       |                | 874 682 668 |

### TABLE IV.
**Electronic Spectra of Naga Bhasma**

| Sr.No. | Sample Code Number | Absorption Maximum \((\lambda)_{Max}\) in nm |
|--------|--------------------|----------------------------------------------|
| (i)    | PbO                | 366 400 422                                   |
| (ii)   | PbO_2              | 287 430 591                                   |
| (iii)  | Pb_3O_4            | 298 418 494                                   |
| 1.     | NGA.01             | 257 406 550                                   |
| 2.     | NGA.02             | 254 400 550                                   |
| 3.     | NGA.03             | 254 400 550                                   |
| 4.     | NGA.04             | 258 400 590-630                               |
| 5.     | NGA.05             | 249 382 520                                   |
Figure 1: XRD Patterns of *Naga bhasma*
Figure 2: Infrared spectra of *Naga Bhasma*
Figure 3: UV (Electronic) spectra of Naga Bhasma
Figure 4: TG Curves of Naga bhasma