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Review article

Ashtawarga plants – Suffering a triple standardization syndrome

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ABSTRACT

Ayurveda is one of the oldest known holistic health care systems recommending diverse medicinal uses of plants for prevention and cure of diseases and illness. World Health Organization (WHO) estimates that the holistic system is gaining more popularity due to its easy availability, low cost, congeniality, better accessibility and higher safety than allopathic medicine. Demand of herbal drugs is increasing day-by-day because of increasing popularity of herbal drugs; however market fails to meet this supply due to numerous factors, one of the important factors being the extinction of these plants from local flora. About 560 herbal species of India have been included in the Red List of Threatened species. Hence to overcome problem of non-availability of endangered species, Department of AYUSH, Govt. of India has permitted the substitution of rare herbal drugs with available substitutes on the basis of Ayurvedic concepts. Due to this, herbal drug industry has started exploiting the situation and now Ayurvedic products are suffering from a serious problem of adulteration with addition of spoiled, inferior, spurious drugs that are inferior in therapeutic/chemical properties and used to enhance profits. Adulteration with other plants degrades the quality and credibility of Ayurvedic medicine. Ashtawarga plants being an important part of many Ayurvedic formulations are also available in a very limited amount and likely to be substituted by cheap adulterants. Keeping in view the above situation, a metadata analysis has been conducted to find out types of adulteration/substitutions malpractices going on for Ashtawarga plants.

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1. Introduction

Multifaceted growth in population, higher literacy and education has changed the perception of health care system during recent two decades. World Health Organization estimates that the holistic system is gaining more and more popularity due to its easy availability, low cost, congeniality and better accessibility. Some hazardous factors of allopathic health care system are also contributing towards higher dependability on health care system. It is not a surprise but is fact that alternative medicine business is going to biggest deal in medicine sector and estimate to catch \$115 billion at end of 2015. Number of patents and grants for herbal are

now practical in India. Survey indicates that these types of patents have novel multi-herb compositions which have synergistic effect.¹ India holds the highest proportion of medicinal plants known for their medicinal value of any country in the world.² Topographically, India is the richest and largest habitat of medicinal plants in the world. It is why the greatest health care science Ayurveda was born here about 5000 years. Ayurveda is one of the oldest known holistic health care systems recommending diverse medicinal uses of plants for prevention and cure of diseases and illness.³

So keeping in view the popularity of herbal drugs, demand of herbal drugs is increasing day-by-day but market fails to meet the supply especially due to un-availability of authentic raw drugs. This is because of varied climatic, altitudinal and ecological habitats, over-exploitation, deforestation, habitat loss, destruction of rare plants and indiscriminate harvesting etc. Ashtawarga plants have been included among 560 plants appearing in the red list of endangered species. To overcome problem of non-availability of endangered species Department of AYUSH, Govt. of India has

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permitted the substitution of rare herbal drugs with available substitutes on the basis of Ayurvedic concepts. Now a day Ayurvedic products are suffering from a serious problem of adulteration with addition of low grade, spoiled, inferior, spurious drugs, and useless parts of same or different plant, harmful substances or totally different drug either free from or inferior in therapeutic and chemical properties from original drug which do not confirm with the authenticated official standards and used to enhance profits. Owing to this, devotion in herbal drugs has turned down.^{4–7} World Health Organization (in its publication on quality standards for medicinal plant materials) recommends rejecting any batch of raw material, which has more than 5% of any other plant part of the same plant (e.g. stem in leaf drugs), even though they are derived from the authentic plant. Based on these standards, adulteration whether, intentional or unintentional, should be rejected.^{8–10} A treatise published in 1820 for adulterations in food and culinary materials is a proof of adulteration.¹¹

There is a steady decline in human expertise capable of recognizing the variety of medicinal plants. The ancient sages themselves suggested that they have to be known with the help of hermits, shepherds and tribal. Moreover olden day's physicians used to collect the herbs, prepare and administer the medicine but modern Ayurvedic physicians are dependent on herbs collected by local traders or readymade Ayurvedic drugs in the market. As a result professional plant collectors have taken over the forest floor and the industry is forced to accept the herbs they bring on their terms without any enquiry and efforts. Suppliers and traders are not aware about the authentic sources. The professional raw material collector is unable to meet the increasing demand and it leads to adulteration with other plants that degrade the quality of drug and credibility of the Ayurvedic system of medicine. It has also been found that the adverse drug reactions are not due to the intended herb, but rather due to the presence of an unintended herb.⁹ Sometimes, it is very difficult to trace these adulterations because medicinal plant dealers have discovered the 'Scientific' methods to adulterate a high quality material in such a way that is difficult to analyze without microscopic and chemical analysis.¹² Ashtawarga plants being an important part of many Ayurvedic formulations are also available in limited amount and likely to be substituted by cheap easily available substitutes or adulterants.¹³ Keeping in view the above situation, a metadata analysis has been conducted to find out types of adulteration/substitutions malpractices going on Ashtawarga plants.

