Journal of Ethnopharmacology 118 (2008) 343–353

Contents lists available at ScienceDirect

Journal of Ethnopharmacology

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

Review

Ethnobotany, biochemistry and pharmacology of *Minthostachys* (Lamiaceae)

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ARTICLE INFO

Article history:
Received 4 March 2008
Received in revised form 22 May 2008
Accepted 28 May 2008
Available online 4 June 2008

Keywords:
Labiatae
Lamiaceae
Minthostachys
Muña
Peperina

ABSTRACT

Aims of the study: The South American mint genus *Minthostachys* is of great importance in the Andes as a medicinal, aromatic, culinary and commercial essential oil plant. After decades of taxonomic confusion and virtual indeterminability of specimens, new systematic and taxonomic work has been conducted in recent years. The present paper attempts to summarize the state of knowledge about *Minthostachys* with a focus on ethnobotany, analyses of essential oil content and pharmacology, to identify the currently accepted species names for the plants examined in these previous studies, and to assess where additional research is needed.
Materials and methods: All available studies on *Minthostachys* were obtained and evaluated. Herbaria were contacted to identify voucher specimens cited in the respective publications.
Results and conclusions: The great majority of published studies was conducted on a single species, Argentinean *Minthostachys verticillata*. In contrast, the most widely distributed and well-known species (*Minthostachys mollis*) as well as several locally important and intensively used species (e.g., *Minthostachys acutifolia*) have received disproportionately little attention, and virtually nothing is known about the local endemics among the 17 species currently recognized. In many cases, however, it is difficult to relate the results to taxonomic entities due to the lack of voucher specimens. Future research efforts should especially be directed at studying the chemistry and potential for use of several common but so far neglected species of the central and northern Andes, at disentangling environmental and genetic influences on essential oil composition, at prerequisites for cultivation, and at the pharmacological basis of the most important traditional uses. Because of the morphological complexity of the genus, future researchers are urged to deposit voucher specimens of the plants used in their studies to facilitate species identification and to make the results more comparable and reproducible.

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doi:10.1016/j.jep.2008.05.030

1. Introduction

Minthostachys (Benth.) Spach (Lamiaceae, Nepetoideae, Mentheae) is a genus of 17 species of scandent aromatic shrubs restricted to Andean South America (Schmidt-Lebuhn, 2008b). It is of great ethnobotanical, pharmacological and commercial interest because of the essential oils found in the plants. It does not only find use, as a condiment or tea, in the traditional cuisine of the Andes, but is one of the most important plants in the folk medicine of the area. On the basis of this observation, it receives growing attention from modern pharmacology and medicine, as plant decoctions and extracted essential oils are tested for pharmacological effects. In Argentina and Peru, essential oil is extracted on a commercial scale.

Unfortunately, the genus is taxonomically complicated and exhibits a high morphological variability that has, in the past, severely hampered the understanding of its diversity. The most comprehensive taxonomic treatment of the past recognized 12 species (Epling, 1936), but the same researcher later changed his opinion and suggested treating *Minthostachys* as monotypic (Epling and Játiva, 1963). Consequently, the same plants were sometimes, with varying degrees of success, determined to species according to the first approach, sometimes universally labeled as *Minthostachys mollis* (HBK) Griseb., and sometimes dismissed as undeterminable, leading to much confusion and lack of comparability in the growing number of ethnobotanical, biochemical, and pharmacological studies.

In contrast to Epling and Játiva (1963) assumptions, several morphologically defined and ecologically distinct species of *Minthostachys* formed clusters in analyses based on Amplified Fragment Polymorphism data, indicating that the recognition of various species is feasible (Schmidt-Lebuhn, 2007). On the basis of these results, extensive field work, and the morphological examination of ca. 1000 herbarium specimens, 17 species are now recognized (Schmidt-Lebuhn, 2008b; Table 1), following a similar species concept as that of Epling (1936). Of these, seven are usually morphologically very distinct local endemics restricted to only one Andean valley or a similarly small area. The best known and most notable species are morphologically variable *Minthostachys mollis* (Fig. 1b) with three varieties occurring from Venezuela to Bolivia (and including the formerly distinct species *Minthostachys mandoniana* (Briq.) Epling and *Minthostachys tomentosa* (Benth.) Epling), southern Peruvian *Minthostachys acris* Schmidt-Leb. (Fig. 1c), and *Minthostachys verticillata* (Griseb.) Epling of Argentina (Fig. 1a).

