*Asian Journal of Chemistry* Vol. 15, No. 2 (2003), 851–854

# Infrared Spectrophotometry in Studies on Herbal Drug Triphala Churna

Mrs. ANAGHA S. BAHULIKAR†, Mrs. R.V. KASHALKAR†
and M.D. PUNDLIK*
*Bhide Foundation for Research and Education in Chemistry*
*Department of Chemistry, S.P. College, Tilak Road, Pune-411 030, India*

Infrared spectrophotometry is a useful analytical technique for the identification of drugs and is recommended as one of the parameters for testing in various pharmacopoeias. At present the Ayurvedic Pharmacopoeia is not referring to sophisticated instrumental analytical techniques for the purpose of characterization and identification of Ayurvedic formulations. The present work demonstrates the utility of the IR spectrophotometry in the identification and characterization of Triphala, based on typical characteristic IR frequencies for identifying the herbal drug.

**Key Words: IR, Triphala Churna.**

## INTRODUCTION

Infrared spectrophotometry is a useful analytical technique for the identification of drugs and is recommended as one of the parameters for qualitative identification in various allopathic pharmacopoeias. In pharmacopoeial analysis, a known compound or a known drug is subjected to various identification tests which provide a means of verifying that the material being examined is in accordance with the contents of the label. Adopting the same approach if one has to study the herbal drugs, one has to perform various identification tests as described in pharmacopoeial standards for Ayurvedic formulations[1].The characterization of Triphala Churna is based on water-soluble extractives, alcohol-soluble extractives, total ash and acid-insoluble ash. Triphala Churna is a mixture of crude herbal drugs—Amalaki (*Emblica officinalis*), Beheda (*Terminalia bellerica*) and Haritaki (*Terminalia chebula*) in 1 : 1 : 1 proportion in powder form. The characterization of these crude herbal drugs is given in Ayurvedic pharmacopoeia[2] and is based on the same characteristics as described for Triphala Churna and also macroscopic and microscopic characteristics. At present both the above Ayurvedic Pharmacopoeial Standards do not refer to any other parameter for characterization and identification of these drugs. In view of the complexity of the herbal drugs, whether a single herbal drug or a formulation, it will be worthwhile to add as many testing parameters as possible including the instru-

†Department of Chemistry, S.P. College, Tilak Road, Pune-411 030, India.

mental techniques, to further strengthen the identification and characterization of herbal formulations. Chromatographic and spectrophotometric techniques have been used for this purpose in phytochemical studies. Thin layer chromatography[3] and high performance liquid chromatography[4] studies on Triphala Churna for the purpose of identification, quality control and standardization have been reported. The literature survey shows that there are few references pertaining to infrared spectral studies on herbal drugs. Standardization of a single herbal drug using IR spectrophotometry has been reported by Asif[5]. The scope of spectroscopy both IR and UV in checking the purity of the herbal drugs and quality control has been studied.[6] Singh and Prakash[7] have reported identification of some Ayurvedic drugs, including Triphala Churna, using IR spectrometer and the identity of the drugs was established by matching the spectra of known standard drug. Recently the utility of FTIR in distinguishing different *Ganoderma lucidum* products (mushroom Rishi), which grows naturally in Japan and China, has been reported.[8] In these studies, the IR spectra were recorded by directly pressing the powdered samples of the products into KBr discs. In the present communication, we report our findings regarding the infrared spectral studies on Triphala Churna and its three constituents with a view to see the possible utility of this technique for the purpose of identification and quality control of Triphala Churna.

## EXPERIMENTAL

Gallic acid and tannic acid (gallotannins, gallotannic acid) obtained from Qualigens were of analytical grade. Fine powders of Amalaki, Beheda and Haritaki were procured from local Ayurvedic agencies. Triphala Churna, a mixture of these powders in 1 : 1 : 1 proportion was prepared as reference standard. The infrared spectra of the powdered samples of Amalaki, Beheda, Haritaki and Triphala Churna as also gallic acid and tannic acid, were recorded on Shimadzu FT-IR 8400 using mull technique.