1.1. Ashtawarga-the amrita

The Ayurveda is the science of life that developed by several Rishis such as Ashwani Kumars, Atreya, Bhardwaja, Dhanwantri, Charaka, and Sushruta etc. in the ancient times. During early phase of Ayurvedic development, Ashwani Kumars (Ayurvedic wonder healers) saw the old frail and emaciated body of Rishi Chayavan and decided to rejuvenate his body through medication. Rishi Chayavan was born in the lineage of Maharishi Bhrigu (who was great astrologist and made birth charts of millions of people which are valid even today). For this, these scientists of old era invented Ashtawarga – a group of eight medicinal plants and did the miracle of rejuvenating the body of Rishi Chayavan as youthful. Since then after the name of Rishi Chayavan, the preparation was called as Chayavan Prash and has been a favorite and most demanded medicine for Kings and rich people.¹⁴

Gurukul system of ancient education encouraged more practical and less theoretical approach for the utilization of herbs. With the disappearance of Gurukul system, the practical knowledge in natural habitats of medicinal plants started fading away which further deteriorated due to lack of written details and thus created a great

confusion about their actual identity. The same was the case with Ashtawarga which included eight plants species with their Sanskrit names as *Kakoli*, *Kshirakakoli*, *Jeevaka*, *Rishbhaka*, *Meda*, *Mahameda*, *Riddhi* and *Vridddhi*. All these plants have their natural habitats in Himalaya especially the north-western Himalaya. Their natural habitats are specific in ecological requirements and hence these occur only in small patches. Ashtawarga plants are known as *Jeevaniya* (drugs strengthening vitality, immunity system etc.), *Brhnayiya* (increase flesh in the body by activating cell regeneration even in old age) and *Vayasthapan* (metabolic processes especially anabolism become active and leads to youthful body complexion). These plants have been excluded from the modern research because of confusion on their identity and difficulty in availability of sufficient drug material.¹⁴

In Nighantu (an Ayurvedic treatise), various authorities and commentators made it clear that the Ashtawarga is even rare to kings and that's why the use of substitutes has been suggested.¹⁴ This suggestion put forth full stop on further efforts to explore these plants in their habitats. After independence, revival of interest in Ayurveda provided the necessary enthusiasm and taxonomic system of plant classification that facilitated the task of correct identification of Ashtawarga plants.

1.2. Types of adulterations in endangered and costly herbal drugs^{15–19}

Crude drugs, used by herbal based pharmaceutical industry, are generally substituted or adulterated with substandard, inferior or artificial drugs. Substitute or adulterants may be following type:

- I. **Using substandard commercial varieties:** This is the most common type of adulteration. In this adulterants have a morphological and chemical resemblance to the original drug however it is therapeutically sub-standard in nature and less expensive.
- II. **Using superficially similar inferior drugs:** Inferior drugs resemble morphologically with original drug which may or may not have any therapeutic value. Due to its resemblance, they are used as adulterants.
- III. **Using artificially manufactured substance:** This technique is very commonly followed for the costly drugs. The drug is adulterated with the artificially prepared substance that resembles the original drug.
- IV. **Using exhausted drug:** Pre extracted drugs devoid of medicinally active constituents are admixed. Mainly volatile oil containing herbs like clove, coriander, fennel, caraway are adulterated by this intention. The loss of color and taste of herbs, due to extraction, is manipulated with additives to maintain natural color and taste.
- V. **Use of synthetic chemicals to enhance natural character:** Synthetic chemicals are used to develop natural characteristics of the exhausted drug. Examples: Citral is added to citrus oils like lemon and orange oils.
- VI. **Presence of vegetative matter of same plant:** Some miniature plants growing along with the medicinal plants are added due to their color, odor and constituents.
- VII. **Harmful adulterants:** This type of adulteration is commonly prevalent for the liquid drugs. Some harmful materials are collected from market waste materials and admixed with the drug.
- VIII. **Adulteration of powders:** The drugs which are in the form of powders are frequently adulterated. Examples: dextrin is added in Ipecacuanha, exhausted ginger in ginger, red and white sandal wood powders in red and white capsicum powders and powdered bark adulterated with brick powder.

