

**UNIVERSIDADE ESTADUAL DO SUDOESTE DA BAHIA
CURSO DE ENGENHARIA FLORESTAL**

**CARACTERIZAÇÃO ESTRUTURAL DA FOLHA DE *Bauhinia
monandra* Kurz
(FABACEAE - CERCIDOIDEAE)**

MARIANA NOVAIS ANTUNES

**VITÓRIA DA CONQUISTA
BAHIA - BRASIL
JUNHO – 2021**

MARIANA NOVAIS ANTUNES

**CARACTERIZAÇÃO ESTRUTURAL DA FOLHA DE *Bauhinia*
monandra Kurz
(FABACEAE - CERCIDOIDEAE)**

Monografia apresentada à Universidade Estadual do Sudoeste da Bahia, como parte das exigências do Curso de Engenharia Florestal, para a obtenção do título de graduado em Engenharia Florestal.

Orientador: Prof. Dr. Carlos André Espolador Leitão (UESB)

**VITÓRIA DA CONQUISTA
BAHIA - BRASIL
JUNHO – 2021**

MARIANA NOVAIS ANTUNES

**CARACTERIZAÇÃO ESTRUTURAL DA FOLHA DE *BAUHINIA*
MONANDRA KURZ
(FABACEAE - CERCIDOIDEAE)**

Monografia apresentada à Universidade Estadual do Sudoeste da Bahia, como parte das exigências do Curso de Engenharia Florestal, para a obtenção do título de graduado em Engenharia Florestal.

Aprovada em 01 de junho de 2021.

Comissão Examinadora:

Prof. Alessandro de Paula (D.Sc., Ecologia e Recursos Naturais) - UESB

Prof. Claudenir Simões Caires (D.Sc., Botânica) – UESB

Prof. Carlos André Espolador Leitão (D.Sc., Biologia Celular e Estrutural) – UESB
Orientador

LISTA DE FIGURAS

Figure 1. Micrographs of the <i>Bauhinia monandra</i> leaf blade	22
Figure 2. <i>Bauhinia monandra</i> leaf parts and larger veins.....	24
Figure 3. <i>Bauhinia monandra</i> minor leaf veins and motile cushion.....	25
Figure 4. <i>Bauhinia monandra</i> distal pulvinus and petiole middle part.	27
Figure 5. <i>Bauhinia monandra</i> proximal pulvinus	28

LISTA DE TABELAS

Table 1. Anatomical features of the leaf blade epidermis of different species of <i>Bauhinia</i>	31
Table 2. Anatomical feature of the mesophyll and leaf margin of different species of <i>Bauhinia</i>	33

SUMÁRIO

1. REVISÃO DE LITERATURA.....	7
1.1. Fabaceae.....	7
1.2. O gênero <i>Bauhinia</i> L.....	8
1.3. <i>Bauhinia monandra</i> Kruz	10
1.4. Anatomia Vegetal.....	11
2. REFERÊNCIAS BIBLIOGRÁFICAS.....	12
INTRODUCTION	20
MATERIAL AND METHODS.....	20
Light microscopy	21
Scanning electron microscopy	21
RESULTS	21
Leaf blade	21
Petiole	26
DISCUSSION.....	28
CONCLUSION.....	34
REFERENCES	34
ANEXO A.....	37
ANEXO B.....	38

1. REVISÃO DE LITERATURA

1.1. Fabaceae

A família Fabaceae demonstra a diversidade geral das angiospermas, abrigando 8% das espécies de plantas vasculares, encontradas nos mais variados habitats. Além disso, demonstram funções particulares nos ecossistemas, como na fixação de nitrogênio (YAHARA et al., 2013). É a terceira maior família de angiospermas e a segunda maior família de importância econômica, proporcionando produtos na indústria alimentícia, usos como forrageira, planta ornamental e usadas como fontes de madeira, gomas e resinas. Estão distribuídas em 630 gêneros e 18.000 espécies, ocorrendo em diversos habitats, onde as principais espécies estão contidas nos gêneros *Astragalus* L., *Acacia* Mill., *Indigofera* L., *Bauhinia* L., entre outras (JUDD et al., 2009).

Tradicionalmente eram reconhecidas três subfamílias pertencentes à Fabaceae: Mimosoideae, Papilionoideae e Caesalpinioideae (JUDD et al., 1999). Porém, atualmente, baseada em análises filogenéticas de sequências de genes de plastídios, o LPWG (2017), realizou uma nova classificação da família de leguminosas, principalmente devido a não monofilia da subfamília caracteristicamente conhecida: Caesalpinioideae, na qual foram reconhecidas seis subfamílias monofiléticas robustamente suportadas. O novo agrupamento que expressa estrutura filogenética, reconhece e consiste de seis subfamílias da família Fabaceae: Caesalpinioideae, Cercidoideae, Detarioideae, Dialioideae, Duparquetioideae, Papilionoideae. Dentre as novas seis subfamílias, Cercidoideae é um dos clados mais basais, com 12 gêneros e 335 espécies principalmente tropicais. Contém representantes como árvores, arbustos e lianas, portando nectários extraflorais, folhas unidas ou bifolioladas e na flor a pétala adaxial é regularmente diferenciada, como em *Bauhinia*.

Várias espécies da família Fabaceae são citadas como importantes plantas apícolas, Barros (1965) citou *Leucaena* Benth., *Mimosa* L. e *Bauhinia*, Ramalho et al., (1990) citou, tanto para abelhas *Apis mellifera* L. como as abelhas sem ferrão em habitats neotropicais, *Aeschynomene* L., *Bauhinia*, *Desmodium* Desv., *Leucaena*, *Mimosa*, *Sesbania* Adans. e *Zornia* J.F.Gmel.

1.2. O gênero *Bauhinia* L.

O gênero *Bauhinia* é pre-lineano, descrito em 1703 por Charles Plumier. O vocábulo genérico foi considerado uma homenagem aos irmãos Bauhin, devido a forma das folhas bilobadas das espécies desse gênero. Linnaeus validou o gênero a partir de 1753 e descreveu 8 espécies, das quais 3 pertencentes ao continente americano (VAZ 1979). É o maior gênero de Cercidoideae, abrigando quase todos os representantes dessa subfamília (LPWG, 2017), e compreendem cerca de 300 espécies que são cultivadas em locais tropicais de todo o mundo (LEWIS, 1987; MIYAKE et al., 1986).

São espécies nativas da Índia, Sri Lanka, sudoeste da China e África tropical e suas árvores distribuem-se pela zona tropical do mundo inteiro e podem ser utilizadas para lenha e carvão. A madeira é empregada em caixotarias e obras leves, têm caráter medicinal, são usadas como plantas ornamentais, na arborização de ruas estreitas e sob rede elétrica por ser de pequeno porte e rápido crescimento, além de serem empregadas no reflorestamento (LORENZI, 1992).

As folhas do gênero *Bauhinia* são características, por apresentarem estruturas inconfundíveis, como a nervação palmatinérvea associada ao pecíolo com duas articulações: uma basal denominada de pulvino proximal, e uma outra articulação apical junto ao mesofilo, o pulvino distal. Além disso, apresentam uma articulação na base da lâmina foliar, chamada de almofada motora, que é responsável pelos movimentos nictinásticos singulares de abertura e fechamento do limbo. E ainda um prolongamento apical ou situado entre os folíolos, no caso de separação total destes (VAN DER PIJL, 1952).

São árvores pequenas ou arbustos eretos com flores grandes, vistosas, perfumadas, púrpuras, rosas, brancas ou amarelas, protegidas por duas brácteas, formando racemos terminais ou axilares. Cálice curto, em forma de tubo, campanulado ou alongado, 5 pétalas, 10 estames ou menos, alguns reduzidos a estaminóides, livres ou concrecentes; filete linear carregando anteras ovadas, oblongas ou lineares, longitudinalmente deiscentes; ovário grande, livre ou unido ao receptáculo, bi ou multi ovulado, estilete curto, estigma pequeno. A ocorrência de raízes pretas ou escuras é típica de espécies não noduladoras de *Caesalpinia* L. e característica das espécies de *Bauhinia* (ALLEN e ALLEN, 1981).

Uma particularidade do gênero *Bauhinia* é sua representatividade por espécies de destaque no uso medicinal, como a *B. monandra* Kurz (MENEZES, 2007; ARGOLO, 2004). Muitas destas plantas são empregadas como remédio na medicina popular em várias regiões do mundo, incluindo a África, Ásia, América do Sul e Central (ACHENBACH et al., 1998) e são frequentemente usadas no tratamento de várias doenças, incluindo diabetes (COELHO e SILVA, 2000; LINO et al., 2004; THIRUVENKATASUBRAMANIAM, 2010). Com o aumento da incidência de diabetes no mundo, a busca por essas plantas aumentou consideravelmente (VASCONCELOS et al., 2004; ALJOBOURI et al., 2015)

As propriedades terapêuticas de *Bauhinia* foram sustentadas por estudos usando os extratos aquosos, etanólicos e hexânicos (LINO et al., 2004; VASCONCELOS et al., 2004) de folhas de *B. forficata* Link, que induziram hipoglicemia em ratos. Estudos fitoquímicos e farmacológicos realizados com estas plantas indicam que elas são constituídas basicamente de glicosídeos esteróidicos, triterpenos, lactonas e flavonoides, terpenos, esteroides e lactonas (SILVA e FILHO, 2002; ARGOLO et al., 2004).

As folhas, caules e raízes das espécies de *Bauhinia*, especialmente *B. manca* Standl., *B. rufescens* Lam., *B. forficata*, *B. cheitantha* (Bong.) Steud e *B. splendens* Kunth, são amplamente utilizadas em forma de chás e outras preparações fitoterápicas para o tratamento de várias enfermidades, principalmente infecções, processos dolorosos e diabetes (GUPTA, 1995; TESKE et al., 1997; ACHENBACH et al., 1998). As espécies mais estudadas fitoquimicamente são *B. manca* (ACHENBACH et al., 1998), *B. candicans* G.Bentham (IRIBARREN e POMILIO, 1983; 1987), *B. uruguayensis* Benth. (IRIBARREN e POMILIO, 1989), *B. purpurea* L. (RAMACHANDRAN e JOSHI, 1967; VIJAYAKUMARI et al., 1997; YADAVA e TRIPATHI et al., 2000) *B. forficata* (SILVA et al., 2000; SOUSA et al., 1998) e *B. splendens* (LAUX et al., 1985; CECHINEL FILHO et al., 1995). A espécie *B. divaricata* L. teve sua atividade hipoglicêmica em seu extrato aquoso demonstrado em camundongos (GUPTA et al., 1980) e *B. megalandra* Griseb. mostrou inibição da absorção intestinal de glicose em ratos (GONZALES-MUJICA et al., 2003). A atividade hipoglicêmica de *Bauhinia* tem sido mais amplamente pesquisada na espécie *B. forficata*, por Juliane (1929; 1931).

Outras espécies de *Bauhinia* são conhecidas e usadas na medicina popular, como a *B. monandra*, *B. holophylla* (Bong.) Steud. e *B. rufa* (Bong.) Steud.

(OLIVEIRA e SAITO, 1987, 1989), porém sem os devidos estudos sobre suas constituições químicas e atividades farmacológicas.

1.3. *Bauhinia monandra* Kurz

A árvore de *B. monandra* Kurz é perenifólia, com altura de 5-7 metros, apresenta flores grandes cor de rosa claro e rosa escuro. Como característica morfológica marcante e distintiva, suas flores possuem um único estame fértil (LORENZI, 2003), motivo pelo qual recebeu o epíteto específico *monandra*. Trata-se de uma espécie ornamental (KÖNEMANN, 1999) utilizada na arborização urbana (DURYEA et al., 2007; ARAÚJO et al., 2009; SILVA e GOMES, 2013).

Na região Nordeste do Brasil, as folhas dessa espécie são amplamente utilizadas na medicina popular com intuito de reduzir os níveis de glicose do sangue. Suas propriedades antiglicêmicas, estimulando a liberação de insulina no sangue, foram confirmadas em roedores (ALADE et al., 2011; ARGOLO et al., 2015;). Estudos realizados também em roedores mostram a capacidade dessa espécie em restaurar a secreção de insulina (ARGOLO et al., 2004). A atividade hipoglicêmica foi comprovada quando administrada com extrato de folha seca a 10% (100 µg/µL) (MINTO e PEREIRA, 2000). Mesmo tendo alguns compostos isolados e identificados, os estudos correlacionando os efeitos biológicos e adversos de seu uso contínuo são escassos (MACÊDO, 2008). Também, possuem atividade antimicrobiana, sendo uma alternativa segura e econômica para o tratamento de doenças infecciosas (AJIBOYE et al., 2015). As folhas são fonte de esteróides e flavonóides antioxidantes (ARGOLO et al., 2004; ADEROGBA et al., 2006; NWORIE e OKORIE, 2018) e da lecitina BmoLL, que possui ação anti-inflamatória e antinociceptiva testada em ratos (CAMPOS et al., 2016) e também, ação inseticida devidamente confirmada (MACEDO et al., 2007).

B. monandra é uma espécie que apresenta um conteúdo expressivo de proteínas específicas, nomeadamente lectina de folhas de *B. monandra*, BmoLL (COELHO e SILVA, 2000) e lectina de raiz de *B. monandra*, BmoRoL (SOUZA et al., 2011). O composto BmoLL mostrou atividade hipoglicêmica sem efeitos citotóxicos ou genotóxicos (SISENANDO et al., 2009).

1.4. Anatomia Vegetal

Os procedimentos de rotina em Anatomia Vegetal fornecem resultados de grande aplicabilidade em diferentes áreas do saber. Além de fornecerem subsídios para elucidação de problemas estruturais e fisiológicos, também fornecem importantes parâmetros para fins taxonômicos. A sua aplicabilidade ambiental está no fornecimento de subsídios para trabalhos em ecologia e conservação. Um aspecto econômico importante da anatomia vegetal está em seu emprego como importante ferramenta para os melhoristas de plantas. Também, para os químicos e farmacognosistas, pois pode identificar os locais de produção de produtos ativos, bem como fornecer informações estruturais de valor para delineamento de estratégias de colheita, armazenamento, extração, produtividade, etc. Por fim, a Anatomia Vegetal é importante no reconhecimento de fragmentos de plantas para fins experimentais, de controle de qualidade e procedência (BARROSO et al., 1984; CUTTER et al., 2009).

Para Silva et al. (2005) existem muitos trabalhos que apresentam correlações importantes entre a Anatomia Vegetal e a Fitotecnia, porém o fato destes estudos serem realizados somente sob a ótica disciplinar os torna limitantes. Conhecer a Anatomia Vegetal é importante quando se trata da propagação vegetativa, pois é imprescindível identificar os aspectos estruturais para garantir o sucesso da propagação, que se baseia na regeneração de tecidos vegetais e além disso, uma das formas de diferenciação de espécies do mesmo gênero é feita através dos estudos anatômicos de seus órgãos.

