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The genus *Psiadia*: Review of traditional uses, phytochemistry and pharmacology

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ABSTRACT

Ethnopharmacological relevance: The genus *Psiadia* Jacq. ex. Willd. belongs to the Asteraceae family and includes more than 60 species. This genus grows in tropical and subtropical regions, being especially well represented in Madagascar and the Mascarene Islands (La Réunion, Mauritius and Rodrigues). Several *Psiadia* species have been used traditionally for their medicinal properties in Africa and the Mascarene Islands. Based on traditional knowledge, various phytochemical and pharmacological studies have been conducted. However there are no recent papers that provide an overview of the medicinal potential of *Psiadia* species. Therefore, the aim of this review is to provide a comprehensive summary of the botany, phytochemistry and pharmacology of *Psiadia* and to highlight the gaps in our knowledge for future research opportunities.

Materials and methods: The available information on traditional uses, phytochemistry and biological activities of the genus *Psiadia* was collected from scientific databases through a search using the keyword '*Psiadia*' in 'Google Scholar', 'Pubmed', 'Sciencedirect', 'SpringerLink', 'Web of Science', 'Wiley' and 'Scifinder'. Additionally, published books and unpublished Ph.D. and MSc. dissertations were consulted for botanical information and chemical composition.

Results: Historically, species of the genus *Psiadia* have been used to treat a wide range of ailments including abdominal pains, colds, fevers, bronchitis, asthma, rheumatoid arthritis, skin infections and liver disorders among others. Phytochemical works led to the isolation of flavonoids, phenylpropanoids, coumarins and terpenoids. Furthermore, phytochemical compositions of the essential oils of some species have been evaluated. Crude extracts, essential oils and isolated molecules showed *in vitro* pharmacological activities, such as antimicrobial, anti-viral, anti-inflammatory, antiplasmodial and antileishmanial activities. Crude extracts of *Psiadia dentata* and *Psiadia arguta* have specifically been found to be potentially useful for inhibition of growth of *Plasmodium falciparum*.

However, pharmacological data on this particular genus is quite limited. Further research is necessary to determine the active compounds and the underlying mechanisms.

1. Introduction

The genus *Psiadia,* belonging to the Asteraceae family, consists of approximately 60 species growing in tropical and subtropical regions. They are predominantly found in Madagascar and the Mascarene islands (La Réunion, Mauritius, and Rodrigues). Indeed, 28 species were identified in Madagascar (Humbert, 1960) and 26 species are endemic to the Mascarene islands (Bosser et al., 1993; Jacob de Cordemoy, 1895). Some species are native to Arabia and East and South Africa including *Psiadia punctulata* (DC.) Vatke.

Plants of this genus have been used in traditional medicine for a long time. Indeed, seven species are used in ethnomedicine for various

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ailments, including treatment of abdominal pains, colds, fevers, bronchitis and asthma (Aumeeruddy-Elalfi et al., 2016; Sussman, 1980; Wang et al., 1989). The leaf has the greatest healing properties, being used for example for preparation of decoctions or as plaster for immobilising fractures.

Taxonomic studies have been conducted on several species. Based on morphological attributes, five groups of species have been classified. Furthermore, molecular phylogenetic studies have led to the identification of two main species clades (Strijk et al., 2012).

Several studies on the phytochemistry and pharmacology of the genus *Psiadia* have led to the isolation and identification of 73 compounds including flavonoids, phenylpropanoids, coumarins and terpenoids. However, only a few have shown pharmacological properties. Of all identified compounds, the only bioactive compounds are considered to be the isolated flavonoids (Robin et al., 2001; Wang et al., 1989). Crude extracts, as well as essential oils of *Psiadia* species, have demonstrated various pharmacological properties including antimicrobial (Aumeeruddy-Elalfi et al., 2015; Govinden-Soulange et al., 2004), anti-viral (Fortin et al., 2002; Robin et al., 1998), antiplasmodial (Jonville et al., 2008, 2011) and anti-inflammatory (Jonville et al., 2011; Recio et al., 1995) activities.

This review strives for a complete overview of the existing knowledge on the botany, traditional uses, phytochemistry and pharmacological research of species belonging to the genus *Psiadia*. Available information on these species enables us to explore their therapeutic potential, to highlight the gaps in our knowledge and to provide the scientific basis for future research.