1.2.1. Other reasons for adulteration of ASU herbal drugs²⁰ (Fig. 1)

i. Lack of patriotism and sympathy towards Indian System of Medicine

Manufacturers are business oriented and forget that adulteration with spurious/substandard drugs will affect the efficacy of the drugs hence finally affecting the authenticity of Indian System of Medicine.²¹

ii. Confusion in vernacular names

In Ayurveda, *Habenaria intermedia* refer to Riddhi whereas as per available literature survey, *H. intermedia* refers to Vriddhi. Similarly Kshirakakoli is also known as Kshira and Kakoli in Hindi. However as per Ayurvedic pharmacopoeia of India, *Fritillaria roylei* and *Lilium polyphyllum* are the botanical names of Kshirakakoli and Kakoli, respectively but research literature listed *L. polyphyllum* and *Roscoeia purpurea* as Kshirakakoli and Kakoli, respectively. Due to the similar or controversial names, the herbs are often interchanged or adulterated (Fig. 2).^{22–24}

iii. Lack of knowledge about authentic source

Majority of plant collectors/folk drug suppliers lack knowledge about authentic source of the concerned plant. Many plants have not been described in Ayurvedic literature and were identified on the basis of superficial characters like morphology. For example Shatavari (Root of *Asparagus racemosus*) had been used in place of Meda and Mahameda. One more illustration is Vidari kand (*Pueraria tuberosa*) being used in place of Jeevaka and Rishbhaka. Another endangered gymnosperm *Cycas circinalis* is sold as Vidari kand because cultivars, suppliers and vendors are unqualified and they are not familiar with authentic source.²¹

iv. Lack of authentic plant

Due to lack of authentic plant, some other plant is used as a substitute. In case of non-availability of Kakoli (rhizomes) and Kshirakakoli (bulbs), Ashwagandha (root) is used as substitute (Fig. 2).²⁵

v. Similarity in color

Some miniature plants growing along with the medicinal plants are inadvertently or deliberately added due to similarity in color of raw drugs (Fig. 2).

vi. Carelessness in collection

Due to lack of skilled labor, some medicinal plants growing along with the desired medicinal plants are inadvertently collected along with the desired of raw drugs. Sometimes plant collectors may collect the raw drugs at an early stage and plant may not have desired active content. Pesticide treated plants may be collected along with the desired medicinal plants due to ignorance or negligence of plant collectors.

vii. Lack of standard chemical markers for most of the plants

The manufacturers are aware of the lack of chemical markers for these plants and inability of regulatory authorities to establish the presence of authentic plants. No standard chemical markers are available till date for Ashtawarga plants. Hence manufacturers take the liberty to use substandard drugs or substitutes (Fig. 2).

viii. Unknown reasons

There could be some other reasons of adulteration that are neither in notice of researchers nor in view of authorities.