Além da descrição do uso medicinal, várias espécies do gênero *Bauhinia* tiveram sua anatomia descrita, como *B. curvula* Benth. (REZENDE et al., 1994), *B. forficata* (MIYAKE, 1986; DONATO, 1995; LUSA e BONA, 2009), *B. variegata* L. (KOTRESHA e SEETHARAM, 1995; LUSA e BONA, 2009), *B. blakeana* Dunn. (FERREIRA et al., 2003; ALBERT e SHARMA, 2013), *B. microstachya* (Raddi.) Macbr. (DUARTE e DEBUR, 2003), *B. racemosa* Lam., *B. tomentosa* L. (KOTRESHA e SEETHARAM, 1995; ALBERT e SHARMA, 2013), *B. unguolata* L., *B. pentandra* (Bong.) D.Dietr. e *B. cheilantha* (PEREIRA et al., 2018). Muitos estudos comprovaram a importância da anatomia foliar na distinção de grupos taxonômicos e relações ecológicas das plantas (CORRÊA et al., 2008), bem como para diferenciar espécies que se encontram separadas geograficamente (PELEGRIN et al., 2009).

2. REFERÊNCIAS BIBLIOGRÁFICAS

- ACHENBACH, M.; STOCKER, M. A.; ONSTENLA, M. A. Flavonoid and other constituents of *Bauhinia manca*. **Phytochemistry**, v. 27, n. 6, p. 1835-1841, 1988.
- ADEROGBA, M. A.; OGUNDAINI, A. O.; ELOFF, J. N. Isolation of two flavonoids from *Bauhinia monandra* (Kurz) leaves and their antioxidative effects. **African Journal of Traditional, Complementary and Alternative Medicines (AJTCAM)**. v. 3, n. 4, p. 59-65, 2006.
- AJIBOYE, A. T.; MUSA, M. D.; OTUN, K. O.; JIMOH, A. A.; BALE, A. T.; LAWAL, S. O.; AROWONA, M. T. The studies of antioxidant and antimicrobial potentials of the leaf extract of *Bauhinia monandra* plant. **Natural Products Chemistry & Research**. v.3, n 4, p.180. 2015.
- ALADE, G. O.; OMOBUWAJO, O. R.; ADEBAJO, C. A.; VERSOPOHL, E. J. Evaluation of the hypoglycaemic activity of *Bauhinia monandra* leaf in Alloxan-diabetic rats and INS-1 inulin cells. **Journal of Chemical and Pharmaceutical Research**. v. 3, p. 506-521, 2011.
- ALBERT S.; SHARMA B. Comparative foliar micromorphological studies of some *Bauhinia* (Leguminosae) species. **Turkish Journal of Botany**. v. 37, n. 2, p. 276-281, 2013.
- ALJOBOURI, A. M.; RASHID, K. I.; IBRAHIM, S. A.; ZYER, A. J.; ABBAS, Z. N. Study the effect of *Bauhinia variegata* Linn. Ethanolic extract on reducing glucose and lipid levels of white albino mice. **International Journal of Current Microbiology and Applied Sciences**, v. 4, n. 3, p. 652-658, 2015.
- ALLEN, O. N.; ALLEN, E. K. **The leguminosae: a source book of characteristics use and nodulation**. Wisconsin, University of Wisconsin Press, 1981. 812 p.
- ARAÚJO, A. C.; RIBEIRO, I. A. M.; DOS SANTOS MORAIS, M.; ARAÚJO, J. D. L. O. Análise quali-quantitativa da arborização no bairro Presidente Médici, Campina Grande-PB. **Revsbau**, v. 4, n. 1, p. 13-144, 2009.
- ARGOLO, A. C. C.; DANTAS, V. C. R.; SATURNINO, A. C. R. D.; SANTOS, A. F. S.; BRANDÃO-NETO, J.; PAIXÃO, A. D. O.; COELHO, L. C. B. B. Leaf ethanolic extract of *Bauhinia monandra* increases insulin secretion in rats subjected to intrauterine malnutrition. **International Journal of Biochemistry Research & Review**, v. 9, n.4, p. 1-9, 2015.
- ARGOLO, A. C. C.; SANT'ANA, A. E. G.; PLETSCHE, M.; COELHO, L. C. B. B. Antioxidant activity of leaf extracts from *Bauhinia monandra*. **Bioresource Technology**, v. 95, n. 2, p. 229-233, 2004.
- BARROS, M. B. de. Apicultura. Rio de Janeiro: **Serviço de Informação Agrícola**, 1965.

BARROSO, G. M.; PEIXOTO, A. L.; COSTA, C. G.; ICHASO, C. L. F.; GUIMARÃES, E. F.; LIMA, H. C. **Sistemática das Angiospermas do Brasil**, v.2, 1984. 377p.

CAMPOS, J. K.; ARAÚJO, C. S.; ARAÚJO, T. F.; SANTOS, A. F.; TEIXEIRA, J. A.; LIMA, V. L.; COELHO, L. C. Anti-inflammatory and antinociceptive activities of *Bauhinia monandra* leaf lectin. **Biochim Open**, v. 2, p. 62-68, 2016.

CECHINEL FILHO, V.; BREVIGLIERI, E.; WILLAIN FILHO, A.; SANTOS A.R.S.; **Revista Brasileira de Farmácia**, v. 76, p. 115-117, 1995.

COELHO, L. C.; SILVA, M. B. Simple method to purify milligram quantities of the galactose-specific lectin from the leaves of *Bauhinia monandra*. **Phytochemical Analysis: An International Journal of Plant Chemical and Biochemical Techniques**, v. 11, n. 5, p. 295-300, 2000.

CORRÊA, P. G.; PIMENTEL, R. M. D. M.; CORTEZ, J. S. D. A.; XAVIER, H. S. Herbivoria e anatomia foliar em plantas tropicais brasileiras. **Ciência e Cultura**, v. 60, n. 3, p. 54-57, 2008.

CUTLTER, D. F.; BOTHA, T.; STEVENSON, D. W. **Anatomia vegetal: uma abordagem aplicada**. Artmed Editora, 2009.

DONATO, A. M. Anatomia foliar e abordagem fitoquímica de *Bauhinia forficata* Link. (Leg-Caes). **Bradea**, v.6, n.42, p.357-371, 1995.

DUARTE, M. R.; DEBUR, M. C. Caracteres morfo-anatômicos de folha e caule de *Bauhinia microstachya* (Raddi) J. F. Macbr (Fabaceae). **Revista Brasileira de Farmacognosia**, v. 13, n.1, p. 7-15, 2003.

DURYEA, M.L; KAMPF, E; LITTELL, R.C; RODRÍGUEZ-PEDRAZA, C.D. Hurricanes and the urban forest: II. Effects on tropical and subtropical tree species. **Arboric Urban For.** v.33, n.2, p.98-112, 2007.

FERREIRA, J. L. P.; VELASCO, E.; PAULA, A. E. S.; ARAÚJO, R. B.; PACHECO, J. M. Anatomia foliar de *Bauhina blakeana* Dunn. **Revista Brasileira de Farmacognosia**, v. 13, p. 11-14, 2003.

LPWG- Legume Phylogeny Working Group. A new subfamily classification of the Leguminosae based on a taxonomically comprehensive phylogeny. **Taxon**. v. 66, n. 1, p. 44-77, 2017.

GONZALEZ-MUJICA, F.; MOTTA, N.; MÁRQUEZ, A. H.; CAPOTE-ZULUETA, J. Effects of *Bauhinia megalandra* aqueous leaf extract on intestinal glucose absorption and uptake by enterocyte brush border membrane vesicles. **Fitoterapia**, v. 74, n. 1-2, p. 84-90, 2003.

GUPTA, A. K.; VIDYAPATI, T. J.; CHAUHAN, J. S. Chemical examination of the stem of *Bauhinia variegata*. **Planta Medica**, v. 38, n. 02, p. 174-176, 1980.

GUPTA, M. P. 270 plantas medicinales iberoamericanas 1ra. ed. **Santa Fé de Bogotá: Convenio Andrés Bello**, p. 413-20, 1995.

IRIBARREN, A. M.; POMILIO, A. B.; J. Components of *Bauhinia candicans*. **Journal of natural products**, v. 46, n. 5, p. 752-753, 1983.

IRIBARREN, A. M.; POMILIO, A. B.; Sitosterol 3-O- α -d-xyluronofuranoside from *Bauhinia candicans*. **Phytochemistry**, v. 26, n. 3, p. 857-858, 1987.

IRIBARREN, A. M.; POMILIO, A. B. STEROIDAL GLYCOSIDES, FLAVONOIDS AND OTHER COMPONENTS OF *BAUHINIA-URUGUAYENSIS*. In: **Anales de la Asociacion Quimica Argentina**. SANCHEZ DE BUSTAMANTE 1749, 1425 BUENOS AIRES, ARGENTINA: ASOC QUIMICA ARGENTINA, 1989. p. 461-466.

JUDD, W. S.; CAMPBELL, C. S.; KELLOGG, E. A.; STEVENS, P. F.; DONOGHUE, M. J. **Sistemática Vegetal: Um Enfoque Filogenético**. Artmed Editora, 2009.

JUDD, W. S.; CAMPBELL, C. S.; KELLOGG, E. A.; STEVENS, P. F.; DONOGHUE, M. J. Plant systematics: a phylogenetic approach. **Ecología mediterránea**, v. 25, n. 2, p. 215, 1999.

JULIANE, C. Ação hipoglicemiante da unha-de-vaca. **Rev Med Pharm Chim Phys**, v. 2, n. 1, p. 165-169, 1929.

JULIANE, C. Ação hipoglicemiante de *Bauhinia forficata* Link. Novos estudos experimentais. **Revista Sudamericana de Endocrinologia Immunologia e Quimioterapia**, v. 14, n. 10, p. 326-334, 1931.

KÖNEMANN, B. The illustrated AZ of over 10,000 garden plants and how to cultivate them. **Hong Kong: Gordon Cheers Publication**, p. 51-3, 1999.

KOTRESHA, K.; SEETHARAM, Y. N. Epidermal studies in some species of *Bauhinia* L. (Caesalpinioideae). **Phytomorphology**, v. 45, n. 1-2, p.127-137, 1995.

LAUX, D. O.; STEFANI, G. M.; GOTTLIEB, O. R. Bausplendin, a dimethylenedioxyflavone from *Bauhinia splendens*. **Phytochemistry**, v. 24, n. 5, p. 1081-1084, 1985.

LEWIS, G. P. Legumes of Bahia. **London: Royal Botanic Gardens**; 1987.

LINO, C. D.; DIOGENES, J. P. L.; PEREIRA, B. A.; FARIA, R. A. P. G.; NETO, M. A.; ALVES, R. S.; QUEIROZ, M. G. R.; SOUSA, F. C. F.; VIANA, G. S. B. Antidiabetic activity of *Bauhinia forficata* extracts in alloxan-diabetic rats. **Biological and Pharmaceutical Bulletin**, v. 27, p. 125- 127, 2004.

LORENZI, H. **Árvores brasileiras. Manual de identificação e cultivo de plantas arbóreas nativas do Brasil**. Nova Odessa: 1992. 352p.

LORENZI, H. **Árvores exóticas no Brasil: madeireiras, ornamentais e aromáticas**. Rio de Janeiro: Editora Plantarum; 2003. 368p.

LUSA, M. G.; BONA C. Comparative morphological and anatomical analyses of *Bauhinia forficata* Link and *B. variegata* Linn. (Leguminosae, Caesalpinioideae). **Acta Botanica Brasilica**. v.23, n.1, p.196-211, 2009.

MACÊDO, M. F. S.; SISENANDO, H. A.; QUEIROZ, J. D. F.; ARGOLO, A. C.; SATURNINO, A. C. R. D.; COELHO, L. C.; MEDEIROS, S. R. Determining the genotoxicity of an aqueous infusion of *Bauhinia monandra* leaves. **Revista Brasileira de Farmacognosia**, v. 18, n. 4, p. 509-516, 2008.

MACEDO, M. L. R.; FREIRE, M. G. M.; SILVA, M. B. R.; COELHO, L. C. B. B. Insecticidal action of *Bauhinia monandra* leaf lectin (BmoLL) against *Anagasta kuehniella* (Lepidoptera: Pyralidae), *Zabrotes subfasciatus* and *Callosobruchus maculatus* (Coleoptera: Bruchidae). **Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology**, v. 146, n. 4, p. 486-498, 2007.

MENEZES, F. D. S.; MINTO, A. B. M.; RUELA, H. S.; KUSTER, R. M.; SHERIDAN, H.; FRANKISH, N. Hypoglycemic activity of two Brazilian *Bauhinia* species: *Bauhinia forficata* L. and *Bauhinia monandra* Kurz. **Revista Brasileira de Farmacognosia**, v. 17, n. 1, p. 8-13, 2007.

MINTO, A. B. M.; PEREIRA, M. A. LATINOAMERICAN CONGRESS OF PHARMACOLOGY, 56, 2000 Águas de Lindóia, **Anales**, Águas de Lindóia, 2000,

MIYAKE, E. T.; AKISUE, G.; AKISUE, M. K. Pharmacognostic characterization of pata-de-vaca *Bauhinia forficata* Link. **Revista Brasileira de Farmacognosia**. v. 1, n. 1, p. 58-68, 1986.

NWORIE, K. M.; OKORIE, N. A. Phytochemicals distribution and antioxidant potential of *Bauhinia monandra* (Linn.) leaves extract. **Research Journal of Medicinal Plant**. v. 12, n. 2, p. 78-83, 2018.

OLIVEIRA, F.E.; SAITO, M.L Alguns vegetais brasileiros empregados no tratamento da diabetes. **Revista Brasileira de Farmacognosia**, p. 170-196, 1989.

PELEGRIN, C. M. G.; LONGHI-WAGNER, H. M.; OLIVEIRA, P. L. Anatomia foliar como subsídio à taxonomia de espécies do *Complexo Briza* L. (Poaceae: Pooideae: Poeae). **Acta Botanica Brasilica**., v. 23, n. 3, p. 666-680, 2009.

PEREIRA, L. B. S.; COSTA-SILVA, R.; FELIX, L. P.; AGRA, M. F. Leaf morphoanatomy of "mororó" (*Bauhinia* and *Schnella*, Fabaceae). **Revista Brasileira de Farmacognosia**. v. 28, n. 4, p. 383-392, 2018.

PLUMIER, C. **Description des plantes de l'Amérique**. Imprimerie royale, 1713.

RAMACHANDRAN, R; JOSHI, B. C. Chemical examination of *Bauhinia purpurea* flowers. **Current Science**, v. 36, n. 21, p. 574-575, 1967.

RAMALHO, M.; KLEINERT-GIOVANNINI, A.; IMPERATRIZ FONSECA, V. L. Important bee plants for stingless bees (*Melipona* and *Trigonini*) and Africanized

honeybees (*Apis mellifera*) in neotropical habitats: a review. **Apidologie**, v.21, p.469-488, 1990.

REZENDE, M. H.; CARDOSO, L. A.; VANNUCCI, A. L. Morphology and anatomy of *Bauhinia curvula* Benth. (Leguminosae-Caesalpinioideae). **Acta Botanica Brasilica**, v. 8, n. 1, p. 19-34, 1994.

da SILVA, K. L., BIAVATTI, M. W., LEITE, S. N., YUNES, R. A., DELLE MONACHE, F., & CECHINEL FILHO, V. Phytochemical and pharmacognostic investigation of *Bauhinia forficata* Link (Leguminosae). **Zeitschrift für Naturforschung C**, v. 55, n. 5-6, p. 478-480, 2000.

