

Pharmaco-Botanical Studies for Quality Assessment of Commercial Samples of Some Herbal Drugs of Root and Rhizome Origin

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Abstract

Commercial samples of six herbal drugs of root and rhizome origin viz. *Acorus calamus* Linn., *Bergenia ciliata* (Haw.) Sternb., *Gmelina arborea* Roxb., *Nardostachys grandiflora* DC, *Picrorhiza scrophulariflora* Pennel. and *Withania somnifera* (Linn.) Dunal. were evaluated to assess their quality in respect of identity, purity and strength. The samples were resourced from Delhi, Hardwar and Cochin/Trichur markets. Evaluation is based on specific parameters and limits prescribed in Ayurvedic, Unani and Siddha Pharmacopoeia and as well in other literature.

Key-words: Pharmacognostic evaluation, Commercial herbal drugs, Quality assessment.

Introduction

Medicinal plants are used not only to formulate medicines but also for health supplements, natural dyes, perfumery, cosmetics, toiletries etc. The demand for medicinal plants to fetch the need of different stakeholders is growing at a very fast pace. There is a global awareness for the herbal products. But in India, the supply of medicinal plants has not kept pace with the increasing global demand for medicinal plants. India is endowed with a rich wealth of medicinal plants and these plants have made a good contribution to the development of ancient Indian Materia Medica.

About 90% of medicinal plants used by the industries are collected from the wild resources. It is estimated that about 800 species are used in production by the pharmaceutical industry, whereas less than 40 species of plants are under commercial cultivation. Over 70% of the plant collection involves destructive harvesting. This poses a definite threat to the genetic stocks and to the diversity of medicinal plants.

Adulterants/substitutes are being traded/used with at times with full knowledge of the sellers/buyers and are very common in the herb trade especially when the trade is involved. Herbs sold in powdered forms, eg: - the powders of *Pterocarpus santalinum* (Red Sandal or Lal Chandan) are much more prone to adulteration. The use of some species as substitute of a medicinal plant comes in the picture when the originally recommended plant gets rare and its price rises. In many cases, substitutes have taken over the original plants. In some cases, substitutes have become popular, manufacturers have forgotten about the original plant and they only use substitutes available in the market. It is very much doubtful if such substitution is made after testing or as recommended by any authority. Sometimes different morphological parts of same plant species

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is used in place of prescribed part. Use of stem bark in place of roots are not uncommon. At times mere look alike species are used as a substitute, which may not even contain the active ingredients available through the main plants nor the effects of the end product is the same as that obtained from that of original plant (Sharma, 1987 and Rai *et al.*, 2011).

In some cases, pharmacopoeia and formularies permits the use of substitutes in place of original plants thus, giving legitimacy to the substitutes.

Materials and Methods

The root and rhizome herbal drugs under study were collected from natural habitats and authenticated with references to pharmacopoeial standards and other literature. The commercial samples sold under the trade names purported to be prescribed species were drawn from the different market sources (Hardwar, Delhi and Cochin/Trichur). Standard protocols/methods prescribed in pharmacopoeia were followed for pharmacognostical, physico-chemical and phytochemical values prescribed in Ayurvedic, Unani and Siddha Pharmacopoeia of India were taken as standards values (Anonymous, 1986,1998,1999,2007a,b,&2008).

Table 1. Commercial Herbal Drugs studied

No.	Botanical Name	Official Name	Trade Name	Morphological	Official Standards
1.	<i>Acorus calamus</i> Linn.	Vacha	Vach	Rhizome	API-II UPI-II
2.	<i>Bergenia ciliata</i> (Haw.) Sternb.	Pashana- bheda	Pashana- bheda	Rhizome	API-I
3.	<i>Gmelina arborea</i> Roxb.	Gambhari	Gambhari	Root Bark	API-I
4.	<i>Nardostachys grandiflora</i> DC syn.N. <i>jatamansi</i> DC	Jatamansi	Jatamansi	Rhizome	API-I UPI-I SPI-I
5.	<i>Picrorhiza scrophulariflora</i> Pennel. Syn. <i>P. Kurroa</i> auct. non Royle	Katuka	Kutaki	Rhizome	API-II UPI-IV SPI-I
6.	<i>Withania Somnifera</i> (Linn.) Dunal.	Ashvagandha	Asgandh	Roots	API-I UPI-I SPI-I

Observations and Results

All the commercial samples of the drugs were evaluated as per the specifications laid in Pharmacopoeia and other literature. Observation made are given in Table 2 to 7.

