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Botanical studies of the leaf of *Pachypodium lamerei* Drake, family Apocynaceae, cultivated in Egypt

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Abstract
Pachypodium lamerei Drake (family Apocynaceae) is native to Madagascar and is known as Madagascar palm. Reviewing the available literature, only one study could be traced concerning the microscopical features of *P. namaquanum*. The present study investigates various standardized parameters such as macroscopic and microscopic characters which could be helpful in authentication of the leaf of *P. lamerei* Drake.

Keywords: *Pachypodium lamerei*, Apocynaceae, leaf, petiole, Botanical studies.

1. Introduction
Pachypodium lamerei Drake belongs to family Apocynaceae. It is native to Madagascar. Nowadays, it is commonly produced as a commercial ornamental plant around the world. It is known as Madagascar palm despite not being a palm at all. This term is attributed to the narrow leaves which grow only on the upper part of the trunk, similar to a palm tree. There are no synonyms for *P. lamerei*. Generally, Pachypodiums are succulents having very fat stems, capable of storing large volumes of water, so they can withstand long periods of drought [1-6]. The available literature showed a study that described the general morphological and anatomical features of *P. namaquanum*, another species of Pachypodium [7], in addition to another study describing the micromorphological characters of the spines and stem of the same plant [8]. The current study involves various parameters such as macroscopic and microscopic characters, which could be useful in authentication of the leaf of *P. lamerei* Drake.

2. Taxonomy
Pachypodium lamerei Drake belongs to [9, 10]: **Kingdom:** Plantae, **Subkingdom:** Viridiplantae, **Infrakingdom:** Steptophyta, **Division:** Tracheophyta, **Subdivision:** Spermatophytina, **Infradivision:** Angiospermae, **Class:** Magnoliopsida, **Suborder:** Asteranae, **Order:** Gentianales, **Family:** Apocynaceae, **Subfamily:** Apocynoidae, **Tribe:** Malouetieae, **Genus:** *Pachypodium* Lindl. and **Species:** *P. lamerei* Drake.

3. Materials and Methods
3.1 Plant material
The leaves of *P. lamerei* Drake were collected in May 2010. It was identified by Agr. Eng./ Tereez Labib, consultant of plant taxonomy at the Ministry of Agriculture and ex. director of El-Orman Botanical Garden, Giza, Egypt. A voucher specimen has been deposited in the herbarium of pharmacognosy department, faculty of pharmacy, Minia University, Minia, Egypt under registration number (Mn-Ph-Cog-006). The plant material used for botanical study was taken from the fresh samples, as well as the samples preserved in alcohol (70%)-glycerine-water (1:1:1). It left for air drying in the shade, reduced to a fine powder for microscopical examination and stored in well-closed containers.

3.2 Preparation of samples for microscopical examination
Safranin, light green, phloroglucinol, concentrated hydrochloric acid, iodine and chloral hydrate were used for preparation the plant sections and the powder.

3.3 Microscopic studies
Surface preparations, transverse sections as well as the powder of the leaves were used for observation of various microscopic features**.** All sections and powder pictures were done by using digital camera 8 megapixels, Samsung (Korea) and microscope with camera, Leica® (Germany).

4. Results and discussion
4.1 Macroscopical characters
The leaves are simple, petiolate and lanceolate. The apex is acuminate, the margin is entire and the base is symmetric. The upper surface is glabrous while the lower one is hairy except for the midrib region. The leaves are pinnately veined. They have a dark green upper surface and a paler lower one. They crown the apex of the stem. They measure (13.5-23.3 cm long and 0.9-1.8 cm wide at the middle parts) while the petioles measures (1.5-2.0 cm long) (Figure **1**).

Fig 1: Leaves including the petiole; **A-**Upper surface and **B-**Lower surface (Both x 0.33).

4.2 Microscopical characters
4.2.1 Leaf blade
A transverse section in the leaf blade is biconvex that shows a prominent midrib on the lower surface and a raised conical ridge on the upper surface (Figure **2B**). The lamina has a dorsiventral structure with upper palisade layer consisting of a single row of columnar palisade cells interrupted in the midrib region by subepidermal collenchyma (Figures **2A** and **4**). A layer of subepidermal collenchyma is also located on the lower surface of the midrib. The vascular system of the midrib is formed of a bicollateral vascular bundle forming an open arc of xylem and phloem while the cambium is indistinct and the pericycle is parenchymatous (Figures **2B** and **6**). Simple and non-glandular unicellular hairs are only present on the lower epidermis of the lamina region (Figures **2A**, **3D** and **4**).