The present paper is intended to summarize ethnobotanical, biochemical, pharmacological, and other literature on the genus as a whole, and thus to provide a concise source of information to researchers of *Minthostachys*, especially those working on a local scale. In addition, an attempt is made to relate the results of the individual studies to taxonomic entities as currently understood. Reliable identification of the study species of these publications should facilitate comparison of their results, and allow to get a clearer picture about which species and what aspects of research may have previously been neglected. In many cases, all species of *Minthostachys* are subsumed under the catch-all name *Minthostachys mollis* regardless of provenance. On the other hand, *Minthostachys acris* is usually treated as separate in Peruvian publications, but then erroneously called *Minthostachys glabrescens* (Benth.) Epling due to a mistake dating back to Epling (1936) (see Schmidt-Lebuhn, 2008b, for details).

Table 1
List of species and subspecies accepted in *Minthostachys* in the recent taxonomic revision (Schmidt-Lebuhn, 2008b), with synonyms and distribution

Accepted name	Synonyms	Distribution
Minthostachys andina (Britt. ex Rusby) Epling	*Bystropogon andinus* Britt. ex Rusby	Bolivia: Sorata
Minthostachys dimorpha Schmidt-Leb.		Peru: Machu Picchu
Minthostachys fusca Schmidt-Leb.		Bolivia: Tipuani valley
Minthostachys verticillata (Griseb.) Epling	*Xenopoma verticillatum* Griseb.; *Bystropogon kuntzeanus* Briq.; *Minthostachys verticillata* var. *eupatorioides* Epling	Northwestern and central Argentina
Minthostachys elongata Schmidt-Leb.		Bolivia: Tarija
Minthostachys glabrescens (Benth.) Epling	*Bystropogon glabrescens* Benth.	Ecuador: Loja
Minthostachys salicifolia Epling		Southern Peru
Minthostachys latifolia Schmidt-Leb.		Andean slopes of southern Peru and western Bolivia
Minthostachys septentrionalis Schmidt-Leb.		Venezuela, Colombia
Minthostachys setosa (Briq.) Epling	*Bystropogon setosus* Briq.; *Bystropogon setosus* var. *menthiodorus* Kuntze; *Bystropogon setosus* var. *citronella* Kuntze	Central Bolivia
Minthostachys diffusa Epling		Bolivia: Yungas
Minthostachys spicata (Benth.) Epling	*Bystropogon spicatus* Benth.	Coastal cordillera of Peru and southernmost Ecuador
Minthostachys acris Schmidt-Leb.	*Minthostachys glabrescens* auct., non (Benth.) Epling quoad typum	Peru: southern highlands
Minthostachys acutifolia Epling		Bolivia: La Paz
Minthostachys ovata (Briq.) Epling	*Bystropogon ovatus* Briq.; *Bystropogon andinus* var. *hypoleucus* Briq.	Central Bolivia
Minthostachys rubra Schmidt-Leb.		Ecuador: Carchi
Minthostachys mollis (HBK) Griseb.	*Bystropogon mollis* HBK; *Mentha mollis* (HBK) Benth.; *Bystropogon canus* Benth.; *Bystropogon pavonianus* Benth.; *Bystropogon tomentosus* Benth.; *Minthostachys tomentosa* (Benth.) Epling	Venezuela, Colombia, Ecuador, Peru, Bolivia
Minthostachys mollis var. *mollis*	*Bystropogon mollis* HBK; *Mentha mollis* (HBK) Benth.; *Bystropogon canus* Benth.; *Bystropogon pavonianus* Benth.; *Bystropogon tomentosus* Benth.; *Minthostachys tomentosa* (Benth.) Epling	Venezuela, Colombia, Ecuador, Peru
Minthostachys mollis var. *hybrida* Schmidt-Leb.		Venezuela, Colombia
Minthostachys mollis var. *mandoniana* (Briq.) Schmidt-Leb.	*Bystropogon mandonianus* Briq.; *Minthostachys mandoniana* (Briq.) Epling	Southern Peru, western Bolivia

Sequence of species and varieties follows that of the revision.