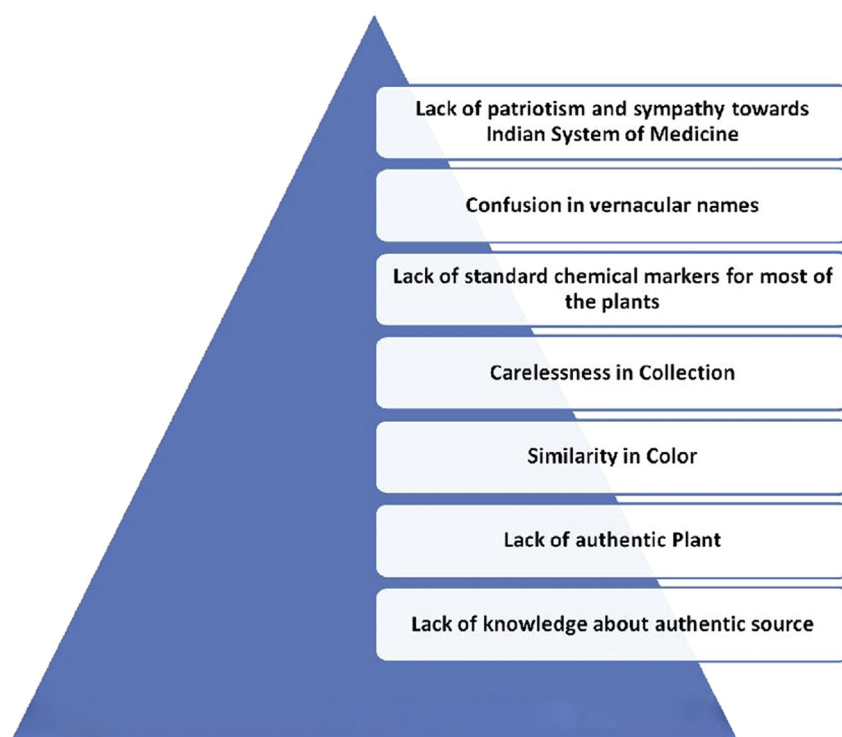


Fig. 1. Reasons for adulterations of ASU herbal drugs.

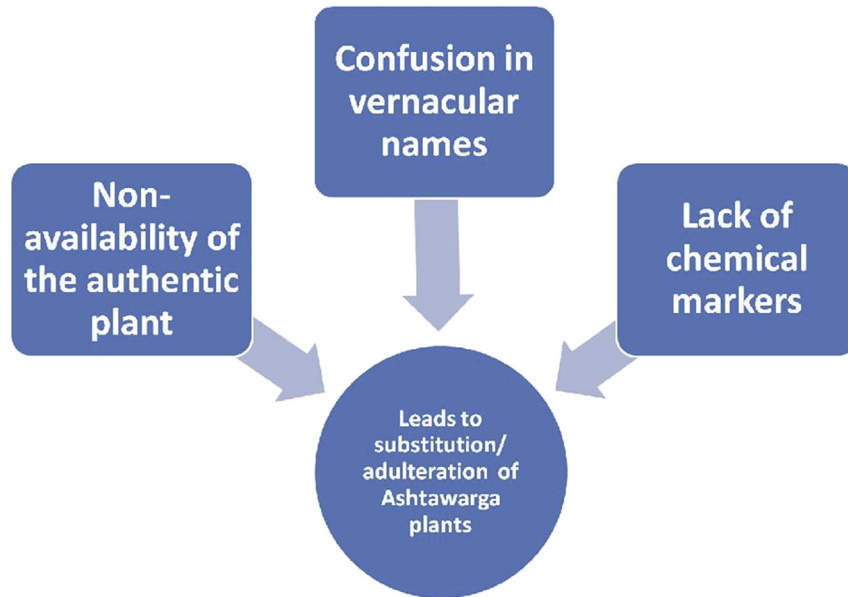


Fig. 2. Three standard reasons for substitution/adulteration of Ashtawarga plants.

1.2.2. Major reasons for substitution of Ashtawarga plants

There are seven major standards against which adulteration in most of raw drugs is evaluated. Out of seven major standards, most of Ashtawarga plants fail in three very common below mentioned standards.

- A. **Confusion in vernacular names** shown by different researchers (as listed in Table 1).
- B. **Non-availability of the drugs** – Ashtawarga plants are endangered and rare drugs are found in high altitude area from 2000 to above 4000 m above sea level in Himalaya northern valleys i.e. now's days official substitutes of Ashtawarga are used (as listed in Table 2).
- C. **Lack of chemical markers** – The lack of fear of regulatory authorities that don't have the standard markers for quality check for most of raw drugs.
- D. Provision of substitutes by regulatory authorities in pressure of pharmaceutical lobby with no scientific basis.²¹

2. Discussion

Traditional therapies have a popular perception of lower adverse effects rate as consumers perceive that natural sourced products are less likely to cause problems. The common causes of herbal product related adverse reaction occurrence are use of toxic herbs/substitutes/adulterants. As in the case of any drug clinical trials, the safety, efficacy, and/or effectiveness are the ultimate demonstration of therapeutic usefulness of herbal products. These will only make scientific sense when the tested herbal products are authentic, standardized, and quality controlled, if good practice guidelines of evidence-based medicine are followed, and if relevant controls and outcome measures are scientifically defined.⁶² The quantity and quality, safety and efficacy of traditional medicine have become a worldwide concern emphasizing the need to develop harmonized international standards. The global market for herbal remedies is about \$83 billion and growing at 10–20% yearly with the top global players like Germany, Asia, Japan, Europe and North America.⁶³ The quantity and quality of the safety and efficacy data on traditional medicine are far from sufficient to meet the criteria needed to support its use worldwide. So there was a need to

see the hiccups in quality standards of plants specifically Ashtawarga plants in this manuscript.