SILVA, K. L. D.; CECHINEL FILHO, V. Plantas do gênero *Bauhinia*: composição química e potencial farmacológico. **Química Nova**, v. 25, n. 3, p. 449-454, 2002.

SILVA, L. M.; ALQUINI, Y.; CAVALLET, V. J. Inter-relações entre a anatomia vegetal e a produção vegetal. **Acta Botanica Brasilica**, v. 19, n. 1, p. 183-194, 2005.

SILVA, R. N.; GOMES, M. A. S. Quali-quantitative comparison of arborization in public spaces of the city of Arapiraca-AL, Brazil. **Revista da Sociedade Brasileira de Arborização Urbana**, v. 8, n. 2, p. 104-117, 2013.

SISENANDO, H. A. A. A. C. N. **Avaliação do potencial de mutagenicidade e toxicidade da lectina hipoglicemiante de folha de *Bauhinia monandra* (Pata-de-vaca)**, 2009, 68p. Dissertação (Mestrado em Ciências da Saúde) - Universidade Federal do Rio Grande do Norte, Natal.

SOUSA, E.; SZPOGANICZ, B.; PIZZOLATTI, M.G.; VI Encontro de Química da Região Sul da Sociedade Brasileira de Química, **Maringá, Brasil**, 1998.

SOUZA, J. D.; SILVA, M. B.; ARGOLO, A. C.; NAPOLEÃO, T. H.; SÁ, R. A.; CORREIA, M. T.; COELHO, L. C. A new *Bauhinia monandra* galactose-specific lectin purified in milligram quantities from secondary roots with antifungal and termiticidal activities. **International Biodeterioration & Biodegradation**, v. 65, n. 5, p. 696-702, 2011.

TESKE, M. **Herbarium compêndio de fitoterapia**. Herbarium Laboratório Botânico, 1997.

THIRUVENKATASUBRAMANIAM, R.; JAYAKAR, B. Anti-hyperglycemic and anti-hyperlipidaemic activities of *Bauhinia variegata* L on streptozotocin induced diabetic rats. **Der Pharmacia Lettre**, v. 2, n. 5, p. 330-334, 2010.

VAN DER PIJL. L. The leaf of *Bauhinia*. **Acta Botanica Neerlandica**. v. 1, n. 2, p. 287-309, 1952.

VAZ, A.M.S.F. Considerações sobre a taxonomia do gênero *Bauhinia* L. sect. *Tylotaea* Vogel (Leguminosae—Caesalpinioideae) do Brasil. **Rodriguésia**, v. 31, n.51, p 127-234, 1979.

VASCONCELOS, F.; SAMPAIO, S. V.; GARÓFALO, M. A.; GUIMARÃES, L. F. L.; GIGLIO, J. R.; ARANTES, E. C. Insulin-like effects of *Bauhinia forficata* aqueous extract upon *Tityus serrulatus* scorpion envenoming. **Journal of ethnopharmacology**, v. 95, n. 2-3, p. 385-392, 2004.

VIJAYAKUMARI, K.; SIDDHURAJU, P.; JANARDHANAN, K. Chemical composition, amino acid content and protein quality of the little-known legume *Bauhinia purpurea* L. **Journal of the Science of Food and Agriculture**, v. 73, n. 3, p. 279-286, 1997.

YADAVA, R. N.; TRIPATHI, P. A novel flavone glycoside from the stem of *Bauhinia purpurea*. **Fitoterapia**, v. 71, n. 1, p. 88-90, 2000.

YAHARA, T.; JAVADI, F.; ONODA, Y.; QUEIROZ, L. P.; FAITH, D. P.; PRADO, D. E.; SLIK, J. F. Global legume diversity assessment: concepts, key indicators, and strategies. **Taxon**, v. 62, n. 2, p. 249-266, 2013.

*Trabalho monográfico escrito em forma de artigo científico submetido e aceito
(Anexo A) na revista científica **Brazilian Archives of Biology and Technology**
(normas em Anexo B).*

Article

STRUCTURAL CHARACTERISATION OF THE LEAF OF *BAUHINIA MONANDRA* Kurz (FABACEAE - CERCIDOIDEAE)

Mariana Novais Antunes¹

<https://orcid.org/0000-0002-4651-7916>

Fabiano Rodrigues Pereira¹

<https://orcid.org/0000-0001-5357-118X>

Carlos André Espolador Leitão^{2*}

<https://orcid.org/0000-0002-1988-7436>

¹ Undergraduate student of Forest Engineering, State University of Southwest Bahia, Vitória da Conquista, Bahia, Brazil; ² State University of Southwest Bahia, Department of Natural Sciences, Vitória da Conquista, Bahia, Brazil.

Received: 2021.03.03; Accepted: 2021.04.07.

*Correspondence: candreel@yahoo.com.br; Tel.: +55-77-3425-9323 (C.A.E.L.)

HIGHLIGHTS

- *Bauhinia monandra* leaf is mesomorphous to xeromorphous.
- It has glandular navicular and uniseriate nonglandular trichomes.
- The petiole has differential anatomical characteristics within the genus.
- The pulvinus and the motile cushion have live pectic septate fibres.

Abstract: *Bauhinia monandra* Kurz (Fabaceae) is an ornamental leguminous tree from Africa. Its leaf has been proven to be hypoglycaemic, and are a source of lecithin BmoLL, providing this species with great medicinal potential. Curiously, there are no reports of the anatomical description of the leaf of this species. The present work aimed at describing the leaf anatomy of *B. monandra*, and make histochemical inferences. To this end, anatomical procedures in light and scanning electron microscopy were performed from different parts of the leaves of plants growing in the state of Bahia, Brazil. The leaf is amphistomatous. It possesses papillate epidermis, nonglandular and navicular trichomes, and the mesophyll is dorsiventral. The central vein is distinct from the others of the first degree. The first, second, and third-degree veins possess thick fibre bundles with associated monocrystals. The other veins are a little fibrous and excessively reduced. The petiole vascularisation consists of circularly arranged collateral bundles, plus two accessory bundles. The pulvinus have a wide parenchymatic cortex with abundant druses and vascularisation restricted to the central region, surrounded by a crystalline sheath and by a starch sheath. The motile cushion has the vascular bundles arranged in series. Associated with the phloem from the pulvinus vascular bundles and the motile apparatus, occur non-lignified septate fibres that confer flexibility to these organs. The absence of lateral projections and the arrangement of vascular bundles in the petiole was the most distinctive anatomical features and of the greatest taxonomic potential observed in the leaf of *B. monandra*.

Keywords: leaf anatomy, lecithin, leguminous, medicinal plant, ornamental tree.

INTRODUCTION

Bauhinia L. is by far the largest genus of Cercidoideae (Fabaceae) [1]. With about 300 species [2], *Bauhinia* has characteristic palmately bilobed or bifoliate leaves, with an apical extension between the lobes or leaflets. The petiole has two thickenings, named proximal and distal pulvinus. At the base of the leaf blade, there is a joint called motile cushion, responsible for the distinctive nyctinastic movements of opening and closing the limb [3]. The genus *Bauhinia* has several species of medicinal importance, mainly hypoglycemic, such as *B. divaricata* [4], *B. forficata* [5], *B. megalandra* [6], and *B. monandra* [7].

Bauhinia monandra Kurz is an African tree [8]. Despite its tropical origin, it adapts well to regions of amene climate. In Brazil, it is often grown in the North and Northeast regions, being rare in the South region of the country. This species is evergreen, 5-7 meters tall, and produces large pink flowers. As a markable and distinctive morphological characteristic, its flowers have a single fertile stamen [9], which is why it received the specific epithet *monandra*.

It is an ornamental tree [10] used in urban arborisation [11-13]. Lately, *B. monandra* has been intensively investigated as to its importance for man. Its seeds are potential sources of biodiesel [14] and amino acids for animal feeding, including humans [15]. The leaves are widely used in folk medicine, mainly in the treatment of diabetes. Its anti-glycaemic properties, stimulating the release of insulin in the blood, have been confirmed in rodents [7,16]. They also have antimicrobial activity, being a safe and economical alternative for treating infectious diseases [17]. The leaves are a source of antioxidant steroids and flavonoids [18-20] and of lecithin BmoLL, which has an anti-inflammatory and anti-nociceptive action tested in mice [21] and also, insecticidal action duly confirmed [22].

Some species of the genus had their leaf anatomy described, such as *B. blakeana* [23, 24], *B. cheilantha* [25], *B. curvula* [26], *B. forficata* [27-29], *B. malabarica* [24], *B. microstachya* [30], *B. pentandra* [25], *B. purpurea*, *B. racemosa*, *B. tomentosa* [24, 31], *B. unguata* [25], and *B. variegata* [29,31]. With this information, it is possible to use a larger amount of parameters, thus giving greater robustness in taxonomic discussions. Anatomical characteristics are of great value in the resolution of phylogenetic relationships [32], and leaf structure aspects are useful even for the development of dichotomous keys to distinguish species [33].

As for the *B. monandra*, despite the great importance and extensive studies carried out on this species, little is known about its anatomy. The leaves, which are of great potential for several applications, do not even have their surface and internal structure satisfactorily described. Knowledge on the leaf structure of *B. monandra* is of basal importance for taxonomic, physiological and pharmacological studies. Also, for the quality control of commercialised phytopharmaceuticals [34], mainly to avoid counterfeiting [35]. It has recently been demonstrated that the pattern of leaf blade veins is a valuable tool for distinguishing several species of *Bauhinia* commercialized for medicinal purposes, although in this study the leaves of *B. monandra* were not analysed [36]. A more detailed analysis of different parts of the leaf would certainly contribute even more to the efficiency of this quality control. Thus, the present study aimed to describe the leaf anatomy of *B. monandra* and, using the Toluidine blue O dye in pH 4.0 [37] among other usual techniques in plant anatomy, to obtain a greater wealth of information from the analysed cells and tissues [38] for taxonomic, physiological and pharmacological purposes.

MATERIAL AND METHODS

Three adult individuals of *B. monandra* growing at the Universidade Estadual do Sudoeste da Bahia, *Campus* of Vitória da Conquista, Bahia State, Brazil, at the coordinates 14°53'28"S, 40°48'14"W, and at 823 meters above sea level, were studied. The vouchers were deposited at the UESC Herbarium under the numbers 21.964, 21.965 and 21.966.

Fully expanded, whole and healthy leaves, with the leaf blade measuring 11-13 cm in length, were obtained from the fifth to the eighteenth nodes, from August 2017 to May 2018. These leaves were preliminarily examined using a Motic SMZ-143-FBLED stereoscopic equipped with a Canon PowerShot SD3500 digital camera for observation and photographic documentation. With the aid of a razor blade, samples from different parts of the leaf were isolated, namely: the petiole, segments of the proximal pulvinus, the middle part of the petiole and the distal pulvinus. From the leaf blade, the motile cushion, mesophyll, veins of all degrees and foliar edge were isolated.

Light microscopy

Part of the samples was immediately sectioned, obtaining numerous cross and longitudinal sections. Paradermal-sections were also performed on both sides of the leaf blade. These sections were made by free-hand with the aid of a razor blade [39] and observed in fresh with and without staining. For staining, obtaining metachromasia and histochemical inferences, Toluidine blue O 0.025% was used in McIlvaine buffer at pH 4.0 [37, 38, 40] for 15 min. For starch identification, the Lugol test [41] was performed. After staining, the sections were washed in distilled water and the slides were mounted with coverslips and distilled water [42].

For analysis and photographic documentation, a Leica DM750 light microscope equipped with an ICC50 HD (Leica) digital image capture system (Leica Microsystems, Wetzlar, Germany) was used. The anatomical description was performed according to the terminological criteria of Metcalfe and Chalk (1957) [43] and Wilkinson (1988) [44]. At least 30 sections per leaf part were analysed. Each individual had at least five leaves analysed.

Scanning electron microscopy

Samples of blades of five leaves from each of the three individuals studied were fixed in a solution containing 0.5% glutaraldehyde, 4% paraformaldehyde, 3% sucrose and 5 mmol/L calcium chloride in 0.2 mol/L phosphate buffer at pH 7.2 [45] for 24h at 6°C, then washed in the same buffer, dehydrated in an ethanolic series and submitted to the CO₂ critical point using a Bal-tec CPD030 (Balzers, Schaan, Liechtenstein). The samples were adhered to stubs and subjected to cathodic gold sputtering in a Bal-tec SCD050 (Balzers, Schaan, Liechtenstein) sputter coater [46]. The observations and electron micrographs acquisition were performed in a Quanta 250 (FEI Company, Oregon, USA) scanning electron microscope at 10Kv, equipped with a digital image acquiring system.

RESULTS

Leaf blade

The epidermis is single-layered and papillate, with epicuticular waxes in a plate pattern (Figure 1 A, B). In paradermal-section, the ordinary cells have sinuous to straight anticlinal walls on the adaxial side (Figure 1 C, D) and straight on the abaxial one (Figure 1 E). There are normal uniseriate multicellular nonglandular trichomes with verrucous ornamentation on both sides (Figure 1 B, F), mainly on the veins, where these trichomes are longer (Figure 1 G). Normal, multiseriate multicellular glandular trichomes (navicular trichomes) are present only on the abaxial surface, being more numerous on the edge and the veins, mainly in the vicinity of the motile cushion (Figure 1 H). The stomata are of the paracytic and anomocytic type, located at the same level as ordinary cells and occurring basically in the abaxial epidermis (Figure 1 E). In the adaxial epidermis, stomata are scarce, restricted to the vicinity of the first-degree veins and are rudimentary (Figure 1 D).

The mesophyll is dorsiventral, with two layers of palisade parenchyma that represent about 3/4 of the mesophyll thickness, and about two layer of spongy parenchyma, whose cells are shorter and tending to bractiform (Figure 1 I). Some mesophyll cells contain druse (Figure 1 I, J), other few accumulate material that stains blue with Toluidine blue O at pH 4.0 (TBO) (Figure 1 K). The leaf edge is enlarged and has one to three layers of cells that appear to be a hypodermis, where some cells can also accumulate material that stains blue with TBO. In cross-section, the vascular bundle present in the leaf edge is characterised by its outline more circular (Figure 1 K, L), by a large number of fibres, mainly associated with phloem, and by the small relative size of the xylem (Figure 1 M), in comparison to the other vascular bundles of the mesophyll, which are described below.

