Phytochemistry Letters 14 (2015) 67–78

Contents lists available at ScienceDirect

Phytochemistry Letters

journal homepage: www.elsevier.com/locate/phytol

Mini review

Residues and contaminants in medicinal herbs—A review

Vandana Tripathy, B.B. Basak, Thania Sara Varghese, Ajoy Saha*

ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand-387310, Gujarat, India

ARTICLE INFO

Article history:
Received 11 June 2015
Received in revised form 5 September 2015
Accepted 9 September 2015
Available online xxx

Keywords:
Chemical contaminant
Food safety
Heavy metals
Mycotoxins
Pesticide residues
PAH
Medicinal herbs

ABSTRACT

With the increasing popularity and use of medicinal herbs, their global demand has gained momentum. Developing countries, including China, India and South East Asian (SEA) countries, are the centres of origin and major global suppliers for most of these traditionally used medicinal herbs. One of the factors affecting the quality of these herbs is the contamination of heavy metals, mycotoxins, pesticide residues, polycyclic aromatic hydrocarbons (PAHs) and fumigants. These contaminants can accumulate during the cultivation, storage and processing of herbs and may have adverse effects on consumer health. There have been various reports regarding the presence of these contaminants in medicinal herbs. This review discusses the important contaminants of medicinal herbs, the frequency and magnitude of their occurrences, the potential causes of contamination and their regulatory limits in medicinal herbs. The major challenge in the international trade of medicinal herbs is the lack of common guidelines, regulatory measures and monitoring body to strictly enforce their regulation.

Contents

1. Introduction

Medicinal herbs have been an integral part of traditional medical practices for thousands of years and have been particularly recognized as being a valuable, readily available and affordable resource for health care. According to the WHO estimate, 80% of the world's population primarily relies on traditional medicine, a major part of which involves the use of plant extracts or their active ingredients (Akerele, 1992). The commercialization of medicinal plants has increased by many folds due to their large scale use in various sectors, such as phytochemicals, pharmaceuticals, nutraceutical, herbal remedies, food supplements, perfumes and cosmetics, and food flavouring agents, among other uses. Moreover, in the recent past, there has been a two-fold increase in the demand of medicinal plants in the international market. According to WHO estimates, the present demand for medicinal plants is $14 billion annually, and by the year 2050, it will be $5 trillion.

* Corresponding author: ICAR-Directorate of Medicinal and Aromatic Plants Research, Boriavi-387 310, Anand, Gujarat, India. Fax: +91 2692 271601.
E-mail address: ajoysahacob@gmail.com (A. Saha).

http://dx.doi.org/10.1016/j.phytol.2015.09.003
1874-3900/

Table 1
Incidence of heavy metal contamination in raw medicinal herbs.

S. No.	Raw medicinal herbs	Origin of the country	Heavy metal present	Number of sample	No. of samples detected at least with one heavy metals	Heavy metal content[h]	Reference
1	130 samples of 10 medicinal plants	Brazil	Cd, Pb and Hg	130	40	Cd: 0.22–0.74 ppm (14)[a] Pb: 2.0–11.7 ppm (6)[a] Hg: 0.01–0.04 ppm	Caldasa and Machado (2004)
2	126Chinese Herbal Medicines (CHMs)	China	Cd, Cr, Pb, As and Hg	334	334	Cd: 0.02–4.35 ppm (2)[b] Cr: 0.01–21.0 ppm Pb: 0.04–8.15 ppm As: 0.08–20.0 ppm (1)[b] Hg: 0.01–0.28 ppm	Harris et al. (2011)
3	Camomile	Egypt	Cd and Pb	70	69	Cd: 0.004–0.13 ppm Pb: 0.06–5.9 ppm	Dogheim et al. (2004)
4	"*Dashmoola*"	India	Cd, Cr Pb, As and Hg	40	40	Cd: 0.02–0.34 ppm Cr: 0.43–15.76 ppm Pb: 1.28–14.49 ppm (6)[c] As: 0.09–3.4 ppm Hg: 0.01–0.86 ppm	Rai et al. (2008)
5	*Glycyrrhiza glabra* L.	Pakistan	Cd, Cr and Pb	21	3	Cd: 1.08 ppm Cr: 5.95 ppm Pb:18.98 ppm	Hina et al. (2011)
6	100 samples of Egyptian medicinal plants	Egypt	Pb, Cd	100	–	Pb: .046–.308 Cg:.054–.294	Arab et al. (1999)
7	Asian and American gingsen	USA	Cd, Hg, Pb, As	47	47	Cd: <0.05–259 ppb Hg:<0.3–72 ppb Pb:3–2710 ppb As: <0.3–918 ppb	Durgnat et al. (2005)
8	27 medicinal plants from Ghana	Ghana	Cd	27	27	Cd: 22.5–59 ppm	Annan et al. (2010)
9	50 medicinal plants	China	Cu, Cd, Pb, As and Hg.	250	75 (Above permissible limit)	Cu: 10–20 ppm (36)[d] Cd:0.3–4.2 ppm (17)[d] Pb:5–10 ppm (6)[d] As: Below permissible limit Hg: 0.2–1.6 ppm (10)[d]	Liu et al. (2013a)
10	*Mikania glomerata*, *Maytenus aquifolia*, *Baccharis trimera* and *Pfaffia paniculata*	Brazil	Pb	8	8	Pb: 3.37–7.03	Campos et al. (2009)
11	8 medicinal plant	Ethiopia	Pb and Cd	26	26	Pb:0.17–98.2 ppm (4)[e] Cd:0.17–1.8 (17)[e]	Baye and Hymete (2010)
12	8 medicinal plant	South Africa	As, Cd, and Pb	37	37	As: 0.35–2.3 ppm Cd: upto 0.02 ppm Pb: upto 4.7 ppm	Street et al. (2008)
13	12 medicinal plant	Botswana	As, Cr, Pb and Ni	12	12	As: 0.19–0.54 ppm Cr: 0.15–1.27 ppm Pb: 0.12–0.23 ppm Ni: 0.09–0.21 ppm	Okatch et al. (2012)
14	10 medicinal plants	India	Cd, Pb, Cr and Hg	10	10	Cd: 2.03–23 ppb Cr: 1.34–7.1 ppb Pb: 3.21–28.7 ppb Hg: BDL	Meena et al. (2010)
15	33 medicinal plants	Sudan	Cd, Pb, Hg and Sn	33	33	Cd: 0.8–187 ppb Pb: 2.6–481 Hg: 0.2–40 Sn: 0.2–845	Ebrahim et al. (2012)
16	10 medicinal plant	India	Cr,Pb, Cd Hg	20	20	Cr: 1.87–8.53 ppm(19)[f]	Kulhari et al. (2013)