Ashtawarga is group of eight medicinal plants i.e. *Kakoli*, *Kshir-akakoli*, *Jeevaka*, *Rishbhaka*, *Meda*, *Mahameda*, *Riddhi* and *Vridddhi* and are divided into four pairs (as shown in Table 3). Ashtawarga group is the vital ingredient of numerous Ayurvedic formulations due to health promoting and immense cell regeneration properties which physiologically work as antioxidants, reinforce the immunity and restore physical condition immediately but at present Ashtawarga plants are comes under category of endangered plants due to limited distribution in their natural habitats. Ashtawarga plants suffer from triple standardization syndrome which may be due to the following factors.

2.1. Lack of knowledge about authentic source

During the olden days physicians themselves used to collect the herbs, prepare and administer the medicine whereas majority of Ayurvedic physicians are dependent on readymade Ayurvedic formulations in the market. The earliest sages recommended identification of authentic plants with the help of hermits, shepherds and tribal people. Today there is lack of skilled plant collectors. At the same time in Ayurvedic texts, many drugs were identified on the basis of organoleptic characters. For example, Shatavari is being in use in place of *Meda* and *Mahameda* because cultivators, suppliers and vendors of raw herbs are uneducated and unconscious about authentic source of medicinal plants. Plant *H. intermedia* refers to *Riddhi* in Ayurvedic texts whereas in literature, *H. intermedia* refers to *Vridddhi*. So due to the resemblance of the botanical names; these herbs are habitually interchanged. Hence lack of knowledge about authentic source of Ashtawarga plants is one of the major reasons for adulteration.

2.2. Non-availability of authentic plant

Demand for Ashtawarga plants is rising day-by-day but accessibility of genuine drug is not in tune with the market requirements.¹³ As a result, professional plant collectors have taken over the floor and the industry is forced to accept the herbs they bring on their terms without question. These suppliers incapable to

Table 1
Controversial names of plants in Ashtawarga.