4.2.1.1 Epidermis
4.2.1.1.1 Upper epidermis
It is formed of one row of oblong to square cells covered with a thick cuticle as seen in the transverse section (Figures **2B** and **3A**). In surface view, the cells appear polygonal, with straight anticlinal walls covered with slightly striated cuticle and stomata are absent (Figures **3B** and **9A**).

4.2.1.1.2 Lower epidermis
It is formed of one row of subrectangular to square cells as seen in the transverse section (Figure **2B**). In surface view, the cells appear polygonal, with slightly sinuous anticlinal walls in contrary with the upper epidermis**.** Stomata of anomocytic type surrounded by 4-6 subsidiary cells are numerous (Figures **3C** and **9C**). The lower epidermis shows abundant non-glandular hairs of one type. The hairs are unicellular, conical, long (sometimes short), with blunt apices and covered with smooth cuticle (Figures **3D** and **9B**).

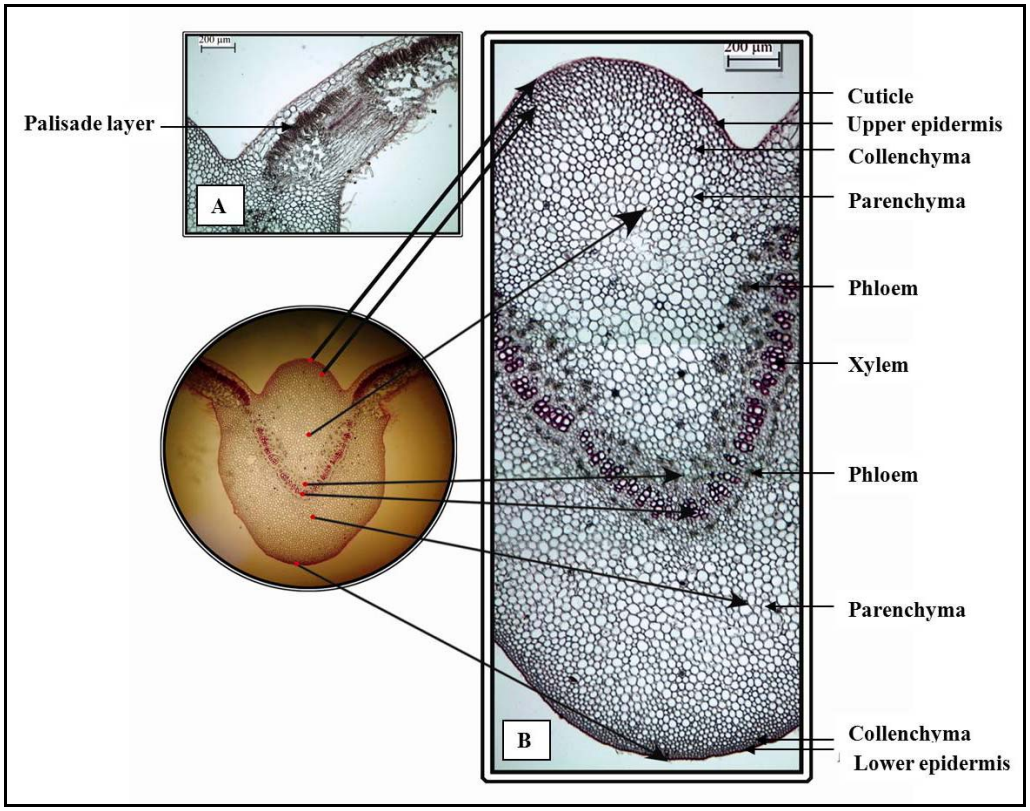

Fig 2: Detailed T.S. in; **A-**Lamina region and **B-**Midrib region (Both x 40).