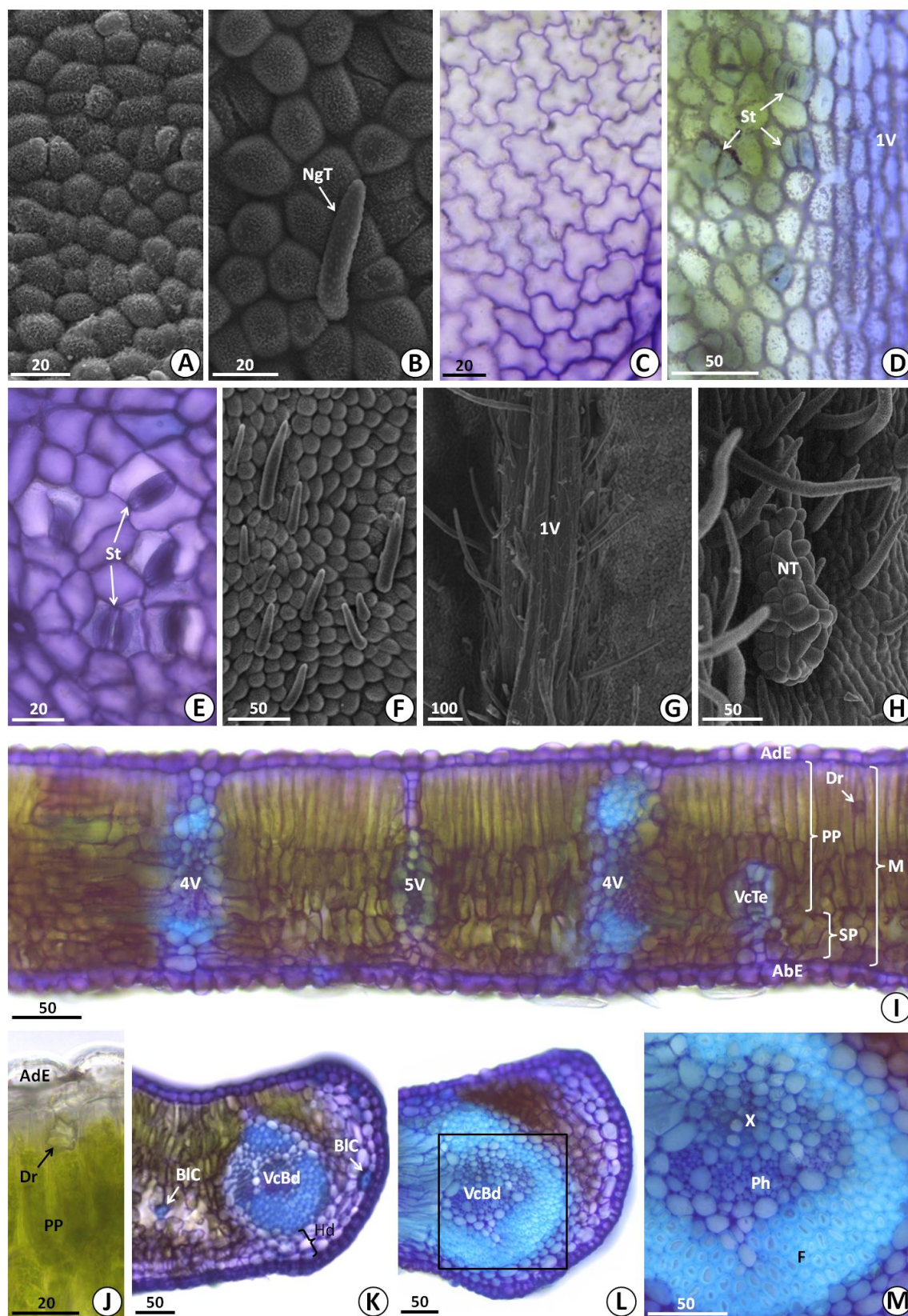


Figure 1. Micrographs of the *Bauhinia monandra* leaf blade. Scanning electron microscopy (A, B, F-H), paradermal (C-E) and cross-sections (I-M) stained with Toluidine blue O (C-E, I, K-M) and not stained (J). A. Adaxial epidermis. B. Abaxial epidermis. C, D. Adaxial epidermis. E-H. Abaxial epidermis. I. Mesophyll, showing the epidermis, chlorenchyma and vascularization. J. Detail of the palisade parenchyma, showing a druse. K, L. Leaf edge. M. Detail of the region delimited by the square in L. Legends: 1V- first-degree vein; 4V- fourth-degree vein; 5V- fifth-degree vein; AbE- abaxial epidermis; AdE- adaxial epidermis; BIC- blue stained cell; Dr- druse; F- fibres; Hd- hypodermis; M- mesophyll; NgT- nonglandular trichome; NT- navicular trichome; PP- palisade parenchyma; Ph- phloem; SP- spongy parenchyma; St- stomata; VcBd- vascular bundle; VcTe- vascular termination; X- xylem. Scale bars are in micrometres.

The central vein is very different from the other first-degree veins (Figure 2 A). It is characterised by an almost complete circular projection towards the adaxial side (Figure 2 B). The adaxial epidermis is wrinkled forming a groove, subtended by circa of two annular collenchyma layers. Subjacent, there is a vascular bundle with a group of fibres which stained in greenish-blue with TBO, dorsal to the xylem (Figure 2 C), and an arched sheath of similar fibres surrounding the phloem (Figure 2 B). In the latter, idioblasts that also stain in greenish-blue with TBO may occur (Figure 2 E). On the abaxial side, there are two layers of collenchyma subjacent to the epidermis. Internally, collapsed cells occur and, subjacent, two layers of ground parenchyma. Finally, there is the fibre sheath whose walls also were coloured in greenish-blue (Figure 2 E). The leaf blade is thinner in the vicinity of the central vein, where the mesophyll consists of two layers of isodiametric cells of chlorenchyma (Figure 2 D).

The other first-degree veins (Figure 2 A, F), excluding the central one, are also conspicuously protruding from the abaxial side, but slightly protruding from the adaxial side (Figure 2 G). Also, they are thicker and less circular in cross-section than the central vein. There is a narrow band of collenchyma that is larger than that of the central vein, which extends from the adaxial epidermis to one fibre bundle (Figure 2 H). This bundle is found at the dorsal portion of a large arc-shaped vascular bundle, in contact with the xylem parenchymal cells. Associated with the phloem, there are fibres organised in an arc that surrounds the vascular bundle in its ventral portion (Figure 2 G). The outermost fibres may be associated with prismatic crystals. Externally surrounding this arc of fibres, there are circa of two layers of ground parenchyma. In the apical region of the veins protrusions, on the abaxial face, there is a parenchyma transitional to collenchyma with collapsed aspect, forming rugosities on its surface. External to the collapsed layer, there is a collenchyma layer and, finally, the epidermis (Figure 2 I).

The second-degree veins (Figure 2 A, F) have a similar structure to the first-degree ones, differing basically by their smaller size, the collenchyma underlying the abaxial as well as the collapsed parenchymatic cells are absent and, consequently, there are no rugosities on the abaxial side (Figure 3 A).

The third-degree veins (Figure 2 F) are not very prominent on both sides. They consist of a vascular bundle with fibre clusters associated with the xylem and phloem. When viewed in cross-section, these fibres have an arrangement tending to elliptical in the xylem and an arc arrangement in the phloem. The vascular bundle is surrounded by a sheath that makes indirect contact with the epidermis by a narrow strip of a single layer of hypodermic cells, on both sides (Figure 3 B).

The fourth-degree veins (Figures 1 I, 2 F) do not protrude on either side. The vascular bundle is very small. The sheath extends from epidermis to epidermis, and the fibres occur in small numbers in each pole of these vascular bundles (Figure 3 C). The fifth-degree veins (Figures 1 I, 2 F) are structurally similar to the fourth-degree ones, however, they are even narrower with less vascular tissues and may not have fibres (Figure 3 D). Finally, the vascular terminations in the centre of the areoles (Figure 2 F) occur in the abaxial half of the mesophyll (Figure 1 I), they are constituted only by xylem surrounded by a sheath that extends merely to the abaxial epidermis (Figure 3 E).

In the motile cushion (Figures 2 A, 3 F), the epidermis is characterised by its wrinkled appearance, with longitudinal creases on both sides (Figure 3 G, H). Both epidermises are single-layered (Figure 3 I). There are no stomata and dense trichomes occur on the abaxial side (Figure 3 H). The cortex is broad (Figure 3 F), with thick parenchyma, and there are also numerous druse idioblasts (Figure 3 I). In the vicinity of the five to six vascular bundles that go to the first order veins of each leaf blade lobe, the parenchyma tends to chlorenchyma. These vascular bundles (Figure 3 J) occur in a linear arrangement (Figure 3 F). They are surrounded by a starch sheath (Figure 3 K) and are interconnected by a parenchyma strip rich in pit-fields (Figure 3 L). The vascular bundles are collateral (Figure 3 J), surrounded by a thick cap adjacent to the phloem, consisting of septate fibres whose walls are rich in pits and assume metachromasia to TBO (Figure 3 M, N).

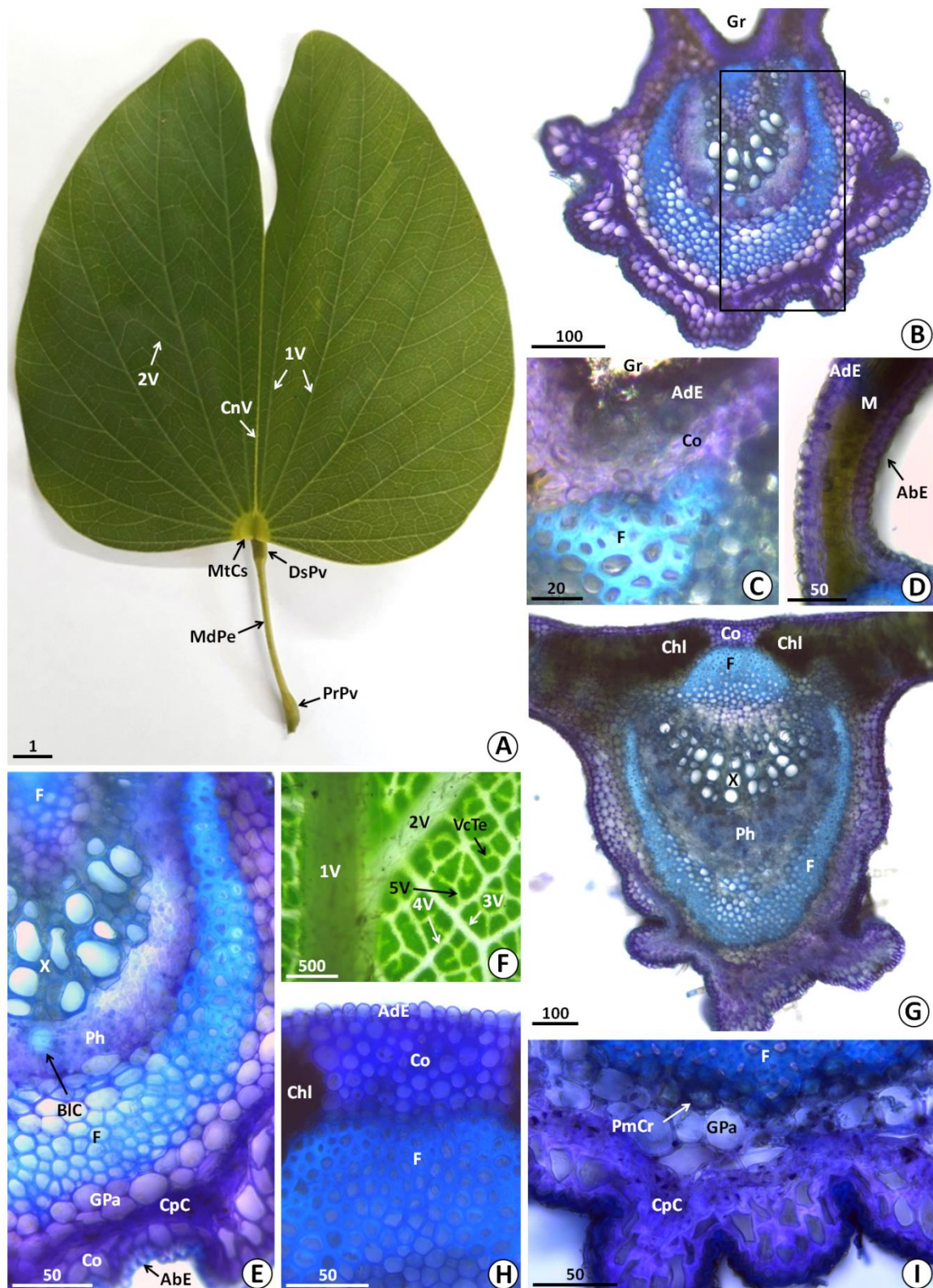


Figure 2. *Bauhinia monandra* leaf parts and larger veins. A. General view of a whole leaf. B. Cross-section of the central vein. C. Detail of the groove region. D. Detail of the leaf blade adjacent to the central vein. E. Magnification of the region bounded by the rectangle in B. F. Detail of the leaf blade, observed under a stereoscope, with veins of all degrees. G. Cross-section of the first degree vein. H. Detail of the adaxial part of the vein. I. Detail of the lateral region. Legends: 1V- first-degree vein; 2V- second-degree vein; 3V- third-degree vein; 4V- fourth-degree vein; 5V- fifth-degree vein; AbE- abaxial epidermis; AdE- adaxial epidermis; BIC- blue stained cell; Chl- chlorenchyma; CnV- central vein; Co- collenchyma; CpC- collapsed cells; DsPv- distal pulvinus; F- fibres; GPa- ground parenchyma; Gr- groove; M- mesophyll; MdPe- medium petiole; MtCs- motile cushion; Ph- phloem; PmCr- prismatic crystal; PrPv- proximal pulvinus; X- xylem. Scale bars are in centimetres (A) and in micrometres (B-I).