Table 2. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Acorus calamus* Linn.

Sl. No.	Specifications	Official Standards API-II & UPI-II	Samples drawn from the market of		
			Delhi	Hardwar	Cochin / Trichur
A.	Identification (Pharmacognostical)-				
	a. Entire Drug-Organoleptic	Specifications prescribed	Conforms	Conforms	Slightly varies
	b. Entire Drug Microscopic		Conforms	No conformance	No conformance
	c. Powdered drug		Conforms	Conforms	No conformance
B.	Purity & Strength (Physico-Chemical constants)-				
	i. Foreign Matter, %, Not more than	1.0	1.20	0.60	2.90
	ii. Total ash, %, Not more than	7.0	5.80	6.80	6.00
	iii. Acid- insoluble ash, %, not more than	1.0	0.80	0.50	0.95
	iv. Alcohol-soluble extractives, %, not less than	9.0	12.50	15.20	12.00
	v. Water-soluble extractives, %, Not less than	16.0	22.30	19.00	17.50
	vi. Volatile Oil, %, Not less than	2.0	1.8	0.6	0.5
C.	Moisture Content, %	No Specifications prescribed	7.20	5.20	6.50
D.	Major organic groups (Phytochemical)-				
	(i) Alkaloids	No Specifications prescribed	-	-	-
	(ii) Tannins		√	√	√

Sl. No.	Specifications	Official Standards API-II & UPI-II	Samples drawn from the market of		
			Delhi	Hardwar	Cochin / Trichur
	(iii) Glycosides	No Specifications prescribed	-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Flavonoids		-	-	-
	(vii) Anthraquinone		-	-	-
	(viii) Resins		-	-	-
	(ix) Fixed oil		-	-	-
	(x) Poly phenolic compounds		-	-	-

Table 3. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Bergenia ciliata* (Haw.) Sternb.

Sl. No.	Specifications	Official Standards API-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
A.	Identification (Pharmacognostical)-				
	Entire Drug-Organoleptic	Specifications prescribed	Slightly varies	Conforms	Conforms
	Entire Drug Microscopic		No conformance	Conforms	Varies
	Powdered drug		No conformance	Conforms	Varies
B.	Purity & Strength (Physico-Chemical constants)-				
	Foreign Matter, %, Not more than	2.0	1.80	0.90	1.30
	Total ash, %, Not more than	13.0	13.00	8.30	12.20
	Acid- insoluble ash, %, Not more than	0.5	2.20	0.16	2.30
	Alcohol-soluble extractives, %, Not less than	9.0	11.00	14.30	10.20
	Water-soluble extractives, %, Not less than	15.0	13.50	18.20	15.40
C.	Moisture Content, %	No Specifications prescribed	5.50	4.20	6.50

Sl. No.	Specifications	Official Standards API-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
D.	Major organic groups (Phyto-chemical)-				
	(i) Alkaloids	No Specifications prescribed	-	-	-
	(ii) Tannins		-	-	-
	(iii) Glycosides		-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Flavonoids		-	-	-
	(vii) Anthraquinone		-	-	-
	(viii) Resins		-	-	-
	(ix) Fixed oil		-	-	-
	(x) Poly phenolic compounds		-	-	-

Table 4. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Gmelina arborea* Roxb.