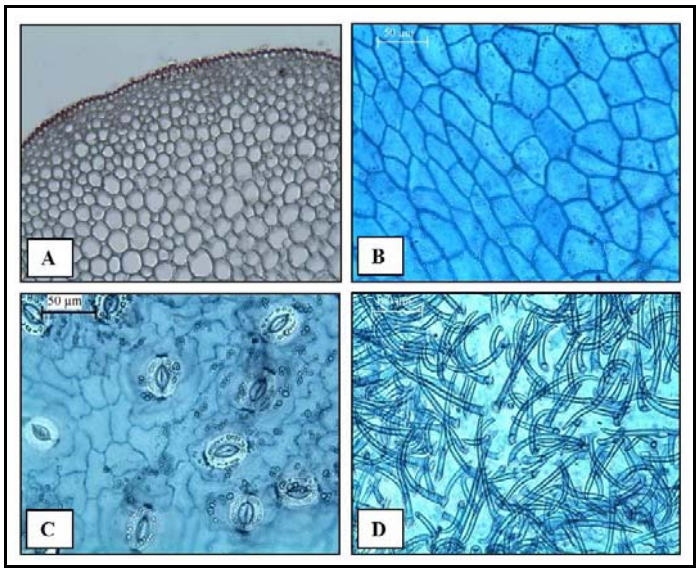

Fig 3: A-Part of T.S. showing upper epidermis, **B**-Upper epidermis (top view), **C**-Lower epidermis showing anomocytic stomata (top view) and **D**-Lower epidermis showing non-glandular unicellular hairs (All x 200 except **D** x 100).

4.2.1.2 Mesophyll

It shows an upper palisade row consisting of columnar, cylindrical, thin walled cells and containing chloroplasts and represents approximately one fourth of the distance between the two epidermises. This layer of palisade cells is absent in the midrib region (Figures **2A**, **4** and **5A**). The spongy tissue is formed of more or less large rounded, thin walled parenchymatous cells with wide intercellular spaces, forming about 2-3 rows and lies just below the upper and lower epidermises of the mesophyll (Figures **2A**, **4** and **5A**). Armed aerenchyma layer is located below the palisade layer and represents the majority of the mesophyll (Figures **2A** and **4**). It contains chloroplasts and its function is to store and exchange gases [11]. Non-glandular hairs are only located on the lower surface of the mesophyll (Figures **2A**, **3D** and **4**). The mesophyll is traversed by separated strands of small vascular bundles representing the lateral veins (Figures **2A** and **4**).

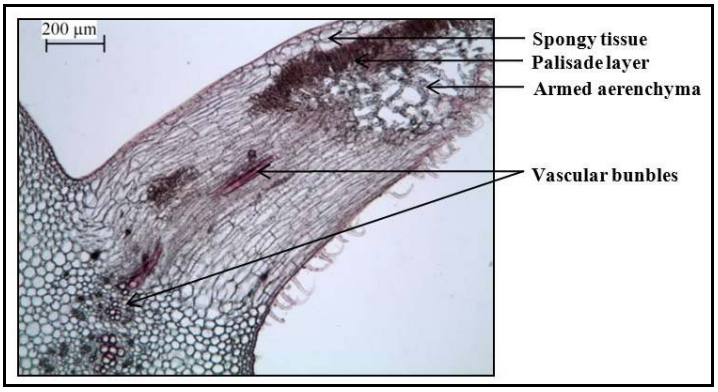

Fig 4: Detailed T.S. in the lamina of the leaf (x 40).

4.2.1.3 Cortex

It shows both upper and lower subepidermal collenchyma layers that consists of 3-6 rows for the upper layer and 2-4 rows for the lower layer. The collenchyma cells have thick cellulosic walls with no intercellular spaces. The rest of the cortical tissue consists of rounded to oval parenchyma cells having thin cellulosic walls with intercellular spaces surrounding the main vascular bundle of the midrib. The parenchyma cells represent 25-45 rows above the vascular bundle, while below the bundle they represent 11-20 rows (Figures **2B** and **5A**). The cortex parenchyma contains cluster crystals of calcium oxalate (Figures **5** and **9D**) and the endodermis is indistinguishable (Figures **2B** and **6A**)**.**