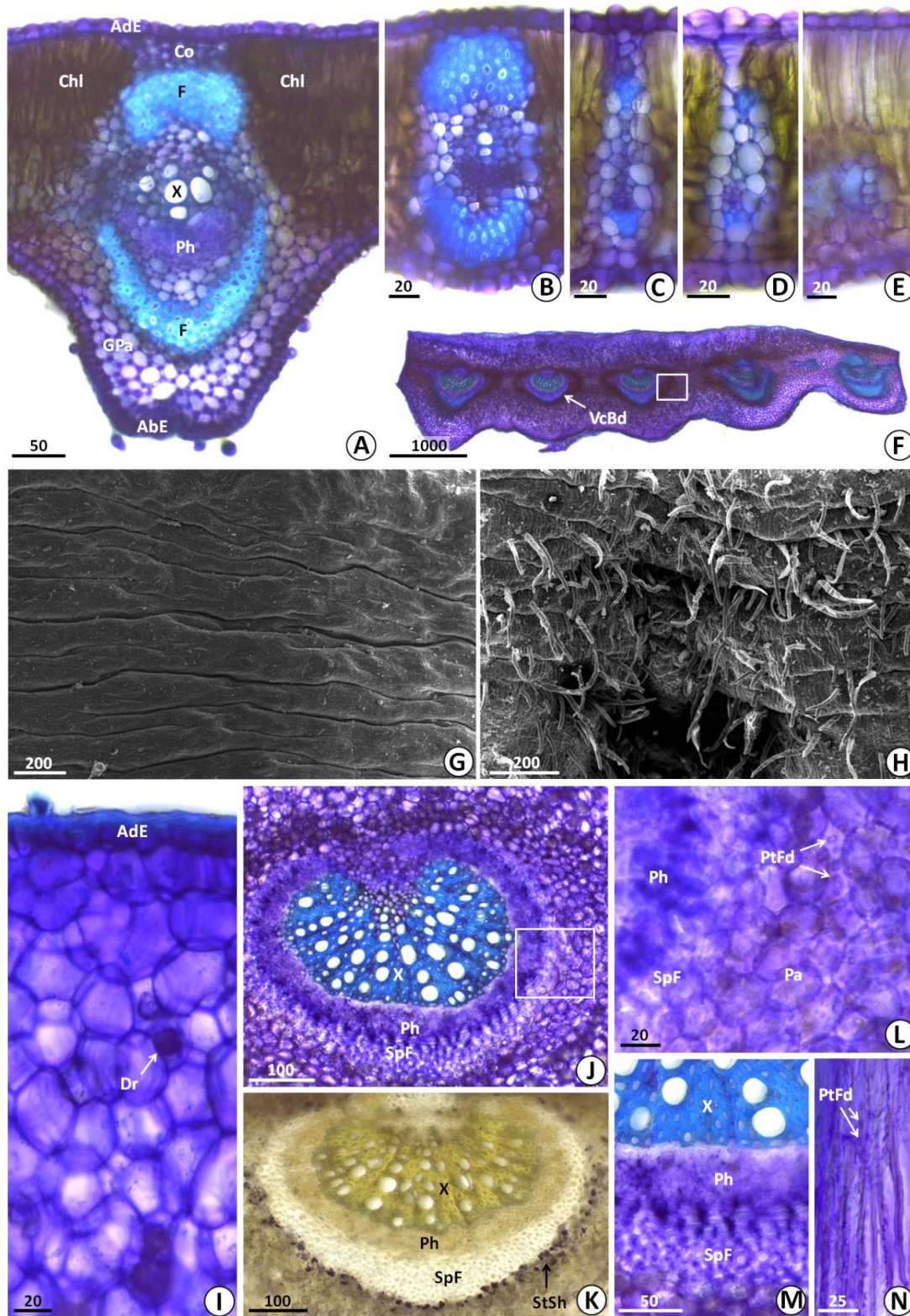


Figure 3. *Bauhinia monandra* minor leaf veins (A-E) and motile cushion (F-N), under the light microscope (A-F, I-N) and the scanning electron microscope (G, H). A. Second-degree vein. B. Third-degree vein. C. Fourth-degree vein. D. Fifth-degree vein. E. Vascular termination. F. General view of the longitudinal-section of the motile cushion. G. Motile cushion in adaxial view. H. Motile cushion in abaxial view. I. Detail of the adaxial part of the motile cushion. J. Detail of the vascular bundle of the motile cushion. K. Like in J, but stained with Lugol, showing the starch sheath. L. Detail of the parenchyma with pit-fields, between vascular bundles in the motile cushion, according to the region delimited by the rectangles in F and J. M. Detail of the abaxial part of the vascular bundle. N. Longitudinal-section of the septate fibres of the motile cushion. Legends: AbE- abaxial epidermis; AdE- adaxial epidermis; Chl- chlorenchyma; Co- collenchyma; Dr- druse; F- fibres; GPa- ground parenchyma; Pa- parenchyma; Ph- phloem; PtFd- pit-fields; SpF- septate fibres; StSh- starch sheath; VcBd- vascular bundle; X- xylem. Scale bars are in micrometres.

Petiole

The distal pulvinus has an elliptical shape in cross-section (Figure 4 A). The epidermis has a layer of ordinary cells whose cuticle corresponds to about half the height of the anticlinal walls (Figure 4 B). Spaced nonglandular trichomes and, eventually, navicular trichomes occur. Subjacent, there is a large parenchyma consisting of large cells (Figure 4 A, B), many of which containing druses. These druse cells occur in a progressively greater quantity towards the four vascular bundles. The parenchymal cells close to vascularisation contain chloroplasts (Figure 4 C). The vascular bundles are wrapped together by a starch sheath (Figure 4 D) where some cells may contain druse or prismatic crystal (Figure 4 E). They are collateral, arranged in two pairs aligned on the longest axis of the organ when in cross-section. Each pair consists of a larger bundle, with the phloem facing the periphery, and a smaller one, with the phloem facing the centre of the organ (Figure 4 A). Eventually, prismatic crystals can occur in the phloem (Figure 4 F). Externally, involving the vascular bundles set, there is a sheath of septated fibres (Figure 4 G) with conspicuous pits. These fibres are characterised for assuming metachromasia to TBO (Figure 4 A, F, G), and are also present between the smaller vascular bundles.

The inter-pulvinus portion of the petiole has a sub-elliptical format in cross-section, with a larger dorsiventral axis and flat adaxial side (Figure 4 H). The epidermis is single-layered, consisting of cells of quadrangular format in both cross and longitudinal-sections. The cuticle is relatively thick (Figure 4 I). Stomata are absent. Uniseriate nonglandular trichomes are practically non-existent and, even more rarely, navicular trichomes occur. Subjacent two to four layers of annular collenchyma occur (Figure 4 I, L) and, internally, about ten layers of chlorenchyma tending to ground parenchyma (Figure 4 J). The vascularisation consists of a ring of collateral vascular bundles of varying sizes, where the most abaxial is the largest one and the most adaxial is the second largest. The other vascular bundles are much smaller than those mentioned above. The most adaxial is in an eccentric position, projecting itself between two accessory collateral bundles external to the ring. These bundles form protrusions on the adaxial face of the petiole, resulting in the flattening of this side (Figure 4 H).

Each of the accessory bundles has a thick cap of fibres associated with the phloem, however without surrounding completely the bundle (Figure 4 J). The ring of vascular bundles is completely surrounded by fibres arranged in circa of six layers (Figure 4 H). Externally, prismatic crystals occur (Figure 4 K, L). All of these fibres are greenish-blue when stained with TBO (Figure 4 H). Inside the ring of vascular bundles, there is a large pith with voluminous parenchymal cells, where the most peripheral ones accumulate starch grains. Druses rarely occur (Figure 4 M).

The proximal pulvinus has a relatively regular circular format when in cross-section (Figure 5 A). It is the thickest portion of the petiole (Figure 2 A). The epidermis is single-layered, with square cells in cross-section. The thickness of the cuticle is practically the same as the cell lumen. Nonglandular trichomes are rare and navicular ones are practically nonexistent. Subjacent, there is a wide cortex of parenchymal cells (Figure 5 A, B), with a progressively greater number of druses occurring in the vicinity of the vascularisation, which is surrounded by a starch sheath (Figure 5 C).

In the centre of the proximal pulvinus there is a concentric amphicribal vascular bundle, with a circular, but slightly triangular, shape with the apex facing the adaxial side. The diameter of the vascular bundle corresponds to just over a third of the pulvinus diameter (Figure 5 A). In the outer portion of the bundle, septate fibres similar to those observed in the distal pulvinus occur (Figure 5 A, C-E). The phloem protrudes centripetally at the apex of the rounded triangle, conferring a depression in the xylem in this region and, consequently, a U-shape to the restricted pith parenchyma. On the adaxial side, the vascular tissues are more voluminous (Figure 5 A).

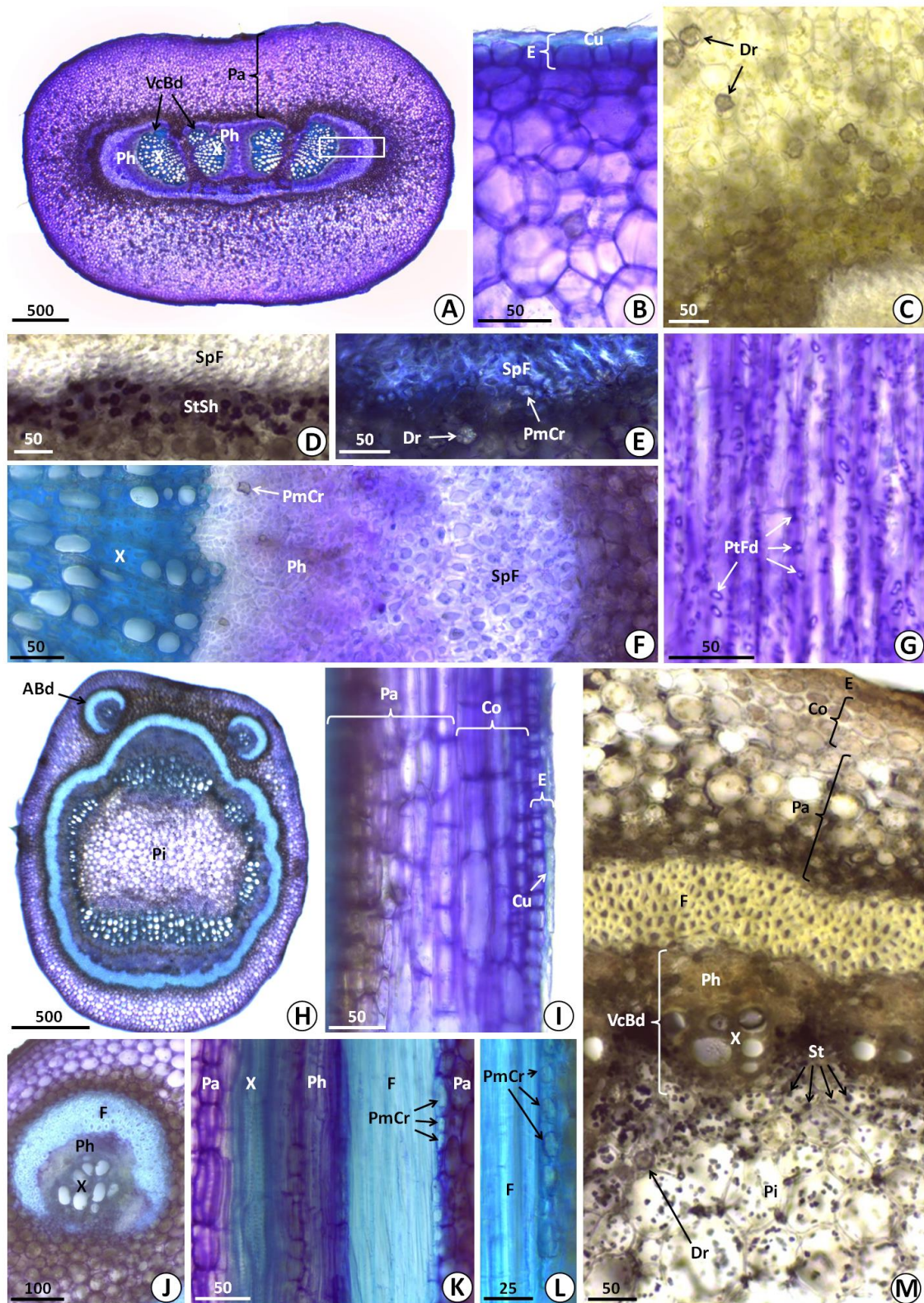


Figure 4. *Bauhinia monandra* distal pulvinus (A-I) and petiole middle part (H-M). A. General view of the distal pulvinus in cross-section. B. Detail of the adaxial portion. C. Detail of the inner region of the cortical parenchyma. D. Detail of the starch sheath adjacent to the septate fibres of the vascular bundles, stained with Lugol. E. Like in D, but stained with Toluidine blue O pH 4.0. F. Detail of the vascular bundles' tissues, as identified in the rectangle in A. G. Septate fibres in longitudinal-section. H. General view of the cross-section of the petiole middle part. I. Longitudinal-section of the cortical region of the petiole. J. Detail of an accessory vascular bundle. K. Longitudinal-section of a vascular bundle of the vascular ring. L. Detail of fibres in longitudinal-section with prismatic crystals in evidence. M. Detail of all tissues of the petiole middle part in cross-section, stained with Lugol. Legends: ABd- accessory vascular bundle; Co- collenchyma; Cu- cuticle; Dr- druses; E- epidermis; F- fibres; Pa- parenchyma; Ph- phloem; Pi- pith; PmCr- prismatic crystal; PtFd- pit-fields; VcBd- vascular bundle; SpF- septate fibres; St- starch grains; StSh- starch sheath; X- xylem. Scale bars are in micrometres.

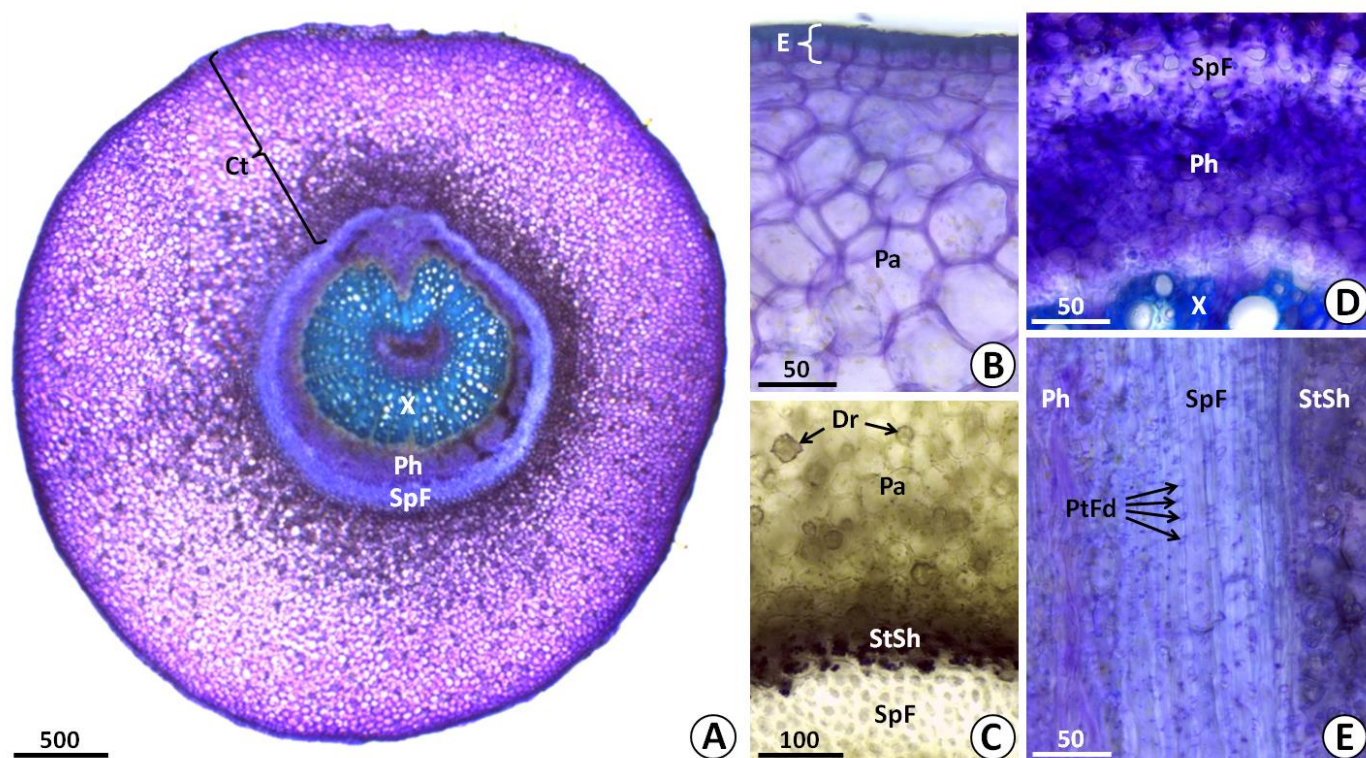


Figure 5. *Bauhinia monandra* proximal pulvinus. A. General view of the cross-section of the pulvinus. B. Detail of the cortical region. C. Detail of the internal region of the cortex, stained with Lugol for starch contrast. D. Detail of the vascular tissues. E. Longitudinal-section of the region of the septate fibres. Legends: Ct- cortex; Dr- druses; Pa- parenchyma; Ph- phloem; PtFd- pit-fields; SpF- septate fibres; StSh- starch sheath; X- xylem. Scale bars are in micrometres.