Sl. No.	Specifications	Official Standards API-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
A.	Identification (Pharmacognostical)-				
	Entire Drug-Organoleptic	Specifications prescribed	Conforms	No conformance	Slightly differs
	Entire Drug Microscopic		Conforms	No conformance	No conformance
	Powdered drug		Conforms	No conformance	No conformance
B.	Purity & Strength (Physico-Chemical constants)-				
	Foreign Matter, %, Not more than	2.0	0.90	1.50	1.80
	Total ash, %, Not more than	5.0	4.10	6.30	7.25
	Acid- insoluble ash, %, Not more than	0.3	0.50	2.12	1.20
	Alcohol-soluble extractives, %, Not less than	7.0	9.20	7.40	6.20
	Water-soluble extractives, %, Not less than	20.0	22.20	21.50	19.40

Sl. No.	Specifications	Official Standards API-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
C.	Moisture Content, %	No Specifications prescribed	5.50	4.80	7.80
D.	Major organic groups (Phyto-chemical)-				
	(i) Alkaloids	No Specifications prescribed	√	√	-
	(ii) Tannins		-	-	-
	(iii) Glycosides		-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Flavonoids		-	-	-
	(vii) Anthraquinone		-	-	-
	(viii) Resins		-	-	-
	(ix) Fixed oil		-	-	-
	(x) Poly phenolic compounds		-	-	-

Table 5. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Nardostachys grandiflora* DC

Sl. No.	Specifications	Official Standards API-I, UPI-I, SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
A.	Identification (Pharmacognostical)-				
	Entire Drug-Organoleptic	No Specifications prescribed	Conforms	Conforms	Conforms
	Entire Drug Microscopic		Varies	Conforms	Slightly varies
	Powdered drug		Varies	Conforms	Conforms
B.	Purity & Strength (Physico-Chemical constants)				
	Foreign Matter, %, Not more than	5.0	6.10	3.80	2.10
	Total ash, %, Not more than	9.0	10.80	5.20	7.50
	Acid- insoluble ash, %, Not more than	5.0	7.20	2.90	3.20
	Alcohol-soluble extractives, %, Not less than	2.0	2.10	9.60	6.00

Sl. No.	Specifications	Official Standards API-I, UPI-I, SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
	Water-soluble extractives,%, Not less than	5.0	3.60	7.50	12.00
	Volatile oil,%, Not less than	0.1	0.05	0.07	0.00
C.	Moisture Content, %	No Specifications prescribed	5.40	3.20	6.80
D.	Major organic groups (Phyto-chemical)-				
	(i) Alkaloids	No Specifications prescribed	-	-	-
	(ii) Tannins		-	-	-
	(iii) Glycosides		-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Essential Oils		√	√	√
	(vii)Flavonoids		-	-	-
	(viii) Anthraquinone		-	-	-
	(ix) Resins		√	√	√
	(x) Fixed oil		-	-	-
	(xi) Poly phenolic compounds		-	-	-

Table 6. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Picrorhiza scrophulariflora* Pennel.

Sl. No.	Specifications	Official Standards API-I,UPI-I & SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
A.	Identification (Pharmacognostical)-				
	Entire Drug-Organoleptic	Specifications prescribed	Conforms	Conforms	Conforms
	Entire Drug Microscopic		Conforms	Varies	Varies
	Powdered drug		Conforms	Varies	Varies
B.	Moisture Content, %	No Specifications prescribed	3.80	4.20	3.50

Sl. No.	Specifications	Official Standards API-I, UPI-I & SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
C.	Purity & Strength (Physico-Chemical constants)-				
	Foreign Matter, %, Not more than	2.0	1.20	1.60	2.10
	Total ash, %, not more than	7.0	6.80	5.20	6.20
	Acid- insoluble ash, %, Not more than	1.0	0.60	0.80	0.95
	Alcohol-soluble extractives, %, Not less than	10.0	10.80	13.60	11.00
	Water-soluble extractives, %, Not less than	20.0	21.00	22.20	20.50
D.	Major organic groups (Phyto-chemical)-				
	(i) Alkaloids	No Specifications prescribed	√	√	√
	(ii) Tannins		-	-	-
	(iii) Glycosides		-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Flavonoids		-	-	-
	(vii) Anthraquinone		√	-	-
	(viii) Resins		-	-	-
	(ix) Fixed oil		-	-	-
	(x) Poly phenolic compounds		-	-	-

Table 7. Pharmacognostical Evaluation of Commercial Crude Drug Samples of *Withania somnifera* (Linn.) Dunal.

