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• Research Article

Studies on metals and pesticide content in some Ayurvedic formulations containing *Bacopa monnieri* L.

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ABSTRACT

OBJECTIVE: Ayurvedic formulations are preferred over other formulations as well as commercialized on broad level to treat various ailments. The World Health Organization has established certain guidelines for quality control of heavy metals and pesticide residues. *Bacopa monnieri*, a popular herb with immunomodulator and memory-enhancing properties is the chief constituent of several Ayurvedic formulations, which include Brahmi Vati (BV), Brahmi Ghrita (BG) and Saraswat Churna (SC), etc. In view of the World Health Organization guidelines, two products of each formulation from six different manufacturers were purchased from Ayurvedic Pharmacy, Bulanala-Varanasi, India for testing heavy metal and pesticide residue.

METHODS: In the present study, all the formulations—BV, BG and SC—were selected for estimation of four heavy metals namely lead (Pb), cadmium (Cd), chromium (Cr) and nickel (Ni) by a plasma emission spectrophotometer. Organochlorine pesticidal residues were estimated for dichlorodiphenyl trichloroethane, isomers of hexachlorocyclohexane (HCH) and α-endosulfan, etc. in total 12 samples of test formulations containing *Bacopa monnieri* L. using gas chromatography technique.

RESULTS: Out of 12 samples, Pb, Cd, Cr and Ni were present in all samples but below the permissible limit. Although atrazine, aldrin, dialdrin were in below detection limit, but other pesticides were detected in some samples as oxamyl, hexachlorocyclohexanes (α-HCH, β-HCH and γ-HCH), dichlorodiphenyl trichloroethane and dichlorodiphenyl dichloroethylene.

CONCLUSION: The presence of heavy metals in the formulations was low to cause toxicity. However evaluation of heavy metals and pesticide residue in every batch is necessary.

Keywords: Ayurvedic formulations; heavy metals; pesticide residues; drug contamination

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1 Introduction

Ayurveda has been practiced in India since ancient times and still serves many of the health needs of a large population in the world[1]. Due to the great demand for Ayurvedic products, persons are growing more alert

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to the quality of the materials. Ayurvedic formulations, used singularly or in combination, generally contain many complex components[2]. Quality, safety, efficacy and batch-to-batch consistency of Ayurvedic formulations are essential to meet the criteria needed to support its use worldwide[3,4]. Some advantages of the Ayurvedic system over the allopathic system of medicine, are that it has fewer side effects, lower cost and generally easy availability of raw materials for formulations. Environmental pollution has increasingly attracted global interest, since the beginning of this century[5]. In fact, contamination of soils with heavy metals has become one of the challenges to be faced by several Ayurvedic manufacturers[6]. Heavy metals are naturally present in agricultural soils at low levels[7]. Imbalances in the concentrations of heavy metals in the soils can exert toxic effect not only on medicinal plants but also on human health[8–10]. More focus is required to estimate the nonessential toxic elements present in raw herbs, which include cadmium, lead, arsenic and mercury, because of their potential toxic nature, even at very low concentrations. Industrial effluents along with fertilizers and pesticides in soil form the basis for imbalance in heavy metal; therefore heavy metals enter into the food chain through accumulation in the tissues of medicinal plants. In the present era, increased consumer demand has resulted in the development of herbal products as dietary supplements as well as for the treatment of various ailments[11]. The World Health Organization (WHO) recommends that Ayurvedic products must be assessed for the presence of heavy metals and pesticide residue, and provides an upper limit on contamination for arsenic, cadmium and lead (1.0, 0.3 and 10 μg/g, respectively)[12]. Medicinal plants that have elevated levels of heavy metals may affect the central nervous system, liver, lungs, heart, kidneys, and brain, and produce serious health hazards. Therefore, it is essential to monitor contaminants in Ayurvedic products. If these medicinal plants are incorporated in Ayurvedic formulae, these products, intended for healing, may pose high risk of heavy metal toxicity[10].

Ayurvedic products are consumed worldwide for the treatment of many ailments. Medicinal plants are composed of several parts, and present a huge variety of formulations due to their different growth, storage and processing characteristics[13].

The cases of adverse health complications due to the use of Ayurvedic formulations are increasing in number, and the chief reason behind this is the poor quality of raw ingredients[14,15]. Safety and quality aspects of Ayurvedic drugs require attention. Some studies have already been performed on Ayurvedic formulations, such as Maha Sudarshan churna, Dashmoola and Sidh Makardhwaj[16]. These studies also demonstrated the presence of heavy metals and pesticides above prescribed limits.

Therefore, we must focus on heavy metal and pesticide contamination at all stages of production. In the current era, initiatives have been taken towards improvement of herb quality. The evaluation of heavy metal and pesticide concentration in finished Ayurvedic products has become essential for formulations being used by a large and growing population.

Pesticides are often used in order to improve crop yield and profit margins in the production of medicinal plants. Hence, pesticide residues in medicinal plants can be a safety concern[17]. Pesticide exposure can cause a range of neurological problems such as memory loss, loss of coordination, reduced speed of response to stimuli, impaired vision, altered or uncontrollable mood and behavior and reduced motor skills. These symptoms are often very subtle and may not be recognized by the medical community as a clinical symptom. Other possible health effects include asthma, allergies and hypersensitivity[18]. Therefore, in the present investigation, trials have been made to quantify the level of nonessential, toxic heavy metals (Pb, Cd, Cr and Ni) as well as organochlorine pesticide residue in the following three Ayurvedic formulations containing *Bacopa monnieri*: Brahmi Ghrita (BG), Brahmi Vati (BV) and Saraswat Churna (SC). BG is used to treat memory problems, insanity, epilepsy, psychiatric disorders and infertility. BV is used to improve memory, and to treat stress, anxiety, convulsions, hysteria, insomnia and epilepsy. SC is used to treat mania, epilepsy, mental weakness and nervous strain and for improving grasping power.

2 Materials and methods

2.1 Procurement of formulations

Twelve samples, representing the three Ayurvedic formulations, namely BG, BV and SC (four different brands of each formulation of Good Manufacturing Practice (GMP)-certified companies), were purchased from the local market. The voucher specimens (SPS/COG/Museum-2399-2410) of all the 12 samples have been deposited in the Museum section of the Department of Pharmacognosy, School of Pharmaceutical Sciences, IFTM University, Lodipur, Moradabad, India for future reference. The labels of all the purchased formulations indicated their expiration date as 3 years from the date of manufacture. All the products were used for study within this time window. All the formulations were sold as over the counter drugs and used orally. In this article, they are coded as BG, BV and SC and were used in semisolid, tablet and powder form respectively; samples from the four different brands are indicated by numbers following