## RESULTS AND DISCUSSION

The constituents of Amalaki, Beheda and Haritaki as mentioned in literature are ascorbic acid and gallotannins, tannins and polyphenolic compounds and gallic acid, tannic acid, ellagic acid, digalloyl glucose, etc. However, recent work of Ghosal *et al.*[10] has shown complete absence of L-ascorbic acid in Amalaki and the potent vitamin C-like activity has been located in the low molecular weight hydrolysable tannins. The hydrolysable tannins in Amalaki are known to contain gallic acid and ellagic acid. All the three constituents of Triphala Churna thus contain gallic acid and gallotannins and therefore we have recorded the IR spectra of gallic acid and tannic acid in our studies along with the spectra of Amalaki, Beheda, Haritaki and Triphala Churna in powder form.

The infrared spectra and their characteristic frequencies are tabulated in Table-1. The infrared spectra of gallic acid and tannic acid show typical frequencies due to —OH stretching vibrations of both phenolic as well as hydroxyl group of carboxylic acid and carbonyl stretching frequencies. All these frequencies, however, have undergone substantial downward shift and consider-

able broadening and intensification of the absorption band due to intermolecular hydrogen bonding in phenols. Further, the conjugation of the carboxyl group with the aromatic ring also results in large decrease in the —OH and C=O stretching frequencies[11]. Therefore the bands in the region 3390–3200 $cm^{-1}$ can be assigned to —OH stretching vibrations. The bands in the region 1725–1600 $cm^{-1}$ may be assigned to C=O stretching vibrations. All these bands are also observed in the spectra of Amalaki, Beheda, Haritaki and Triphala Churna as they also have gallic acid and gallotannins as major constituents. In all the IR spectra there is a band of low intensity at 2360 $cm^{-1}$ which could not be assigned to any of the frequencies attributable to gallic acid or gallotannins.

TABLE-1
INFRARED SPECTRAL BANDS ($cm^{-1}$) OF TRIPHALA CHURNA AND ITS COMPONENTS

| Gallic acid | Tannic acid | Amalaki | Beheda | Haritaki | Triphala | Probable assignments |
|---|---|---|---|---|---|---|
| 3359 b | 3390 b | — | 3371 b | 3328 b | 3352 b | |
| 3278 b | — | 3286 b | — | — | — | OH- stretching vibrations |
| 2854 sl | 2881 bl | 2852 sm | 2852 s | — | — | |
| — | — | — | 2727 l | 2725 l | 2725 b | |
| 2360 l | — | 2351 l | 2360 l | 2360 l | 2358 l | ? |
| 1699 ss | 1714 sm | 1714 l | 1712 l | 1716 lm | 1722 sm | C=O stretching vibrations |
| 1616 ss | 1608 sm | 1614 l | 1614 bl | 1608 bm | 1608 sm | |
| 1541 sm | 1541 sl | — | — | — | — | |
| 1249 bl | — | — | — | — | — | |
| 1203 sl | — | 1213 bl | 1238 bl | 1213 bl | 1207 l | Aryl-o-Aryl bridges |
| | 1193 bm | — | 1157 l | 1163 l | — | |
| 1026 ss | 1056 sl | 1022 l | 1029 bl | 1029 bl | 1031 bl | |
| | 1024 sm | — | — | — | — | |
| 867 sl | 869 sl | — | — | — | — | |
| 765 sl | 756 sl | — | — | — | — | |
| | 723 sl | — | 725 sm | 723 sm | 721 sm | |
| 702 sl | — | — | — | — | — | |

b, broad; m, medium; l, low; ss, sharp strong; sm, sharp medium; lm, low medium; bl, broad low; sl, shoulder.