DISCUSSION

The papillate or subpapillate leaf epidermis is characteristic of *Bauhinia* [43]. The hypostomatous condition is common for the genus [28, 30] and is the one reported for fossil records of several *Bauhinia* species from the Miocene [47]. However, in the living *Bauhinia* species, the amphistomatous condition with a higher density of stomata on the abaxial side is generally reported, [24, 26, 27, 31], although *B. curvula* presents an inverse condition, with greater stomatal density on the adaxial epidermis [26]. *B. monandra* is amphistomatous, but stomata on the adaxial side are few and restricted to the immediate vicinity of the larger veins, where the mesophyll is thicker. A similar condition is described in *B. forficata* [29]. However, in *B. monandra* the adaxial stomata have a rudimentary aspect which suggests little functionality and, in this case, it can be inferred that this species is physiologically hypostomatous.

The stomata described for the genus are of the paracytic, anisocytic, tetracytic, and anomocytic type, corroborating with the paracytic and anomocytic types observed in *B. monandra* in the present work, similarly to *B. blakeana* [23] and *B. curvula* [26]. It is possible that, from the paracytic, described for fossil records of *Bauhinia* from the Miocene [47], it has derived into the other stomata types of the genus.

The plate pattern of the epicuticular waxes observed in *B. monandra* is similar to that illustrated for *B. forficata* and *B. variegata*, however, a notable higher density was not observed on the abaxial epidermis, as reported for these two species [29]. On the contrary, in *B. monandra* a slightly more coarse appearance of the epicuticular waxes was noted in the adaxial epidermis.

Uni to pluricellular, normal (non-branched) uniseriate trichomes are typical for the *Bauhinia* genus. They are usually pluricellular, although, in *B. microstachya* [30], *B. racemosa* and *B. tomentosa* [24] unicellular trichomes are exclusively reported. The verrucous cuticle of these trichomes was emphasised only in the description of *B. microstachya* [30], a condition similar to that of *B. monandra*. The glandular trichomes are also characteristic for the genus. It is generally described in the petiole and the abaxial side of the leaf blade in other *Bauhinia* species, in agreement with that observed in *B. monandra*. In *B. forficata*, alkaloids, glycosides and lipid droplets were found to occur in these trichomes [28]. However, there are no reports on this type of trichome in anatomical leaf studies for several species of the genus [30, 31].

The straight to sinuous anticlinal walls of the ordinary epidermal cells of the leaf blade is typical for the genus, and both sides may or may not have the same pattern. Apparently, straight anticlinal walls are the most common type [24, 31]. In *B. monandra*, sinuous to straight walls in the adaxial epidermis and straight walls in the abaxial one can be a strong diagnosis, since no reports of this pattern were found in the bibliographic survey carried out for any other species of the genus. Some epidermal features of the leaf blade of different species of *Bauhinia* are organised, comparatively, in Table 1.

In descriptions of the mesophyll for the *Bauhinia* genus, patterns of chlorenchyma consisting of elongated cells are common, as in *B. curvula* [26], *B. forficata* [27, 28] and *B. unguolata*, and also in the related genus *Schnella*. In these last two species, the spongy parenchyma constitutes the largest thickness of the mesophyll, and its cells delimit remarkably large intercellular spaces [25]. In *B. monandra*, although the cells of the spongy parenchyma cells are somewhat elongated, they are shorter than those of the palisade one and in a relatively compact layout, similar to the illustrations in the descriptions for *B. forficata* [29] and *B. pentandra* [25]. Although in most reports for *Bauhinia* the mesophyll is dorsiventral, in *B. forficata* the mesophyll was described as homogeneous [27] and isobilateral [28]. This disagreement may be due to differences in interpretation among the authors or by phenotypic differences between the studied individuals.

The leaf margin has special potential for taxonomic application in *Bauhinia*, as it provides distinctive anatomical characteristics between species of the genus [25]. Nevertheless, due caution is necessary, as environmental factors can result in small anatomical variations in the leaf margin of the same species, as reported in *B. forficata* [28]. Unfortunately, little emphasis is given to the leaf margin in anatomical descriptions for the genus. Like *B. forficata* and *B. variegata* [29], *B. monandra* has a vascular bundle on the margin resulting in its dilatation. The more rounded condition of this vascular bundle also coincides with that illustrated in the work of Lusa and Bona [29]. The presence of what appears to be a parenchymatous hypodermis with one to three cell layers observed in *B. monandra* is, apparently, a characteristic that deserves attention. It is important to note that ontogenetic studies are necessary to confirm whether this tissue is, in fact, an actual hypodermis.

The lesser thickness of the mesophyll observed in the vicinity of the central vein of *B. monandra* is also visible in the illustrations of the anatomical descriptions of the other species of *Bauhinia* [23, 25, 26, 28, 29]. This narrowing was mentioned only in the work on *B. forficata* [28], but in a superficial way. This is probably a condition found in all species of the genus, being an adaptation for the greater flexibility of the leaf blade in the nastic movements of leaf opening and closing.

All *B. monandra* leaf veins, including the fifth-degree ones, extend from epidermis-to-epidermis, interrupting the continuity of the mesophyll chlorenchyma. Thus, the leaf blade is a mosaic of chlorenchyma compartments delimited by areoles, which restrict the free lateral gases movement along the mesophyll. Leaves like this are called heterobaric [48]. Some features of leaf blade of different species of *Bauhinia* are organised, comparatively, in Table 2.

The cross-section of the *B. monandra* petiole middle part demonstrated a remarkable feature at first sight: the absence of lateral projections on the adaxial side. These projections, which are subtended by the two accessory collateral bundles, are reported in most leaf anatomical descriptions for the genus, causing the petiole adaxial face to have the greatest width. In *B. monandra*, the largest vascular bundle width is found on its middle portion. A similar condition is reported for *B. microstachya*, however, this species vary in not having accessory bundles [30]. Some *Bauhinia* species have a vascular bundle in a central position, surrounded by the ring of non-accessory vascular bundles, such as *B. cheilantha* [25] and *B. curvula* [26]. *B. blakeana* has the unusual characteristic of having one or two accessory collateral vascular bundles and about eight bicollateral bundles distributed in the central region, apparently without delimiting a ring [23]. A common condition is that ring vascularisation forms a projection towards its central part, as reported for *B. forficata* [27], *B. microstachya* [30] and *B. pentandra* and, in a extreme case, the separation into two large amphicribal bundles in *B. unguolata* [25]. *B. monandra* has the vascular bundles situated in a circular arrangement, forming a projection towards the cortex, between the two adaxial accessory bundles, being another remarkable differential for the species. This variety of forms indicates a great taxonomic potential for the petiole anatomy in *Bauhinia*.

The *B. monandra* pulvinus follows the general pattern described for Fabaceae, with a wide cortex, vascularisation in a central position and a restricted or absent of pith [25, 28, 29, 49-51]. A starch sheath was found in both *B. monandra* pulvinus, which also occurs around the motile cushion bundles. Interestingly, in the inter-pulvinus petiole, this sheath is absent, with amyloplasts occurring only in the cells of the pith parenchyma, similar to the condition described for *B. forficata* e *B. variegata* [29]. Unfortunately,

little attention is paid to the starch sheath in the reports of leaf anatomy in *Bauhinia*, although the Lugol test [38], for starch detection, is extremely simple.

The appearance of the proximal pulvinus of *B. monandra* is practically identical to that reported for *B. forficata* [29], as it presents a single large amphicribal concentric vascular bundle delimiting a small pith, with a vascular projection on the adaxial side directed to the centre. *B. pentandra* also has the same pattern according to the illustration of Pereira *et al.* [25] work, although the authors classified the vascular bundle as of bicollateral type.

The distal pulvinus of *B. monandra* has the vascular arrangement typical to all the few reports found for the genus, with two pairs of collateral bundles, where the largest ones are peripheral with the phloem facing the cortex, and the two central ones are smaller vascular bundles with the phloem facing the centre [25, 26, 28, 29]. As it is a transitional structure between the inter-pulvinus petiole and the motile cushion, some variation can be found depending on the level of the section in the same pulvinus, which requires some caution in using the vascular aspects of this structure for taxonomic purposes.

The ripples observed in the epidermis pulvinus in legumes are related to their ability to move [50]. Similar ripples have been reported in *Bauhinia* species [29] and also observed in the *B. monandra* pulvinus and motile cushion in the present work, with them certainly being related to the wide flexing movements of these structures. The rich plasmodesmata connection between parenchymal cells that interconnect the vascular bundles in the motile cushion is also reported in *B. curvula* [39] and it may be related to the physiological processes for the movements of this structure.

The pectic nature of the septate fibres walls in the pulvinus of *B. monandra*, verified by the metachromasia to TBO, as well as the lignified nature of the petiole's rigid fibres, by the bluish colouration conferred by this same dye [38], corroborates with the reported for *B. curvula* [26]. Likewise, the bluish colouration conferred by this dye for the fibres of *B. monandra* leaf blade veins also indicates their lignified nature [38]. In the primary and secondary pulvinus of *Pterodon pubescens*, septate fibres similar to those observed in *B. monandra* are described as pericyclic [49] and, by analogy, it can be deduced that the septate fibres of the *B. monandra* pulvinus have this same origin. The pits and the lack of lignification guarantee, respectively, symplastic and apoplastic continuity between pith and cortex [49, 51, 52] within the latter there are the motor cells [53] responsible for pulvinus movement. There are also similar septate fibres external to the phloem of the vascular bundles of the *B. monandra* motile cushion, which allows inferring the same pericyclic origin and the similar flexibility and physiological functions in this motor structure continuous to the distal pulvinus. The rich impregnation of pectates in the walls of these fibres define them as gelatinous fibres.

The occurrence of phenolic compounds is common in pulvinus, being reported in the phloem, pith, and cortex in several legume species [49, 50]. The dye used in the present work, TBO, indicated the presence of this chemical class only in some mesophyll and hypodermis cells, as well as in the phloem of the central vein of the *B. monandra* leaf. Nevertheless, no phenolic cells were seen in the pulvinus or motile cushion. This dye provides a typical bluish or greenish-blue colouration to phenolic compounds [38], however, it is not a specific histochemical test and, therefore, the results on phenols presented here are only inferences, requiring verification by further studies.

The sclerenchyma and crystal sheath involving the vascularisation of the middle petiole is a characteristic reported in all work on *Bauhinia* in the bibliographic survey carried out. In the leaf vein sheath, prismatic crystals are reported [23, 36], corroborating the condition observed in *B. monandra*. Druses are also reported in the mesophyll of several *Bauhinia* species [25, 29, 36], and mainly in the pulvinus cortex and/or motile cushion [25, 26, 28, 29]. The accumulation of calcium oxalate crystals in photosynthetic organs is a normal phenomenon that is linked to plant metabolism [54]. These substances are forms of calcium storage [55] in response to its excess [56-59], and can be a repository with high capacity for this ion [60]. Since the movements performed by the pulvinus are the result of osmotic phenomena where Ca^{2+} acts [61, 62], and considering that the motile cushion is a structure physiologically similar to the pulvinus, the rich presence of druses in the cortex of these motor structures may be related to the local availability of this ion. Also, calcium oxalate crystals are considered to be feeding deterrents, preventing herbivory [63].

Table 1. Anatomical features of the leaf blade epidermis of different species of *Bauhinia*.
 NR - Not reported.

<i>Bauhinia</i> species	Features						References
	Anticlinal walls of ordinary cells		Stomata types		Trichomes		
	Adaxial	Abaxial	Adaxial	Abaxial	Adaxial	Abaxial	
<i>B. monandra</i>	Sinuuous, straight	Straight	Anomocytic, paracytic	Anomocytic, paracytic	Normal uniseriate multicellular nonglandular	Normal uniseriate multicellular nonglandular, normal multiseriate multicellular glandular (navicular).	Present work
<i>B. acuminata</i>	Sinuate	Wavy	Absent	Anisocytic, paracytic, tetracytic	Absent	Present	[31]
<i>B. blakeana</i>	Straight, beaded	Straight	Anisocytic, anomocytic, paracytic	Anisocytic, anomocytic, paracytic	Absent or normal uni- multicellular nonglandular, normal multicellular glandular	Normal uni-multicellular nonglandular, normal multicellular glandular	[23, 24]
<i>B. cheilantha</i>	Straight-curved	Sinuuous	Anisocytic, anomocytic	Anisocytic, anomocytic	Absent	Normal, multicellular nonglandular, glandular (navicular)	[25]
<i>B. curvula</i>	Curved?	NR	Anomocytic, paracytic	Anomocytic, paracytic	Absent	Normal uniseriate multicellular nonglandular, multicellular "gland"	[26]
<i>B. forficata</i>	Curved,	Straight, sinuous	Absent or anomocytic	Anomocytic, paracytic	Absent	Normal uniseriate uni- multicellular nonglandular, normal multicellular glandular (navicular)	[27-29]
<i>B. galpinii</i>	Wavy	Wavy	Anomocytic	Anomocytic	?	?	[31]
<i>B. hookeri</i>	Sinuuous	Sinuuous	Absent	Tetracytic	Absent	Absent	[31]
<i>B. malabarica</i>	Straight, beaded	Straight	Absent	Anomocytic, anisocytic	Multicellular uniseriate, unicellular hooked	Multicellular uniseriate, unicellular dovering	[24, 31]
<i>B. microstachya</i>	Sinuuous	Sinuuous	Absent	Anomocytic, paracytic	Unicellular glandular	Unicellular nonglandular	[30]
<i>B. pentandra</i>	Straight-curved	Sinuuous	Anisocytic,	Anisocytic,	Absent	Normal, multicellular	[25]

<i>B. phoenicea</i>	Wavy	Wavy	anomocytic, paracytic Absent	anomocytic, paracytic Anomocytic, tetracytic	Present	nonglandular, glandular (navicular) Present	[31]
<i>B. purpurea</i>	Beaded, wavy	Straight, wavy	Absent or anisocytic	Anisocytic, paracytic, tetracytic	Absent	Multicellular, uniseriate, covering	[24, 31]
<i>B. racemosa</i>	Straight	Straight	Absent or tetracytic	Anisocytic, anomocytic, paracytic Tetracytic	Absent or normal uniseriate uni-multicellular nonglandular ?	Normal uniseriate uni- multicellular glandular	[24, 31]
<i>B. rufescens</i>	Straight	Straight	Anisocytic, anomocytic	Tetracytic	?	?	[31]
<i>B. tomentosa</i>	Undulated	Undulated	Absent or tetracytic	Anisocytic, paracytic, tetracytic	Unicellular nonglandular	Unicellular nonglandular	[24, 31]
<i>B. ungulata</i>	Straight-curved	Curved	Anisocytic, anomocytic, paracytic	Anisocytic, anomocytic, paracytic	Nonglandular	Normal, multicellular nonglandular, glandular (navicular)	[25]
<i>B. variegata</i>	Curved	Straight	Anisocytic, anomocytic	Anisocytic, anomocytic, paracytic, tetracytic	Normal uniseriate uni- multicellular nonglandular, normal multicellular glandular (navicular)	Normal, uniseriate uni- multicellular nonglandular, normal multicellular glandular (navicular)	[29, 31]

Table 2. Anatomical feature of the mesophyll and leaf margin of different species of *Bauhinia*.
NR - Not reported.