Sl. No.	Specifications	Official Standards API-I, UPI-I & SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
A.	Identification (Pharmacognostical)-				
	Entire Drug- Organoleptic	Specifications prescribed	Conforms	Conforms	Conforms
	Entire Drug Microscopic		Slightly Varies	Conforms	Conforms
	Powdered drug		Varies	Conforms	Conforms

Sl. No.	Specifications	Official Standards API-I, UPI-I & SPI-I	Samples drawn from the market of		
			Delhi	Hardwar	Cochin/Trichur
B.	Purity & Strength (Physico-Chemical constants)-				
	Foreign Matter, %, Not more than	2.0	0.90	1.80	2.60
	Total ash, %, Not more than	7.0	7.80	3.90	4.20
	Acid- insoluble ash, %, Not more than	1.0	0.90	0.80	0.56
	Alcohol-soluble extractives, %, Not less than	15.0	17.20	18.50	12.50
	Water-soluble extractives, %, Not less than	–	6.10	2.10	3.25
C.	Moisture Content, %	No Specifications prescribed	3.20	2.80	4.50
D.	Major organic groups Major organic groups (Phytochemical)-				
	(i) Alkaloids	No Specifications prescribed	√	√	√
	(ii) Tannins		-	-	-
	(iii) Glycosides		-	-	-
	(iv) Sterols		-	-	-
	(v) Volatile Oil		-	-	-
	(vi) Flavonoids		-	-	-
	(vii) Anthraquinone		-	-	-
	(viii) Resins		-	-	-
	(ix) Fixed oil		-	-	-
	(x) Polyphenolic compounds		-	-	-

Abbreviation: API-Ayurvedic Pharmacopoeia of India, Part-I, UPI-Unani Pharmacopoeia of India, Part-I, and SPI-Siddha Pharmacopoeia of India, Part-I.

Discussion and Conclusion

Pharmaco-botanical evaluation of commercial samples of herbal drugs with comparison to genuine and authenticated crude drug sample as well with pharmacopoeial standards revealed the extent of authenticity of commercial samples. Each drug is discussed in discussed in foregoing text below-

Acorus calamus Linn. - Drug consists of dried a rhizome which occurs in simple or rarely with thumb- like branches at nodes, sub-cylindrical to slightly flattened or rarely straight. Light brown with reddish tinge to pinkish externally, buff coloured internally. The dried rhizome is wrinkled longitudinally. Taste is bitter and pungent. Powder is brownish or buff in colour.

Delhi sample conform to the authentic sample. Micro-morphological characteristics of Hardwar and Cochin samples do not conform to the specification. Market sample procured from the markets of Delhi and Cochin varies considerably in appearance. The macroscopica details of both the drug samples are more or less similar whereas microscopically characteristics of Hardwar and Cochin samples do not conform fully with that of the authentic specimen. Powder characteristics of Cochin sample do not conform to the authentic sample. A Physico-Chemical constant also varies from sample to sample. The volatile oil content of samples also varies probably due to the storage conditions. Wide variations exist between certain samples. Alkaloids and Tannins noticed in all the samples.

Bergenia ciliata (Haw.) Sternb. - Authentic drug samples are morphologically rhizomes, cylindrical and bowel shaped with ridges, furrows and distinct root scars, 1.5 to 3 cm long and 1 to 2 cm in diameter, brown in colour with distinct root scars and circular markings, dense and housed with reddish colour. Major phyto- constituents are Tannic and, Gallic acid .Tannins are present in all the three samples.

The drug is available throughout the country. It is a highly controversial drug. Micro morphological characteristics and powdered drug of Delhi sample do not conform to the authentic sample. Similarly, a micro morphological and powder characteristic of Cochin sample varies from the authenticated sample. Foreign matter content varies from 0.90% to 1.8%.Haridwar sample perfectly conforms to the authentic drug sample in all respects. Cochin sample varies in respect of micro morphological and powder characteristics. The Delhi sample not conforms to the authentic drug sample in respect of micro morphological and powder characteristics. However, the foreign matter in all the samples remains within the official limit. The demand of the drug is fairly growing.