S. No.	Published paper/API	Ashtawarga plants (Common name)							
		Jeevaka	Rishbhaka	Meda	Mahameda	Kakoli	Kshirakakoli	Riddhi	Vridhhi
1	Approved project by NMPB, New Delhi (Project No. R&D/CH-01/2012)	<i>Microstylis muscifera</i>	<i>Malaxis acuminata</i>	<i>Polygonatum cirrhifolium</i>	<i>Polygonatum verticillatum</i>	<i>Roscoea procera</i> <i>Roscoea purpurea</i>	<i>Fritillaria roylei</i>	<i>Habenaria edgeworthii</i>	<i>Habenaria intermedia</i>
2	http://rareayurvedicplants.blogspot.in/2011/08/ashtavarga-rare-medicinal-plants.htm ²⁶	<i>Microstylis wallichii</i> <i>Malaxis wallichii</i>	<i>Microstylis muscifera</i>	<i>Polygonatum verticillatum</i> <i>Convallaria verticillata</i> <i>Evallaria verticillata</i>	<i>Polygonatum cirrhifolium</i>	<i>Roscoea procera</i> <i>Roscoea purpurea</i> <i>Fritillaria roylei</i>	<i>Lilium polyphyllum</i>	<i>Habenaria edgeworthii</i>	<i>Habenaria intermedia</i> <i>Habenaria arietina</i>
3	API Part II, Volume I ²⁷	<i>Malaxis acuminata</i> <i>Pueraria tuberosa</i> (Official Substitute)	<i>Malaxis muscifrea</i> <i>Pueraria tuberosa</i> (Official Substitute)	<i>Polygonatum cirrhifolium</i> <i>Asparagus racemosus</i> (Official Substitute)	<i>Asparagus racemosus</i> (Official Substitute)	<i>Lilium polyphyllum</i> <i>Withania somnifera</i> (Official Substitute)	<i>Withania somnifera</i> (Official Substitute)	–	–
4	API Part II, Volume II ²⁸	<i>Malaxis acuminata</i>	<i>Malaxis muscifrea</i>	<i>Polygonatum cirrhifolium</i>	–	<i>Lilium polyphyllum</i>	–	–	–
5	API Part II, Volume III ²⁹	<i>Microstylis walichii</i> <i>Pueraria tuberosa</i> (Official Substitute)	<i>Microstylis walichii</i> <i>Pueraria tuberosa</i> (Official Substitute)	<i>Polygonatum verticillatum</i> <i>Asparagus racemosus</i> (Official Substitute)	<i>Polygonatum cirrhifolium</i> <i>Asparagus racemosus</i> (Official Substitute)	<i>Lilium polyphyllum</i> <i>Withania somnifera</i> (Official Substitute)	<i>Fritillaria roylei</i> <i>Withania somnifera</i> (Official Substitute)	<i>Habenaria intermedia</i> <i>Dioscorea bulbifera</i> (Official Substitute)	<i>Habenaria intermedia</i> <i>Dioscorea bulbifera</i> (Official Substitute)
6	API Part I, Volume III ³⁰	–	–	–	–	<i>Lilium polyphyllum</i>	–	–	–
7	API Part I, Volume V ³¹	<i>Malaxis acuminata</i>	–	–	<i>Polygonatum cirrhifolium</i>	–	<i>Fritillaria roylei</i>	<i>Habenaria intermedia</i>	–
8	API Part I Volume VI ³²	<i>Malaxis acuminata</i>	–	<i>Polygonatum cirrhifolium</i>	<i>Polygonatum cirrhifolium</i>	–	<i>Fritillaria roylei</i>	<i>Habenaria intermedia</i>	–
9	Singh, 2006 ³³	<i>Malaxis acuminata</i>	<i>Microstylis muscifera</i>	<i>Polygonatum verticillatum</i> <i>Convallaria verticillata</i> <i>Evallaria verticillata</i>	<i>Polygonatum cirrhifolium</i>	<i>Roscoea procera</i> <i>Roscoea purpurea</i> <i>Fritillaria roylei</i>	<i>Lilium polyphyllum</i>	<i>Habenaria edgeworthii</i>	<i>Habenaria intermedia</i> <i>Habenaria arietina</i>
10	Mehrotra et al., 2006 ²⁰	<i>Microstylis walichii</i>	<i>Microstylis muscifrea</i>	<i>Ltsea glutinosa</i>	<i>Polygonatum cirrhifolium</i>	<i>Lilium polyphyllum</i>	<i>Fritillaria roylei</i>	<i>Habenaria intermedia</i>	–
11	Chauhan et al., 2007 ³⁴	–	–	–	–	–	–	<i>Habenaria intermedia</i>	–
12	Jalal et al., 2008 ³⁵	<i>Malaxis muscifrea</i>	<i>Malaxis acuminata</i>	–	–	–	–	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
13	Singh et al., 2009 ³⁶	<i>Malaxis muscifrea</i>	<i>Malaxis acuminata</i>	<i>Polygonum verticillatum</i>	<i>Polygonatum cirrhifolium</i>	<i>Roscoea procera</i>	<i>Fritillaria roylei</i>	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
14	Jalal et al., 2009 ³⁷	<i>Malaxis muscifrea</i>	<i>Malaxis acuminata</i>	–	–	–	–	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
15	Kaur et al., 2010 ³⁸	–	<i>Malaxis acuminata</i>	–	–	–	–	–	–
16	Chauhan et al., 2011 ³⁹	–	–	–	–	<i>Fritillaria roylei</i>	–	–	–
17	Rath et al., 2011 ⁴⁰	<i>Malaxis muscifrea</i>	<i>Malaxis acuminata</i>	–	–	–	–	–	–
18	Rath et al., 2011 ⁴¹	–	–	–	–	<i>Roscoea purpurea</i>	<i>Lilium polyphyllum</i>	–	–
19	Sharma et al., 2011 ⁴²	<i>Malaxis acuminata</i>	–	–	–	–	–	–	–
20	Bisht et al., 2011 ⁸	–	–	<i>Polygonatum cirrhifolium</i> <i>Convallaria cirrhifolium</i>	<i>Polygonatum verticillatum</i> <i>Convallaria verticillata</i>	–	–	–	–
21	Giri et al., 2011 ⁴³	–	–	–	–	–	–	–	<i>Habenaria edgeworthii</i>
22	Kazmi et al., 2012 ⁴⁴	–	–	<i>Polygonatum verticillatum</i>	<i>Polygonatum verticillatum</i>	–	–	–	–
23	Marasini et al., 2012 ⁴⁵	<i>Malaxis muscifrea</i>	<i>Malaxis acuminata</i>	–	–	–	–	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
24	Balkrishna et al., 2012 ¹⁴	<i>Crepidium acuminatum</i> <i>Malaxis acuminata</i>	<i>Malaxis muscifrea</i> <i>Microstylis muscifera</i>	<i>Polygonatum verticillatum</i> <i>Convallaria verticillata</i>	<i>Polygonatum cirrhifolium</i> <i>Convallaria cirrhifolium</i>	<i>Roscoea purpurea</i>	<i>Lilium polyphyllum</i> <i>Lilium punctatum</i>	<i>Habenaria intermedia</i> <i>Ochyrorchis intermedia</i>	<i>Habenaria edgeworthii</i> <i>Platanther edgeworthii</i> <i>Habenaria intermedia</i>
25	Habbu et al., 2012 ⁴⁶	–	–	–	–	–	–	–	<i>Habenaria intermedia</i>