<i>Bauhinia</i> species	Mesophyll		Features	Leaf margin	References
	Palisade parenchyma	Spongy parenchyma			
<i>B. monandra</i>	2 layers	1 layer	Dilated, hypodermis 1-2 layers, vascular bundle with circular contour		Present work
<i>B. blakeana</i>	3-4 layers	4-5 layers		NR	[23]
<i>B. cheilantha</i>	2 layers	2-4 layers		Obtuse and slightly reflexed	[25]
<i>B. curvula</i>	Compact	NR		Parenchymal cells and small epidermal cells	[26]
<i>B. forficata</i>	Predominant, 3-4 layers	NR		No curvature, thick, rounded and dilated, with a large vascular bundle	[27-29]
<i>B. microstachya</i>	1-2 layers	3 layers		NR	[30]
<i>B. pentandra</i>	2 layers	2-4 layers		Obtuse with a collateral vascular bundle with sclerenchymal sheath, filled by sclerenchyma	[25]
<i>B. unguolata</i>	1 layer	4-5 layers with large intercellular spaces		Acute, filled by sclerenchyma	[25]
<i>B. variegata</i>	3-4 layers	Large intercellular spaces		Dilated, with tapered terminal projection	[29, 31]

CONCLUSION

It was observed that the *B. monandra* leaf shares common anatomical characteristics described for other species of the genus. However, the analysis of diverse structural parameters showed distinctive aspects in relation to the reports of other species of *Bauhinia* available in the literature. It is worth mentioning that the petiole was structurally more different compared to reports from other *Bauhinia* species because it did not have lateral projections and because of the ring of vascular bundles protruding between the accessory bundles. The leaf of *B. monandra* exhibits mesomorphic to xeromorphic characteristics and is, apparently, little pubescent, in comparison to most reports found on the genus.

Funding: This research received no external funding.

Acknowledgments: We thank Prof. PhD Claudenir Simões Caires, from the Department of Natural Sciences of State University of Southwest Bahia, for the identification of the species; Prof. PhD Delmira da Costa Silva, from the Department of Biological Sciences, and MSc Lucas Ribeiro, from the Center of Electronic Microscopy of State University of Santa Cruz, Ilhéus, Bahia, Brazil, for the support in the electron microscopy procedures; and biologist Valdir Carvalho Ribeiro, for revising the English translation of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

1. LPWG. A new subfamily classification of the Leguminosae based on a taxonomically comprehensive phylogeny. *Taxon*. 2017;66(1):44-77.
2. Lewis GP. Legumes of Bahia. London: Royal Botanic Gardens; 1987.
3. Van der Pijl L. The leaf of *Bauhinia*. *Acta Bot Neerland*. 1952;1(2):287-309.
4. Gupta AK, Vidyapati TJ, Chauhan JS. Chemical examination of the stem of *Bauhinia divaricata*. *Planta Med*. 1980;38:174-176.
5. Menezes FS, Minto ABM, Ruela HS, Kuster RM, Sheridan H, Frankish N. Hypoglycemic activity of two Brazilian *Bauhinia* species: *Bauhinia forficata* L. and *Bauhinia monandra* Kurz. *Braz J Pharmacogn*. 2007;17(1):8-13.
6. Gonzalez-Mujica F, Motta N, Márquez AH, Capote-Zulueta J. Effects of *Bauhinia megalandra* aqueous leaf extract on intestinal glucose absorption and uptake by enterocyte brush border membrane vesicles. *Fitoterapia*. 2003;74:84-90.
7. Alade GO, Omobuwajo OR, Adebajo CA, Versopohl EJ. Evaluation of the hypoglycaemic activity of *Bauhinia monandra* leaf in Alloxan-diabetic rats and INS-1 inulin cells. *J Chem Pharm Res*. 2011;3(2):506-521.
8. Sinou C, Forest F, Lewis GP, Bruneau A. The genus *Bauhinia* s.l. (Leguminosae): a phylogeny based on the plastid *trnL-trnF* region. *Botany*. 2009;87(10):947-960.
9. Lorenzi H. Árvores exóticas no Brasil: madeireiras, ornamentais e aromáticas. Rio de Janeiro: Ed. Plantarum; 2003.
10. Könenmann. Botanica: the illustrated A-Z of over 10,000 garden plants and how to cultivate them. 3th ed. Sydney: Random House Australia Pty Ltd.; 2004.
11. Duryea ML, Kampf E, Littell RC, Rodríguez-Pedraza CD. Hurricanes and the urban forest: II. Effects on tropical and subtropical tree species. *Arboric Urban For*. 2007;33(2):98-112.
12. Araújo AC, Ribeiro IAM, Morais MS, Araújo JLO. Análise quali-quantitativa da arborização no bairro Presidente Médici, Campina Grande-PB. *Revsbau*. 2009;4(1):133-144.
13. Silva RN, Gomes MAS. Quali-quantitative comparison of arborization in public spaces of the city of Arapiraca-AL, Brazil. *REVSAU*. 2013;8(2):104-117.
14. Akintunde AM, Ojala SO, Betiku E. Optimization of *Bauhinia monandra* seed oil extraction via artificial neural network and response surface methodology: a potential biofuel candidate. *Ind Crop Prod*. 2015;67:387-394.
15. Anhwange BA, Ajibola VO, Oniye SJ. Amino acid composition of the seeds of *Moringa oleifera* (Lam), *Detarium microcarpum* (Guill & Sperr) and *Bauhinia monandra* (Linn.). *Chemclass J*. 2004;(9-13).

16. Argolo ACC, Dantas VCR, Saturnino ACRD, Santos AFS, Brandão-Neto J, Paixão ADO, Coelho LCBB. Leaf ethanolic extract of *Bauhinia monandra* increases insulin secretion in rats subjected to intrauterine malnutrition. *Int J Biochem Res Rev*. 2015;9(4):1-9.
17. Ajiboye AT, Musa MD, Otum KO, Jimoh AA, Bale AT, Lawal SO, Arowona MT. The studies of antioxidant and antimicrobial potentials of the leaf extract of *Bauhinia monandra* plant. *Nat Prod Chem Res*. 2015;3(4):1000180.
18. Argolo ACC, Sant'Ana AEG, Pletsch M, Coelho LCBB. Antioxidant activity of leaf extracts from *Bauhinia monandra*. *Bioresour Technol*. 2004;95:229-233.
19. Aderogba MA, Ogundaini AO, Eloff JN. Isolation of two flavonoids from *Bauhinia monandra* (Kurz) leaves and their antioxidative effects. *Afr J Trad CAM*. 2006;3(4):59-65.
20. Nworie KM, Okorie NA. Phytochemicals distribution and antioxidant potential of *Bauhinia monandra* (Linn.) leaves extract. *Res J Med Plants*. 2018;12(2):78-83.
21. Campos JKL, Araújo CSF, Araújo TFS, Santos AFD, Teixeira JA, Lima VLM, Coelho LCBB. Anti-inflammatory and antinociceptive activities of *Bauhinia monandra* leaf lectin. *Biochim Open*. 2016;2:62-68.
22. Macedo MLR, Freire MGM, Silva MBR, Coelho LCBB. Insecticidal action of *Bauhinia monandra* leaf lectin (BmoLL) against *Anagasta kuehniella* (Lepidoptera: Pyralidae), *Zabrotes subfasciatus* and *Callosobruchus maculatus* (Coleoptera: Bruchidae). *Comp Biochem Physiol A Mol Integr Physiol*. 2007;146:486-498.
23. Ferreira JLP, Velasco E, Paula AES, Araújo RB, Pacheco JM. Anatomia foliar de *Bauhinia blakeana* Dunn. *Rev Bras Farmacogn*. 2003;13 Suppl.:11-14.
24. Albert S, Sharma B. Comparative foliar micromorphological studies of some *Bauhinia* (Leguminosae) species. *Turk J Bot*. 2013;37:276-281.
25. Pereira LBS, Costa-Silva R, Felix LP, Agra MF. Leaf morphoanatomy of "mororó" (*Bauhinia* and *Schnella*, Fabaceae). *Rev Bras Farmacogn*. 2018;28:383-392.
26. Rezende MH, Cardoso LA, Vannucci AL. Morphology and anatomy of *Bauhinia curvula* Benth. (Leguminosae-Caesalpinioideae). *Acta Bot Bras*. 1994;8(1):19-34.
27. Miyake ET, Akisue G, Akisue MK. Pharmacognostic characterization of pata-de-vaca *Bauhinia forficata* Link. *Rev Bras Farmacogn*. 1986;1:58-68.
28. Donato AM. Anatomia foliar e abordagem fitoquímica de *Bauhinia forficata* Link. (Leg-Caes). *Bradea*. 1995;6(42):357-371.
29. Lusa MG, Bona C. Comparative morphological and anatomical analyses of *Bauhinia forficata* Link and *B. variegata* Linn. (Leguminosae, Caesalpinioideae). *Acta Bot Bras*. 2009;23(1):196-211.
30. Duarte MR, Debur MC. Caracteres morfo-anatômicos de folha e caule de *Bauhinia microstachya* (Raddi) J. F. Macbr (Fabaceae). *Rev Bras Farmacogn*. 2003;13(1):7-15.
31. Kotresha K, Seetharam YN. Epidermal studies in some species of *Bauhinia* L. (Caesalpinioideae). *Phytomorphology*. 1995;45(1-2):127-137.
32. Janačković P, Gavrilović M, Rančić D, Dajić-Stevanović Z, Giweli AA, Marin PD. Comparative anatomical investigation of five *Artemisia* L. (Anthemideae, Asteraceae) species in view of taxonomy. *Braz J Bot*. 2019;42(1):135-147.
33. Kolb KL, Gomes SMA, Lombardi JA. Leaf anatomy as a taxonomy tool for the identification of Brazilian native species of *Chionanthus* (Oleaceae). *Flora*. 2020;266:151590.
34. Engel IC, Ferreira RA, Cechinel-Filho V, Meyre-Silva C. Controle de qualidade de drogas vegetais a base de *Bauhinia forficata* Link (Fabaceae). *Rev Bras Farmacogn*. 2008;18(2):258-264.
35. Bochner R, Fizon JT, Assis MA, Avelar KES. Problemas associados ao uso de plantas medicinais comercializadas no Mercado de Madureira, município do Rio de Janeiro, Brasil. *Rev Bras PI Med*. 2012;14(3):537-547.
36. Fortunato RH, Varela BG, Castro MA, Nores MJ. Leaf venation pattern to recognize austral South American medicinal species of "cow's hoof" (*Bauhinia* L. Fabaceae). *Rev Bras Farmacogn*. 2017;27:158-161.
37. Vidal BC. Acid glycosaminoglycans and endochondral ossification: microspectrophotometric evaluation and macromolecular orientation. *Cell Mol Biol*. 1977;22:45-64.
38. Ribeiro VC, Leitão CAE. Utilisation of Toluidine blue O pH 4.0 and histochemical inferences in plant sections obtained by free-hand. *Protoplasma*. 2020;257:993-1008.
39. Kraus JE, Arduin M. Manual básico de métodos em morfologia vegetal. Seropédica: EDUR; 1997.
40. O'Brien TP, Feder N, McCully ME. Polychromatic staining of plant cell walls by Toluidine blue O. *Protoplasma*. 1964;59:368-373.
41. Foster AS. Practical plant anatomy. Princeton: D; van Nostrand Co. Inc.; 1949.
42. Johansen DA. Plant microtechnique. New York: McGraw-Hill Book Co. Inc.; 1940.
43. Metcalfe CR, Chalk L. Anatomy of the dicotyledons. Oxford: Clarendon Press; 1957.

44. Wilkinson HP. The plant surface (mainly leaf). In: Metcalfe CR, Chalk L, editors. *Anatomy of the dicotyledons*, Volume I. 2nd ed. Oxford: Clarendon Press; 1988. p. 97-165.
45. Karnovsky MJ. A formaldehyde-glutaraldehyde fixative of high osmolality for use in electron microscopy. *J Cell Biol.* 1965;27:137-138.
46. Bozzola JJ, Russel LD. *Electron microscopy*. Boston: Jones and Bartlett Publishers; 1992.
47. Lin Y, Wong WO, Shi G, Shen S, Li Z. Bilobate leaves of *Bauhinia* (Leguminosae, Caesalpinioideae, Cercideae) from the middle Miocene of Fujian Province, southeastern China and their biogeographic implications. *BMC Evol Biol.* 2015;15:252.
48. Beerling DJ, Chaloner WG, Huntley B, Pearson JA, Tooley MJ. Stomatal density responds to the glacial cycle of environmental change. *Proc R Soc Lond.* 1993;251:133-138.
49. Rodrigues TM, Machado SR. Comparative anatomy of pulvinus, petiole and rachis of *Pterodon pubescens* Benth. (Fabaceae - Faboideae). *Acta Bot Bras.* 2004;18(2):318-390.
50. Rodrigues TM, Machado SR. Primary pulvinus comparative anatomy of leguminous species with different leaf movement velocity. *Revista Bras Bot.* 2006;29(4):709-720.
51. Rodrigues TM, Machado SR. Pulvinus functional traits in relation to leaf movements: a light and transmission electron microscopy study of the vascular system. *Micron.* 2008;39:7-16.
52. Machado SR, Rodrigues TM. Anatomia e ultra-estrutura do pulvino primário de *Pterodon pubescens* Benth. (Fabaceae - Faboideae). *Revista Brasil Bot.* 2004;27(1):135-147.
53. Toriyama H. Observational and experimental studies of sensitive plants, I. The structure of parenchymatous cells of pulvinus. *Cytologia.* 1953;18:283-292.
54. Francheschi VR, Nakata PA. Calcium oxalate in plants: formation and function. *Annu Rev Plant Biol.* 2005;56:41-71.
55. Ilarslan H, Plamer R, Imsande J, Horner H. Quantitative determination of calcium oxalate and oxalate in developing seeds of soybean (Leguminosae). *Am J Bot.* 1997;84(8):1042-1046.
56. Borchert R. Calcium-induced patterns of calcium-oxalate crystals in isolated leaflets of *Gleditsia triacanthos* L. and *Albizia julibrissin* Durazz. *Planta.* 1985;165:301-310.
57. Borchert R. Calcium acetate induces calcium uptake and formation of calcium-oxalate crystals in isolated leaflets of *Gleditsia triacanthos* L. *Planta.* 1986;168:571-578.
58. Francheschi VR. Calcium oxalate formation is a rapid and reversible process in *Lemna minor* L. *Protoplasma.* 1989;148(2-3):130-137.
59. Fink S. The micromorphological distribution of bound calcium in needles of Norway spruce [*Picea abies* (L.) Karst.]. *New Phytol.* 1991;119:33-40.
60. Zindler-Frank E. Oxalate biosynthesis in relation to photosynthetic pathway and plant productivity - a survey. *Z Pflanzenphysiol.* 1976;80(1):1-13.
61. Toriyama H, Jaffe MJ. Migration of calcium and its role in the regulation of seismonasty in the motor cell of *Mimosa pudica* L. *Plant Physiol.* 1972;49:72-81.
62. Moysset L, Simón E. Secondary pulvinus of *Robina pseudoacacia* (Leguminosae): structural and ultrastructural features. *Am J Bot.* 1991;78(11):1467-1486.
63. Molano-Flores B. Herbivory and calcium concentrations affect calcium oxalate crystal formation in leaves of *Sida* (Malvaceae). *Ann Bot.* 2001;88(3):387-391.



