Polygonum punctatum Elliott

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Polygonum punctatum Elliot
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Abstract *Polygonum punctatum* Elliot is found all over on the American continent in areas of flooded, sandy or fertile land. It belongs to Polygonaceae family and it is popularly known in Brazil as erva-de-bicho, cataia, persicária do Brasil, pimenteirad'água. In Spain is known as ajicillo, erva do bicho, caa-tai and in the United States of America dotted smartweed, water smartweed and water pepper. It is widely used in folk medicine and the uses of *P. punctatum* are referred in literature to treat hemorrhoids and rheumatism, besides presenting diuretic, abortive and emmenagogue action. There is a range of secondary metabolites groups in aerial parts, like tannins, free anthraquinones, saponins, pelargonidin, flavonoids and acids, polyphenols, coumarins, glycosides, terpenoids, sesquiterpenes and the major components, the sesquiterpenes polygodial and isotadeonal are the main active compounds. Pharmacological pre-clinical studies of the hydroalcoholic extract showed antihistaminic activity, anti-inflammatory, antipyretic and hypotensive activities emphasizing the popular indication for the treatment of intestinal pains and as a disinfectant in the treatment of skin infections. So, this species has potential to develop into an herbal medicine. Presently, however, there are just a few studies aimed at growing and improving its chemical quality.

Keywords *Polygonum punctatum* · Polygonaceae · *Erva-de-bicho* · Antihemorrhoidal drugs · Dotted smartweed

1 Taxonomic Characteristics

Polygonaceae is a cosmopolitan plant family, with most genera and species occurring in northern temperate regions and are herbs, shrubs, or rarely trees. The family consists of 31 genera and about 750 species. In the western hemisphere, 16 of these genera are restricted to western North America, with three disjuncts to Chile and Argentina (Melo 1999; Melo and França 2009). The genus *Polygonum* comprises about 300 species (Wang et al. 2005). Brazil is represented by 16 species including *Polygonum punctatum* Elliott (Melo and França 2009).

P. punctatum was described by Elliott and published in A Sketch of the Botany of South Carolina and Georgia 1 (5): 455–456, 1821 [1817]. It belongs to Equisetopsida class, Caryophyllales order, Polygonaceae family and *Polygonum* genus. It has an homonym, *Polygonum punctatum* Buch.-Ham. ex D. Don, published in Prodromus Florae Nepalensis 72. (1825) and two basionym *Discolenta punctate* (Elliott) Raf. and *Persicaria punctate* (Elliott) Samll. The species also has 35 synonyms, five from *Persicaria* genus and thirty from *Polygonum* genus (Tropicos 2015).

Synonyms *Persicaria punctata* (Elliott) Small, *Persicaria punctata* var. eciliata Small, *Persicaria punctata* var. robustior (Small) Small, *Persicaria punctata* var. tacubayana Nieuwl., *Persicaria robustior* (Small) E.P. Bicknell, *Polygonum acre* Kunth, Polygonum acre Lam., Polygonum acre var. aquatile Meisner in Martius,

Polygonum acre var. brachystachyum Meisn., Polygonum acre var. confertiflorum Meisn., Polygonum acre var. leptostachyum Meisn., Polygonum acre var. majus Meisn., Polygonum acre var. riparium Meisn., Polygonum antihaemorrhoidale fo. aquatile Mart, Polygonum antihaemorrhoidale fo. riparium Mart., *Polygonum var. aquatile* Mart., *Polygonum antihaemorrhoidale* var. riparium Mart., *Polygonum epilobioides* Wedd., *Polygonum hydropiperoides* Michx., *Polygonum punctatum* fo. longicollum Fassett, *Polygonum punctatum* fo. stipitatum Fassett, *Polygonum punctatum* var. aquatile (Mart.) Fassett, *Polygonum punctatum* var. confertiflorum (Meisn.) Fassett, *Polygonum punctatum* var. eciliatum Small, *Polygonum punctatum* var. ellipticum Fassett, *Polygonum punctatum* var. littorale Fassett, *Polygonum punctatum* var. majus (Meisn.) Fassett, *Polygonum punctatum* var. mexicanum Fassett, *Polygonum punctatum* var. parviflorum Fassett, *Polygonum punctatum* var. parvum Vict. & J. Rousseau, *Polygonum punctatum* var. riparium (Meisn.) Fassett, *Polygonum punctatum* var. robustius Small, *Polygonum punctatum* var. tacubayanum (Nieuwl.) Fassett, *Polygonum punctatum* var. typicum Fassett, Polygonum robustius (Small) Fernald.