Table 1 (continued)

S. No.	Published paper/API	Ashtawarga plants (Common name)							
		Jeevaka	Rishbhaka	Meda	Mahameda	Kakoli	Kshirakakoli	Riddhi	Vriddhi
26	Garg et al., 2012 ⁴⁷	<i>Malaxis acuminata</i>	–	–	–	–	–	–	–
27	Kalaivasan et al., 2012 ⁴⁸	<i>Malaxis muscifera</i>	<i>Malaxis acuminata</i>	–	–	–	–	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
28	Kumari et al., 2013 ⁴⁹	<i>Malaxis muscifera</i>	<i>Malaxis acuminata</i>	–	–	–	–	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
29	Wagh et al., 2013 ⁵⁰	<i>Malaxis acuminata</i>	<i>Malaxis muscifera</i>	<i>Polygonatum cirrhifolium</i>	–	<i>Lilium polyphyllum</i>	–	<i>Habenaria intermedia</i>	–
30	Subedi et al., 2013 ¹⁰	–	–	–	–	–	–	<i>Habenaria intermedia</i>	–
31	Lohani et al., 2013 ⁵¹	<i>Malaxis acuminata</i>	–	–	–	–	–	–	–
32	Lohani et al., 2013 ⁵²	<i>Microstylis walichii</i> <i>Malaxis acuminata</i>	–	–	–	–	–	–	–
33	Uddin et al., 2013 ⁵³	–	–	–	–	–	<i>Fritillaria roylei</i>	–	–
34	Ghosh et al., 2013 ⁵⁴	<i>Malaxis acuminata</i>	<i>Malaxis muscifera</i>	<i>Polygonatum cirrhifolium</i>	–	<i>Lilium polyphyllum</i>	–	<i>Habenaria intermedia</i>	–
35	Bhatt et al., 2013 ⁵⁵	–	–	<i>Polygonatum cirrhifolium</i>	<i>Polygonatum verticillatum</i>	–	–	–	–
36	Sharma et al., 2013 ⁵⁶	<i>Malaxis acuminata</i>	<i>Malaxis muscifera</i>	<i>Polygonatum cirrhifolium</i>	<i>Polygonatum verticillatum</i>	<i>Fritillaria roylei</i>	<i>Lilium polyphyllum</i>	–	–
37	Sagar et al., 2014 ⁵⁷	<i>Crepipium acuminatum</i>	<i>Malaxis muscifera</i>	<i>Polygonatum verticillatum</i>	<i>Polygonatum cirrhifolium</i>	<i>Rosea purpurea</i>	<i>Fritillaria roylei</i> <i>Lilium polyphyllum</i>	<i>Habenaria intermedia</i>	<i>Habenaria edgeworthii</i>
38	Gopal et al., 2014 ⁵⁸	–	–	–	–	<i>Rosea purpurea</i>	–	–	–
39	Rawat et al., 2014 ⁵⁹	<i>Malaxis acuminata</i>	<i>Malaxis muscifera</i>	<i>Polygonatum verticillatum</i>	<i>Polygonatum cirrhifolium</i>	<i>Roscoea procera</i>	<i>Lilium polyphyllum</i>	–	–
40	Miyazaki et al., 2014 ⁶⁰	–	–	–	–	<i>Roscoea purpurea</i>	–	–	–
41	Raj et al., 2014 ⁶¹	<i>Microstylis walichii</i>	<i>Microstylis muscifera</i>	<i>Polygonatum verticillatum</i>	<i>Polygonatum cirrhifolium</i>	<i>Roscoea purpurea</i>	<i>Lilium polyphyllum</i>	–	–

Table 2
Official substitutes of Ashtawarga plants.