2. Botany

2.1. Taxonomy

Taxonomic studies have been conducted on Madagascar and Mascarene Islands *Psiadia* species, as the majority of them are to be found in this region. In 1895, Jacob de Cordemoy was the first to recognised four groups of species in La Réunion based on certain morphological features (Table 1).

With some name changes and rearrangement of the groups, in 1993, A. J. Scott distinguished five main groupings of species within the Mascarene Islands, Madagascar and Sri Lanka, based on morphological characteristics (Bosser et al., 1993) (Table 2).

Besides taxonomic studies, molecular phylogenetics have been carried out on *Psiadia* species and related genera (Strijk et al., 2012). Their focus was on the reconstruction of the evolutionary and biogeographical history of the genus based on DNA sequencing of four molecular markers. Using this different approach, Strijk et al. did not define the same groupings as above (Table 2). They recognised only two clades containing *Psiadia* species. The first contained species from the Mascarene Islands, Madagascar, continental Asia and South Africa (clade A). The second clade (clade B) contained all species from La Réunion except *P. retusa* and *P. dentata*, which were inherent to clade A. Both clades were separated from each other by other genera included in the study. Those findings support the hypothesis of an African origin of *Psiadia* species. Furthermore, both clades appeared to have a different evolutionary origin and history. The Mascarenes were colonised by two evolutionary very distinct lineages from Madagascar. On one hand, the ancestor of clade A from Madagascar colonised Rodrigues and Mauritius, with some species even reaching La Réunion *via* these two islands. This explains the presence of *P. retusa* and *P. dentata* in clade A. Secondly, the colonisation of La Réunion from Madagascar by the ancestor of clade B produced the actual species.

Furthermore, the study supported the theory that the genus *Psiadia* has many similarities to the genus *Conyza*. The taxonomy of the Mascarene and Madagascan species has previously been confused. Some *Psiadia* species have initially been identified as *Conyza* species (Table 3). In like manner, *Psiadia rotundifolia* (Roxb.) Hook. fil, a species endemic to St Helene has been transferred to the genus *Commidendrum*, endemic to this island. *Psiadia rotundifolia* is nowadays considered a synonym of *Commidendrum rotundifolium* (Robx.) DC. according to the website "Catalogue of life".

False classification of species has been perceived within the genus *Psiadia* itself. *Psiadia punctulata* Vatke and *Psiadia arabica* Jaub and Spach have been considered as distinct taxa by some researchers based on chemical composition (Juma et al., 2001; Midiwo et al., 2002; Ogweno Midiwo et al., 1997). But these differences could be attributed to ecological adaptations or geographical location since *P. punctulata* occurs in a wide area from Africa to Arabia. According to the 'Plant List' (http://www.theplantlist.org), *Psiadia arabica* is described as a synonym of *Psiadia punctulata*. Table 3 summarises all synonyms of *Psiadia* species based on the website 'Catalogue of Life' (http://www.catalogueoflife.org).

Table 1
Jacob de Cordemoy's grouping of *Psiadia* species.

Groups	Species	Plant type	Leaves	Inflorescence	Achenes
Psiadiastrum					
	P. amygdalina *P. anchusifolia* *P. argentea* *P. aspera* *P. callocephala* *P. frappieri* *P. lithospermifolia* *P. salaziana* *P. scabra* *P. sericea*	Shrubs or sub-shrubs densely hairy.	–	Conical receptacle, female florets with truncated corolla, male florets with tubular corolla.	Compressed.
Tubifera					
	P. insignis *P. laurifolia*	Small trees.	Leaves are slightly hairy.	Female florets with truncated or short corolla, male florets with tubular corolla.	Compressed.
Frappieria					
	P. littoralis *P. montana* *P. thermalis*	Shrubs.	Leaves are hairy, subsessile, slightly lanceolated with penninerve venation.	Much-branched inflorescences.	Very compressed.
Glutinaria					
	P. ambigua *P. dentata* *P. glutinosa* *P. linearifolia* *P. retusa*	Shrubs or sub-shrubs.	Hairy or glabrous leaves, hardly glutinous.	Female florets with a distinct ray.	–