© 2021 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY NC) license (<https://creativecommons.org/licenses/by-nc/4.0/>).

ANEXO A

Print Screen da tela principal do *Author Dashboard* da plataforma de submissão da Brazilian Archives of Biology and Technology, mostrando o *status* de *accept*.

The screenshot shows the Author Dashboard interface. On the left is a sidebar with navigation options: '6 Manuscripts with Decisions', 'Start New Submission', 'Legacy Instructions', and '5 Most Recent E-mails'. The main area is titled 'Manuscripts with Decisions' and contains a table with columns: ACTION, STATUS, ID, TITLE, SUBMITTED, and DECISIONED.

ACTION	STATUS	ID	TITLE	SUBMITTED	DECISIONED
	ADM: BAPT, Adim • Accept (07-Apr-2021) vol:64, iss:Biol App	BAPT-2020-0618.R2	STRUCTURAL CHARACTERISATION OF THE LEAF OF BAUHINIA MONANDRA Kurz. (FABACEAE - CERCIDOIDEAE) View Submission	03-Mar-2021	07-Apr-2021
a revision has been submitted (BAPT-2020-0618.R2)	ADM: BAPT, Adim • Minor Revision (23-Feb-2021) • a revision has been submitted	BAPT-2020-0618.R1	STRUCTURAL CHARACTERISATION OF THE LEAF OF BAUHINIA MONANDRA Kurz. (FABACEAE - CERCIDOIDEAE) View Submission	13-Dec-2020	23-Feb-2021
a revision has been submitted (BAPT-2020-0618.R1)	ADM: BAPT, Adim • Major Revision (15-Nov-2020) • a revision has been submitted	BAPT-2020-0618	STRUCTURAL CHARACTERISATION OF THE LEAF OF BAUHINIA MONANDRA Kurz. (LEGUMINOSAE - CERCIDOIDEAE) View Submission	24-Sep-2020	15-Nov-2020

ANEXO B

Print Screen das normas da Brazilian Archives of Biology and Technology. Disponível em <<https://www.scielo.br/revistas/babt/iinstruc.htm>>, Acesso em 15 de maio de 2021.



ISSN 1678-4324 online version

Updated: 21/02/2020

INSTRUCTIONS TO AUTHORS

- [Scope and Policy](#)
- [Form and preparation of manuscripts](#)
- [Submission of manuscripts](#)

SCOPE AND POLICY

The Brazilian Archives of Biology and Technology (BABT), is a scientific journal published by the Paraná Institute of Technology - Tecpar, since 1946. It publishes original articles and review articles in the following areas: Agriculture, Agribusiness and Biotechnology; Human and Animal Health; Biological and Applied Sciences; Food / Feed Science and Technology; Environmental Sciences; Engineering, Technology and Techniques.

The chief editors are responsible for the mission, objectives, policy and setting the editorial criteria, striving for the high quality of the articles, which will compose the journal in the dissemination of research results and scientific and technological advances aimed at promoting the progress of science. It is also responsible for the supervision of the editorial office, which operates the workflow with the assistance of the Scholar One Manuscripts System.

In order to promote the continuous improvement of the journal and published articles, as well as to provide researchers with new information on their thematic area, the editors conduct a prior analysis of the submitted manuscripts for scientific and / or technological relevance, innovative character or applicable results in specific problem solving.

Manuscripts to be considered for publication must be submitted by the authors through the ScholarOne Manuscripts™ online system, strictly observing the information available for publication available on the BABT page at SCIELO: www.scielo.br/revistas/babt/iinstruc.htm. Manuscripts that do not comply with the standards set for publication will be automatically rejected.

When submitting an article, the authors assign the copyright and use of all its content to the BABT, if it is approved for publication, but the opinions expressed in the texts are the sole responsibility of the authors.

Similarities will be verified in the manuscripts through specific plagiarism verification software, providing a report to support the decision regarding the originality and originality of the text. Manuscripts with 40% or greater similarity will be automatically rejected.

The selected articles should have originality and scientific or technological innovation that fit the journal's publishing areas, providing increased visibility and recognition in the scientific environment, corroborating also the increase of the impact factor of the journal.

The Editorial Board is composed of Brazilian and foreign researchers specialized in the journal's areas, with credibility and recognition from the national and international scientific community. The criteria for selection of its members is linked to recent production in the specific area and the timeliness of evaluations. The permanence of the board members is reevaluated every two years, subject to their scientific production (number of citations and index h) through validation in the Lattes Platform or ISI and Scopus basis.

Manuscripts pre-selected by the BABT Scientific Editor are sent to at least two experts from the Editorial Board, or from ad hoc BABT referees and consultants. Thus, these specialists are responsible for evaluating the quality and relevance of manuscripts submitted for publication. Brazilian evaluators are selected based on their expertise, according to the Lattes Platform, and foreigners based on their reputation in the corresponding area based on the ISI and Scopus platform.

The assistant editor, with the collaboration of the other team members, is responsible for the management, monitoring, and control of incoming manuscripts.

For technical support, the team has the support of three employees properly trained to provide technical support related to infrastructure, system and users.

Form and Preparation of Manuscripts

When submitting the article, the authors must send a cover letter to the editor, summarizing the findings of his manuscript, showing that it is in the interest of the Brazilian Archives of Biology and Technology to publish it, that it is original and has been not submitted or published previously elsewhere. Moreover, the cover letter should clearly address Biology or Technology area of Knowledge. And that there are no conflicts of interest associated with the manuscript and meet all applicable standards regarding the ethics of experimentation and research, and there are no duplicate publications, fraud, plagiarism, or concerns about animal or human experimentation.

The cover letter must follow the template form attached [here](#).

The manuscript must be prepared in English only. We suggest that the manuscript should be reviewed before it's submission for the first time by an English native speaker and, preferably, scientific experience in the area. In addition, assistance of independent editing services can be found at <http://journalexerts.com>.

All services are paid for and arranged by the author and use of one of these services does not guarantee acceptance or preference for publication.

IMPORTANT:

1. For submission of manuscripts, the authors must inform their ORCID ID, **without this data, the manuscript will be returned**. <https://orcid.org/>
2. The manuscript must be submitted in accordance with the available template and within all BABT submission policies. If the manuscript does not meet the submission criteria, **it will be returned to the author for the necessary adjustments**.

The template details the sections that can be used in a manuscript. Sections that are not mandatory are listed as such. The section titles given are for Articles. Review papers have a more flexible structure. Please use the styles present on the template. **Manuscript must have a maximum of 15 pages including all article elements as figures, tables, and references. Longer manuscripts will be immediately rejected.** For any questions, please contact the editorial office of the journal on babt@tecpa.br.

The template can be found attached [here](#). Below is a guide to the styles contained in the file.

Title (Font: Arial 20 and Bold)

Must be precise, clearly reflecting the content of the manuscript. (Put each word in upper case).

Author's full name 1 (Font: Arial 10 and Bold)

<https://orcid.org/0000-0000-0000-0000> (Font: Arial 10)

Affiliation must be submitted in English, as example:

University, College, Department, City, State, Country;
(Font: Arial 10)

Running Title (Font: Arial 9)

Must be short, reflecting the content of the manuscript. (Maximum 40 characters).

Highlights

Research highlights concisely summarize the core findings and provide readers with an overview of the paper. They include three to five bullet points describing the main achievements of the research (e.g., results or conclusions) and highlight what is unique about the study.

Include 3 to 5 highlights.

Maximum 85 characters in each highlight including spaces.

Only the core results of the paper should be covered.

Write the research highlight in the present tense.

Be concise and specific.

Abstract (Font: Arial 11 and Bold)

A single paragraph of about 250 words maximum. For research articles, abstracts should give a pertinent overview of the work. We strongly encourage authors to use the following style of structured abstracts, but without headings: (1) Background: Place the question addressed in a broad context and highlight the purpose of the study; (2) Methods: Describe briefly the main methods or treatments applied; (3) Results: Summarize the article's main findings; and (4) Conclusion: Indicate the main conclusions or interpretations. The abstract should be an objective representation of the article, it must not contain results that are not presented and substantiated in the main text and should not exaggerate the main conclusion. (Text: Font Arial 11).

Keywords (Font: Arial 11 and Bold)

keyword 1; keyword 2; keyword 3. List three to ten pertinent keywords specific to the article; yet reasonably common within the subject discipline. (Text: Font Arial 11).

Graphical Abstract (Optional)

A Graphical Abstract is a single, concise, pictorial and visual summary of the main findings of the article. This could either be the concluding figure from the article or a figure that is specially designed for the purpose, which captures the content of the article for readers at a single glance.

Introduction (Font: Arial 11, Bold and Caps Lock)

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be reviewed carefully, and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets, e.g., [1] or [2,3], or [4-6]. See the end of the document for further details on references. (Text: Font Arial 11).

Materials and Methods (Font: Arial 11, Bold and Caps Lock)

Material and Methods should be described with sufficient details to allow others to replicate and build on published results. Please note that publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the availability of materials or information in cover letter. New methods and protocols should be described in detail while well-established methods can be briefly described and appropriately cited. This section may be divided by subheadings as reported below. (Text: Font Arial 11).

Tables

Must be numbered consecutively in Arabic digits and inserted in proper place in the text. A brief and descriptive title must be included above each table and the explanations put below as a subtitle.

Formatting of Tables:

- Title and content: Font Arial 10.
- Footnotes: Font Arial 10.
- Vertical and Diagonal lines must not be used in tables.
- The tables must be elaborated and edited in cells, using the resources of the text editor. Observation: Tables in figure format (jpg, tiff or png) are not accepted, or that contain lines drawn.

Figures

Must be numbered consecutively in Arabic digits and cited in the text in numerical order.

- Figures should be submitted preferably in color.
 - Images must be adjusted to the width (16.5 cm) of the page and must be smaller than the page to allow the inclusion of the subtitle.
 - Figures must be presented in separated file and in .tiff format with a minimum of 300 dpi.
- Illustrations must be cited in the text with the word "Figure", without being abbreviated when it is part of a sentence.
- When figures present different parts, each one must be indicated by uppercase (Fig. 1 A, B, C, etc.).

Formulas and Equations

Formulas and equations must not be in image format.

Results (Font: Arial 11, Bold and Caps Lock)

This section may be also divided by subheadings. It should provide a concise and accurate description of the experimental results, their interpretation as well as the experimental conclusion that can be drawn. (Text: Font Arial 11).

Discussion (Font: Arial 11, Bold and Caps Lock)

Authors should discuss the results and how they can be interpreted in perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted. (Text: Font Arial 11).

Conclusions (Font: Arial 11, Bold and Caps Lock)

This section is not mandatory but can be added to the manuscript if the discussion is unusually long or complex. (Text: Font Arial 11).

Patents (Font: Arial 11, Bold and Caps Lock)

This section is not mandatory but may be added if there are patents resulting from the work reported in this manuscript. (Text: Font Arial 10)

Funding (Font: Arial 10 and Bold)

Please add: "This research received no external funding" or "This research was funded by NAME OF FUNDER, grant number XXX". Check carefully that the details given are accurate. (Text: Font Arial 10)

Acknowledgments (Font: Arial 10 and Bold)

In this section you can acknowledge any support given which is not covered by the author contribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments). (Text: Font Arial 10)

Conflicts of Interest (Font: Arial 10 and Bold)

Declare conflicts of interest or state, "The authors declare no conflict of interest." Authors must identify and declare any personal circumstances or interest that may be perceived as inappropriately influencing the representation or interpretation of reported research results. Any role of the funders in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript, or in the decision to publish the results must be declared in this section. If there is no role, please state, "The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results". (Text: Font Arial 10).

References (Font Arial 11, Bold and Caps Lock)

References must be numbered in order of appearance in the text (including citations in tables and legends) and listed individually at the end of the manuscript. We recommend preparing the references with a bibliography software package, such as EndNote, Reference Manager or Zotero to avoid typing mistakes and duplicated references. In the text, reference numbers should be placed in square brackets [], and placed before the punctuation; for example [1], [1–3] or [1,3].

Reference list should be in Font 10, with organized in numerical order. The full list of references, at the end of the article, must follow the Vancouver style:

- References Guide:

http://www.nlm.nih.gov/bsd/uniform_requirements.html

- Important Note:

There will be no restrictions on the reference article source language, despite the recommendation be in English, however the title should be translated and presented in English, between brackets

Important:

1. Save the file in .doc or .docx format.
2. The file name should be the manuscript ID
Example: BAPT-2020-0000.

SUBMISSION OF MANUSCRIPTS

There is no fee for online access, submission and evaluation articles.

Submission of manuscripts will only be accepted when submitted electronically using the following link:

<http://mc04.manuscriptcentral.com/babt-scielo>

Manuscript submission will only be accepted if it contains:

- Cover letter
- Template filled with the manuscript content

Completing Publishing Process

The journal submits the final test of the revised and ready article for publication to the author of correspondence with the period of 1 (one) week for review and correction of the article. If the deadline for response expires without a return of the authors, the magazine considers that the article is approved (since the author has not spoken about the need for any changes / fixes) and therefore ready for publication.

An erratum applies only to cases where the journal has effectively wrong without the knowledge of the author. The author has a number of instances where errors / mistakes can and should be corrected such as author name, keywords, title, errors in the main text, etc.

Communication with editorial staff

All communication with the editorial staff must be by the email babt@tecpar.br

The Subject of the email must follow the pattern below:

[Manuscript ID*] Subject

Examples:

[BAPT-2020-0000] Review and Correction
[BAPT-2020-0000] Approved Article

Emails sent outside this standard are automatically rejected by our system.

*Manuscript ID – BAPT-YYYY-NNNN

Editorial Staff

Marilene Aparecida Boaron
Brazilian Archives of Biology and Technology
Email: babt@tecpar.br

[\[Home\]](#) [\[About the journal\]](#) [\[Editorial board\]](#) [\[Subscription\]](#)

 All the content of the journal, except where otherwise noted, is licensed under a [Creative Commons License](#)

Brazilian Archives of Biology and Technology
Rua Prof. Algacyr Munhoz Mader 3775-CIC
81350-010 Curitiba-PR, Brazil
Tel.: +55-41-3316-3052/3054


babt@tecpar.br