Gmelina arborea Roxb. - Root bark is used as the drug which is yellowish in colour when fresh, root greyish brown in colour with fracture somewhat tough and brittle. Powder is greyish brown in colour.It contains alkaloids and lignans.

Delhi sample conforms to the authentic sample, while Cochin and Hardwar samples showed marked variation in macro and micro morphological and powder characteristics. Foreign matter content varies from 0.90% to 1.80%.Commercial

samples of Hardwar and Cochin markets show deviation from the authentic samples. Both the samples do not conform to the authentic sample in respect of macro-morphological, micro-morphological and powder characteristics.

Nardostachys grandiflora DC. –The drug is available as dried rhizome which are which are dark brown in colour covered with reddish brown fibres and internally reddish brown in colour. Powder is light brown in colour. Active chemical constituents are essential oils and resinous matter.

Micro-morphological and powder characteristics of the Delhi sample shows variation to that of authentic sample. Hardwar sample conforms to authentic sample. Foreign matter content is varying from 2.1% to 6.1%.It is an erect perennial herb mostly grows in the alpine zones of Central and Eastern Himalayas. The samples of Delhi showed considerable variation in respect of Micro morphological, powder characteristics and physico-chemical constants with the samples of Cochin and Hardwar. Hardwar samples show perfect correlation with authentic sample. All samples contain essential oil of varying degrees. A fresh sample of Hardwar contains more essential oil than others. Roots of *Selinium vaginatum* C B Clarke and *Cymbopogon schoenanthum* are reported to be used as adulterants (Sharma, 1987).

Picrorhiza scrophulariflora Pennel. – The drug is available as pieces of rhizomes greyish brown in colour straight or slightly curved with longitudinal wrinkles and Powder is grey in colour. Active chemical constituents are alkaloids.

Delhi sample conforms to that of authentic sample. Micro-morphological characteristics and powder characteristics of Hardwar and Cochin sample varies from that of authentic sample. Foreign matter content varies from 1.2% to 2.1%.This trailing herb is found in the alpine Himalayas from Kashmir to Sikkim up to 4300 m.above sea level. Market samples also differ considerably. Roots of *Helleborous niger* are also sold in the market of Cochin as Katu Kutki. The Samples of Cochin market seems to be adulterated. Probably it might be substituted with *Gentiana kurroo*. The micro-morphological characteristics and powder characteristics of Cochin and Hardwar samples varies from Delhi sample. All the samples contain alkaloids.

Withania somnifera (Linn.) Dunal. - Drug is available as cut pieces of un-branched or rarely branched root. Outer surface buff to greyish yellow with longitudinal wrinkles. Powder is creamish brown in colour with fragments of cork cells and non-lignified cells. Active constituents are Alkaloids.

Micro-morphological and powder characteristics of Delhi sample varies to that of the authentic sample. Hardwar and Cochin samples conform to the values of authentic sample. A Physico-chemical characteristic of all the samples

conforms to the values of authentic sample. Foreign matter content varies from 0.90% to 2.60%. The erect branching under-shrub is found throughout the drier parts of India and also under cultivation. All samples show more or less perfect correlation with authentic sample. However, a micromorphological and powder characteristic of Delhi sample varies from authentic sample. Foreign matter is within the limits of authentic sample in all the three samples.

The study reveals that commercial samples are always subject to quality control for their authenticity to ensure identity, purity and strength as per pharmacopoeial and other quality standards before their use to formulate the medicine. This quality evaluation practice may also ensure the safety and efficacy of medicine up to a larger extent.



Acorus calamus Linn.



Bergenia ciliata (Haw.) Sternb



Gmelina arborea Roxb



Nardostachys grandiflora DC



Picrorhiza scrophulariflora Pennel.



Withania somnifera (Linn. Dunal.

Fig. 1: Studied Herbal Drugs of Root and Rhizome Origin

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