2 Crude Drug Used

The infusion of the dried aerial parts is indicated as antihemorrhoidal. It must be prepared with 3 g of aerial parts in 150 mL of water, used externally, in a sitz bath, three times a day. It should not be used by pregnant and lactating women (Brasil 2011).

3 Major Chemical Constituents and Bioactive Compounds

Essential oils, flavonoids, triterpenoids, anthraquinones, coumarins, phenylpropanoids, tannins, and drimanes are secondary metabolites that are characteristic of the genus *Polygonum* (Fukuyama et al. 1980; Gilabert et al. 2014; López et al. 2006; Wang et al. 2005).

There is a range of secondary metabolites in the aerial parts of *P. punctatum*. Tannins, free anthraquinones, saponins, pelargonidin, flavonoids: quercetin, kaempferol, luteolin and acids: formic, acetic, valproic, lactic and malic (Teske and Trentini 1994). Polyphenols, coumarins, glycosides, were observed by Jácome et al. (2004) and volatile terpenoids such as sesquiterpenes: α-bisabolol (3.4%), various methylated phenol like α-tocopherol or vitamin E (3.6%), phytosterols: stigmasterol (2.1%) and β-sitosterol (29.9%) and the majors components, polygodial and isotadeonal (34.0%) were identified by Gilabert et al. (2014) showing that this species can be a promising source of drimane sesquiterpenes and phytoestrogens with important bioactivities.

The sesquiterpene polygodial is the active compound of *P. punctatum* and is responsible for most biological activities, especially the fungicidal activity of this species (Alves and Ribeiro 2001).

4 Morphological Description

This plant is 50–60 cm tall, branching occasionally and rather erect in habit. The alternate leaves are lanceolate-ovate or narrowly ovate, usually hairless, tapering to short petioles. At the base of each leaf, there is a sheath (ocrea) that wraps around the stem, which drops from the stem with age. The upper stems terminate in more or less erect spike-like racemes with small flowers that are sparsely distributed along its length. Each flower is about 3 mm long, white or greenish white, and its sepals have glandular dots that are either pale or dark-colored. The five sepals of the flower are more or less tightly folded against one other, while the short style is divided at its base into two or three segments. It has no noticeable floral scent. Each flower is replaced by an achene that is shiny, dark-brown to black, three-angled, and rather oblong (Hilty 2013; Lorenzi and Matos 2002; Melo 1999).

5 Geographical Distribution

P. punctatum is found throughout in the temperate, subtropical and tropical America, from Canada to Argentina (Pott and Pott 2000). In the USA it occurs in the south of California, Texas and Florida. In Canada, from Quebec to British Columbia. It also occurs in Mexico, Central America and West Indies (Mohlenbrock and Thomson 2009). In Brazil, it occurs in the North (Acre, Amazonas, Pará, Roraima), Northeast (Alagoas, Bahia, Ceará, Maranhão, Paraíba, Pernambuco, Piauí, Sergipe), Midwest (Distrito Federal, Goiás, Mato Grosso do Sul, Mato Grosso), Southeast (Espírito Santo, Minas Gerais, Rio de Janeiro) and in the South (Paraná, Rio Grande do Sul, Santa Catarina) (Melo 2014). It occurs in areas with climatic and environmental characteristics that are very different, such as the Amazon, Caatinga, Pantanal, Cerrado and Atlantic Forest, in the mixed ombrophilous forest (Melo 2000).

6 Ecological Requirements

Although widely distributed, this species occurs in humid environments. As an herbaceous species, emergent or amphibious, it is abundant in flooded fields, edge ponds, lowlands, wetlands, floodplain, clay or silty-organic soils and fertile sandy soils (Melo 2014). The plants often form colonies, of varying size, and require full

or partial sun, moist to wet conditions, in mucky soil that is high in organic matter. This plant tolerates shallow standing water (Hilty 2013).

7 Collection Practice

The way of obtaining the plant material is still by collection in the natural populations. According to Ming et al. (2012) there is no commercial cultivation in Brazil, then harvesting is usually performed in moist or swampy areas.

Plant material recommended to use is aerial parts (leaves and stems), so it is important not to collect the flower.

In the USA the blooming period occurs from mid-summer to early fall, and lasts about 1–2 months (Hilty 2013).

The dried plant material should be stored away from light and heat, in tightly closed containers.