S. No.	Published paper/API	Ashtawarga plants (Official substitutes)							
		Jeevaka	Rishbhaka	Meda	Mahameda	Kakoli	Kshirakakoli	Riddhi	Vriddhi
1	API Part II Volume I ²⁷	<i>Malaxis acuminata</i> <i>Pueraria tuberosa</i> (Official substitute)	<i>Malaxis muscifera</i> <i>Pueraria tuberosa</i> (Official substitute)	<i>Polygonatum cirrhifolium</i> <i>Asparagus racemosus</i> (Official substitute)	– <i>Asparagus racemosus</i> (Official substitute)	<i>Lilium polyphyllum</i> <i>Withania somnifera</i> (Official substitute)	<i>Withania somnifera</i> (Official substitute)	–	–
2	API Part II Volume II ²⁸	–	–	<i>Polygonatum cirrhifolium</i>	<i>Asparagus racemosus</i> (Official substitute)	<i>Withania somnifera</i> (Official substitute)	<i>Withania somnifera</i> (Official substitute)	<i>Dioscorea bulbifera</i> (Official substitute)	<i>Dioscorea bulbifera</i> (Official substitute)
3	API Part II Volume III ²⁹	<i>Microstylis walichii</i> <i>Pueraria tuberosa</i> (Official substitute)	<i>Microstylis walichii</i> <i>Pueraria tuberosa</i> (Official substitute)	<i>Polygonatum verticillatum</i> <i>Asparagus racemosus</i> (Official substitute)	<i>Polygonatum cirrhifolium</i> <i>Asparagus racemosus</i> (Official substitute)	<i>Lilium polyphyllum</i> <i>Withania somnifera</i> (Official substitute)	<i>Fritillaria roylei</i> <i>Withania somnifera</i> (Official substitute)	<i>Habenaria intermedia</i> <i>Dioscorea bulbifera</i> (Official substitute)	<i>Habenaria intermedia</i> <i>Dioscorea bulbifera</i> (Official substitute)

Table 3
Ashtawarga plants and their substitutes.¹³

S. No.	Pairs of Ashtawarga plants	Single substitute for each pair of Ashtawarga
1.	Kakoli and Kshirakakoli	Ashwagandha
2.	Jeevaka and Rishbhaka	Vidari kand
3.	Meda and Mahameda	Shatavari
4.	Vridhhi and Riddhi	Varahi kand

meet the increasing demand opt for adulteration with other plants. At the same time the manufacturers make substitution/adulteration to bring the product to a competitive lower price with other freely available cheaper plant species. Hence to reduce the scarcity of these plants, industries use other similar plants e.g. non-availability of Ashwagandha (root) is being in use in the absence of Kakoli (rhizomes) and Kshirakakoli (bulbs).

2.3. Lack of standard chemical markers

Till now none of the Ashtawarga plants are supported by identified standard chemical markers which could be used for the correct identification of authentic plant. This gives liberty to manufacturers to use substitutes/adulterants in a fearless manner.

3. Conclusion

After a big gap once again Ayurveda has made its come back to the center of our health care programs and it is gaining popularity not only in India but also abroad. Some shortcomings are required to be addressed to put Ayurveda back on track with a more objective and scientific manner without any biasness. It is worth mentioning here that without establishing standards in sources of raw drugs, it is difficult to evolve standards in Ayurvedic formulation. There are seven major standards against which adulteration in most of raw drugs is evaluated. Out of seven major standards, most of Ashtawarga plants fail in three very common above mentioned standards. From the analysis it can be easily concluded that Ashwagandha species are suffering from three common standardization quality parameters hence “triple standardization syndrome”. There is a great need to encourage the cultivation of these plant species with proper taxonomical identification by experts. There is also a dire need of developing chemical markers for the raw drugs of Ashtawarga that can be used for regulating intentional and unintentional adulteration/substitution.

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