One more interesting feature observed in all these spectra is the presence of the band of low to medium intensity in the region of 1250–1200 $cm^{-1}$ and another band in the region 1030–1020 $cm^{-1}$ whose intensity varies considerably from being strong in case of gallic and tannic acids to low in case of Amalaki and broad band in case of Beheda, Haritaki and Triphala. The major tannin constituents present in the three myrobalans belong to ellagitannins class. Ellagitannins have a strong tendency to combine to higher aggregates, which are characterized by aryl-o-aryl bridges[12]. Aryl ethers show strong broad band due to C—O

stretching vibrations in the region 1275–1200 $cm^{-1}$ and a weaker band in the region 1075–1020 $cm^{-1}$. [13] Therefore the bands observed in all the spectra in the region 1250–1200 $cm^{-1}$ and 1075–1020 $cm^{-1}$ may be assigned to aryl-o-aryl bridges in ellagitannins.

The IR spectra of Triphala Churna and its three constituents distinctly show the presence of —OH stretching vibrations of both phenolic and carboxylic acid group, carbonyl stretching vibrations and the bands due to aryl-o-aryl bridges, which are typical features of gallic acid, gallotannins and ellagitannins (hydrolysable tannins) which are constituents of Triphala. In view of the above, the infrared spectrophotometry may be used for identification and characterization of Triphala Churna by comparing the market samples with known standard drug, in addition to the parameters listed in pharmacopoeial standards for Ayurvedic formulations.

## ACKNOWLEDGEMENTS

Authors' thanks are due to Prof. A.S. Bhave, Head, Department of Chemistry for providing necessary facilities. One of us (ASB) is grateful for the award of late Dr. T.R. Ingle fellowship of Department of Chemistry, S.P. College, Pune.

## REFERENCES

1. Pharmacopoeial Standards for Ayurvedic Formulations (a publication of Central Council for Research in Ayurveda and Siddha, Ministry of Health and Family Welfare, New Delhi-16) (1987).
2. The Ayurvedic Pharmacopoeia of Indla, Vol. I, part I, Government of India, Ministry of Health and Family Welfare, Department of Indian Systems of Medicine and Homeopathy, pp. 5, 26 (2001).
3. Mrs. A.S. Bahulikar, Mrs. R.V. Kashalkar and M.D. Pundlik, *Asian J. Chem.*, **15**, 155 (2003).
4. ———, *Asian J. Chem.*, **15**, 229 (2003).
5. Asif M. Shafiullah, Hamdard Medicus (*Medicinal and Aromatics Plant Abstracts*, **35**, 116 (1992), Abstr. No. 9205-3387).
6. M. Asif, Spectroscopy and Standardization of Herbal Drugs, Proceedings of National Seminar on History of Unani Medicine in India, 16–17 April 1993, New Delhi *(Medicinal and Aromatic Plants Abstracts*, **15** (1993), Abstr. No. 3238).
7. Jnanandra Singh and Ram Prakash, *Indian Drugs*, **34**, 360 (1997).
8. S.Q. Sun, D.G. Du, X.Y. Liang and X.R. Yang, *Fenxi Huaxue*, **29**, 309 (2001) (*Analytical Abstracts*, **63** (2001), Abstr. No. 9G148).
9. Wealth of India: Raw Materials, Council of Scientific and Industrial Research, New Delhi.
10. Sibnath Ghosal, V.K. Tripathi and Satish Chowhan, *Indian J. Chem.*, **35B**, 941 (1996)
11. L.J. Bellamy, The Infrared Spectra of Complex Molecules, Chapman & Hall, London, pp. 113, 132, 185 (1975).
12. Sir Derek Barton and Koji Nakanishi (Eds.), Comprehensive Natural Products Chemistry, Vol. 3, Elsevier, Amsterdam, p. 801 (1999).
13. R.T. Morrison and R.N. Boyd, Organic Chemistry , Prentice-Hall of India, New Delhi, p. 812 (1969).

(*Received*: 5 October 2002; *Accepted*: 18 December 2002) · AJC-2940