8 Traditional Use and Common Knowledge

P. punctatum is popularly known as *erva de bicho, cataia, persicária do Brasil, pimenteirad'água, barbasco*; in Spain is known as, *ajicillo, erva do bicho* and *caa-tai* and in the United States of America dotted *smartweed, water smartweed* and *water pepper* (Lorenzi and Matos 2002; Martínez-Crovetto 1981). It is used in folk medicine as an astringent, stimulant, diuretic, vermicide, antigonorrheic and antihemorrhoidal also being used locally against skin ulcers, erysipelas and arthritis (Lorenzi and Matos 2002; Mors et al. 2000). In traditional medicine from Toba Indians of the northeastern region in Argentina, *P. punctatum* is used as a disinfectant and also commonly used as a spice in Japanese cuisine (Martínez-Crovetto 1981). At traditional medicine, in rural areas of Colombia, a decoction of the aerial plant is used externally in the treatment of skin infections (Lopez et al. 2001).

9 Modern Medicine Based on Its Traditional Medicine Uses

The uses of *P. punctatum* are referred in literature to treat hemorrhoids and rheumatism, besides presenting diuretic, abortive and emmenagogue action (Lorenzi and Matos 2002). Aqueous extracts of *P. punctatum* have shown *in vitro* activity against infectious diseases. In an ethnopharmacological screening of medicinal plants used in Argentina, aqueous extracts of *P. punctatum* showed in vitro activity against Herpes Simplex Virus type 1 (HSV-1) and antiviral activity against respiratory syncytial virus (RSV) (Kott et al. 1999).

It has also been observed stronger antiviral and antimicrobial activities in the methanolic extract. According to Lopez et al. (2001) a complete virus inactivation was detected in Herpes Simplex Virus type 1 (HSV-1) in a minor dose described by Kott et al. (1999). In addition, a potent antimicrobial activity against *Streptococcus faecalis*, *Mycobacterium phlei*, *Bacillus subtilis* and *Staphylococcus aureus* was reported by Lopez et al. (2001), emphasizing the popular indication as a disinfectant and in the treatment of skin infections and the importance of further pharmacological studies.

Gilabert et al. (2014) provide evidence that support the antimicrobial use of *P. punctatum* against *Staphylococcus aureus* and *Pseudomonas aeruginosa*, as well as, demonstrates that the isotadeonal has been a bioactive compound able to control biofilm formation and bacterial growth of both human pathogens. Furthermore, the aqueous extract of the leaves has potential antidiarrhoeic effect by increasing the intestinal absorption of water (Almeida et al. 1995).

Toxicity assays of the methanolic and aqueous extracts, in a rat model, indicate low toxicity and relative safety of use, shown by a LC50>1 g/kg (Bhakuni et al. 1969).

The in vivo pharmacological studies with rats highlighted the bioactivity of *P. puctatum* extracts. According to Oliveira-Simões et al. (1989) the ethanol/water extract of the entire plant disclosed antihistaminic, anti-inflammatory, antipyretic and hypotensive activities. Alves and Ribeiro, (2001) reported anti-inflammatory activities of the decoction and the presence of polygodial, a sesquiterpene with a strong antibiotic compound (Kott et al. 1999; Lopez et al. 2001; Penna et al. 2001). It also displays anti-hyperalgesic properties in models of inflammatory and neurogenic pain (Mendes et al. 1998). All these reports support the ethnomedical use of this plant for the treatment of intestinal pains and infections.

10 Conclusions

P. punctatum is widely used in folk medicine. Preclinical studies validate the popular indication in the treatment of intestinal pains and as a disinfectant in the treatment of skin infections. The species seems a promising source of important bioactive compounds, such as drimane sesquiterpenes and phytoestrogens for the production of herbal medicines. Farther studies aimed at domestication and improving chemical quality are needed. With the growing market demand, its availability can be threatened dramatically, since these studies don't seem to take into account such important factors, such as plant regeneration, frequency and intensity of collection.

References

Almeida C, Karnikowski G, Foleto R, Baldisserotto B (1995) Antidiarrhoeic effect of plants used in popular medicine. Rev Saúde Publica 29(6):428–433

Alves T, Ribeiro F (2001) Polygodial, the fungitoxic component from the Brazilian medicinal plant Polygonum punctatum. Mem Inst Oswaldo Cruz 96(6):831–833

Bhakuni O, Dhar M, Dhar M, Dhawan B, Mehrotra B (1969) Screening of Indian plants for biological activity: part II. Indian J Exp Biol 7(1):250–262

Brasil (2011) In: Anvisa (ed). Agencia Nac. Vigil. SanitáriaFormulário de Fitoterápicos da Farmacopéia Brasileira. Agencia Nacional de Vigilancia Sanitária (ANVISA), Brasilia

Fukuyama Y, Sato T, Asakawa Y, Takemoto T (1980) A potent cytotoxic warburganal and related drimane-type sesquiterpenoids from *Polygonum hydropiper*. Phytochemistry 21(12):2895–2898

Gilabert M, Cartagenab E, Gilabert M, Cartagena E, Escobar G, Bardón A et al (2014) Volatile terpenoids from water pepper (polygonum punctatum) against pseudomonas aeruginosa and staphylococcus aureus virulence strategies. Glob J Agric Innov Res Dev 1:3–10

Hilty J (2013) Wetland wildflowers of Illinois [Internet]. World Wide Web Electron. Publ. Available from: http://www.illinoiswildflowers.info/wetland/plants/water_smartweed.htm

Jácome RLRP, Lopes DES, Recio RA, Macedo JF, Oliveira AB (2004) Caracterização farmacognóstica de Polygonum hydropiperoides Michaux e P. spectabile (Mart.) (Polygonaceae). Rev Bras Farmacogn Sociedade Brasileira Farmacogn 14(1):21–27

Kott V, Barbini L, Cruañes M, Muñoz JD, Vivot E, Cruañes J et al (1999) Antiviral activity in Argentine medicinal plants. J Ethnopharmacol 64:79–84

Lopez A, Hudson J, Towers GH (2001) Antiviral and antimicrobial activities of Colombian medicinal plants. J Ethnopharmacol 77:189–196

López SN, Sierra MG, Gattuso SJ, Furlán RL, Zacchino SA (2006) An unusual homoisoflavanone and a structurally-related dihydrochalcone from Polygonum ferrugineum (Polygonaceae). Phytochemistry 67(19):2152–2158

Lorenzi H, de Matos FA (2002) Plantas medicinais no Brasil: nativas e exóticas, 2nd edn. Nova Odessa, Plantarum

Martínez-Crovetto R (1981) Las plantas utilizadas en medicina popular en el noroeste de Corrientes (República Argentina). Miscelanea Educacion, Ministerio de Cultura y Educacion, San Miguel de Tucuman

Melo E (1999) Levantamento da família Polygonaceae no estado da Bahia, Brasil: espécies do semi-árido. Rodiguésia 50(76/77):29–47

Melo E (2000) Polygonaceae da cadeia do espinhaço, Brasil. Acta Bot Bras 14(3):273–300

Melo E (2014) Polygonaceae [Internet]. List. espécies da flora do Bras. Jard. Botânico do Rio Janeiro. Available from: http://floradobrasil.jbrj.gov.br/jabot/floradobrasil/FB13728

Melo E, França F (2009) Neotropical Polygonaceae – Neotropikey from Kew [Internet]. Milliken, W., Klitgård, B. Baracat, A. Interact. key Inf. Resour. Flower. plants Neotrop [cited 2015 Feb 14]. Available from: http://www.kew.org/science/tropamerica/neotropikey/families/Polygonaceae.htm

Mendes GL, Santos ARS, Campos MM, Tratsk KS, Yunes RA, Filho VC et al (1998) Anti-hyperalgesic properties of the extract and of the main sesquiterpene polygodial isolated from the barks of Drymis winteri (Winteraceae). Life Sci 63(5):369–381

Ming LC, Ferreira MI, Gonçalves GG (2012) Pesquisas agronômicas das plantas medicinais da Mata Atlântica regulamentadas pela ANVISA. Rev Bras Plantas Med Sociedade Brasileira Plantas Medicinais 14(spe):131–137

Mohlenbrock RH, Thomson PM (2009) Flowering plants: smartweeds to hazelnuts- illustrated Flora of Illinois. Book 13, 2nd edn. Southern Illinois University Press, Carbondale

Mors WB, Rizzini CT, Pereira NA, DeFilipps RA (2000) Medicinal plants of Brazil. Reference Publications, Michigan

Oliveira-Simões C, Ribeiro-do-Vale R, Poli A, Nicolau M, Zanin M (1989) Pharmacological investigation on Polygonum punctatum Elliott (P. acre H.B.K.) extracts. Part I. Tests in vivo. J Pharm Belg 44:275–284

Penna C, Marino S, Vivot E, Cruañes MC, de Muñoz DJ, Cruañes J et al (2001) Antimicrobial activity of Argentine plants used in the treatment of infectious diseases. Isolation of active compounds from Sebastiania brasiliensis. J Ethnopharmacol 77(1):37–40

Pott V, Pott A (2000) Plantas aquáticas do Pantanal. Brasilia, Embrapa Comunicacao Para Transferencia de Tecnologia

Teske M, Trentini AMM (1994) Compêndio de fitoterapia, 3rd edn. Herbarium Lab. Bot. Ltda, Curitiba

Tropicos (2015) Polygonum punctatum [Internet]. Missouri Bot. Gard. Available from: http://www.tropicos.org/Name/26000886

Wang K-J, Zhang Y-J, Yang C-R (2005) Antioxidant phenolic compounds from rhizomes of Polygonum paleaceum. J Ethnopharmacol 96(3):483–487