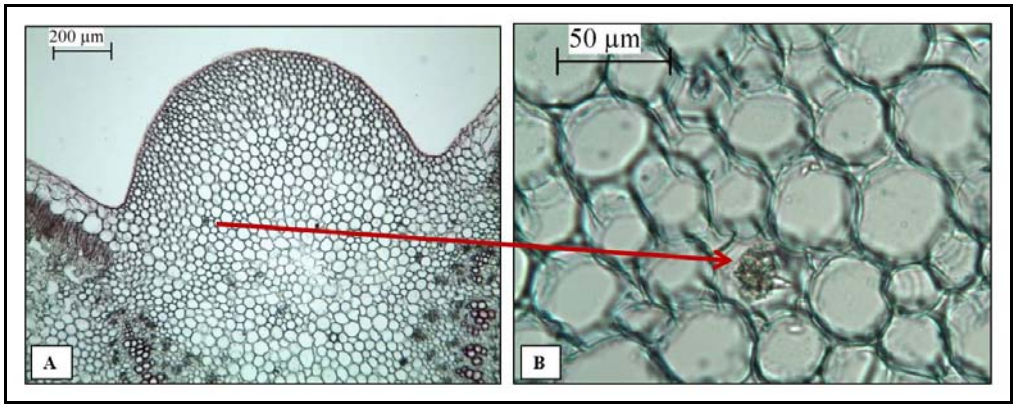

Figure 5: Leaf cortex; A-Part of detailed T.S. in the midrib (x 40) and B-Magnified cluster crystal of Caox (x 200).

4.2.1.4 Vascular tissue

The midrib typically has an arc-shaped strand of the vascular tissue. The vascular bundles are bicollateral with two zones of phloem, with indistinct cambium (Figures **2B** and **6A**).

4.2.1.4.1 Pericycle

It is parenchymatous and indistinguishable (Figures **2B**, **5A** and **6A**)**.**

4.2.1.4.2 Phloem

It consists of groups of thin walled, soft cellulosic elements alternating with parenchyma cells**.** It is formed of sieve tubes, companion cells and phloem parenchyma. The phloem region is free from any lignified elements and represents a wider zone above the xylem than that below the xylem (Figures **2B** and **6**).

4.2.1.4.3 Cambium

It is indistinct (Figures **2B** and **6**).

4.2.1.4.4 Xylem

The xylem zone forms a band interrupted by parenchyma. It is formed of lignified vessels and non-lignified wood parenchyma (Figures **2B** and **6**). The vessels have mainly spiral thickening as shown in the powder (Figure **9E**). The wood parenchyma cells are polygonal, with non- lignified thin walls (Figure **6**).

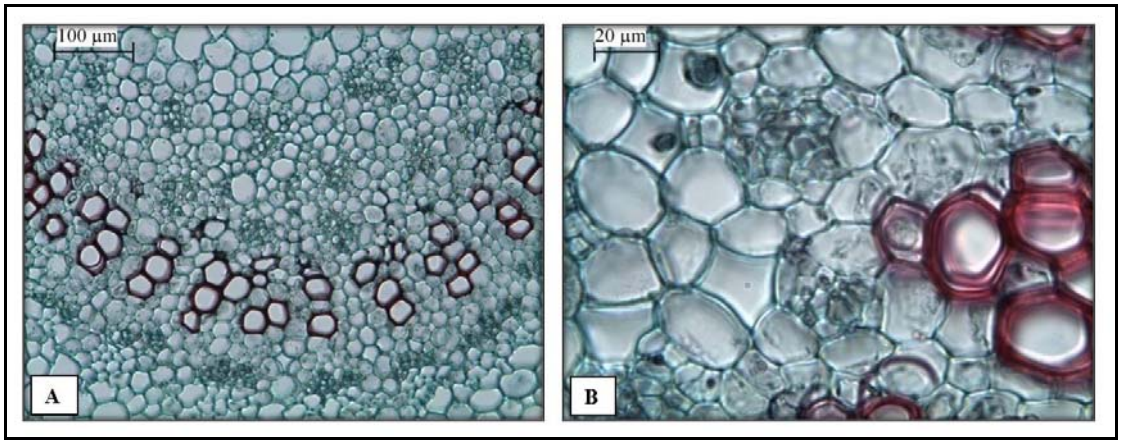

Fig 6: Detailed T.S. in the midrib of the leaf showing vascular tissue; **A-**(x 100) and **B-**(x 400).

4.2.2 Leaf petiole

A transverse section in the petiole shows that it is biconvex in outline with two ridges on its upper side. The lower side is more prominent than the upper side which is more or less sub rounded in the outline (Figure **7**). The petiole shows non glandular unicellular hairs, like those of the lamina of the leaf, present only on the lower part of the two ridges (Figure **8**). The bundle of the petiole is arc-shaped in transverse section and it is similar in structure to that of the midrib of the leaf (Figure **7**).

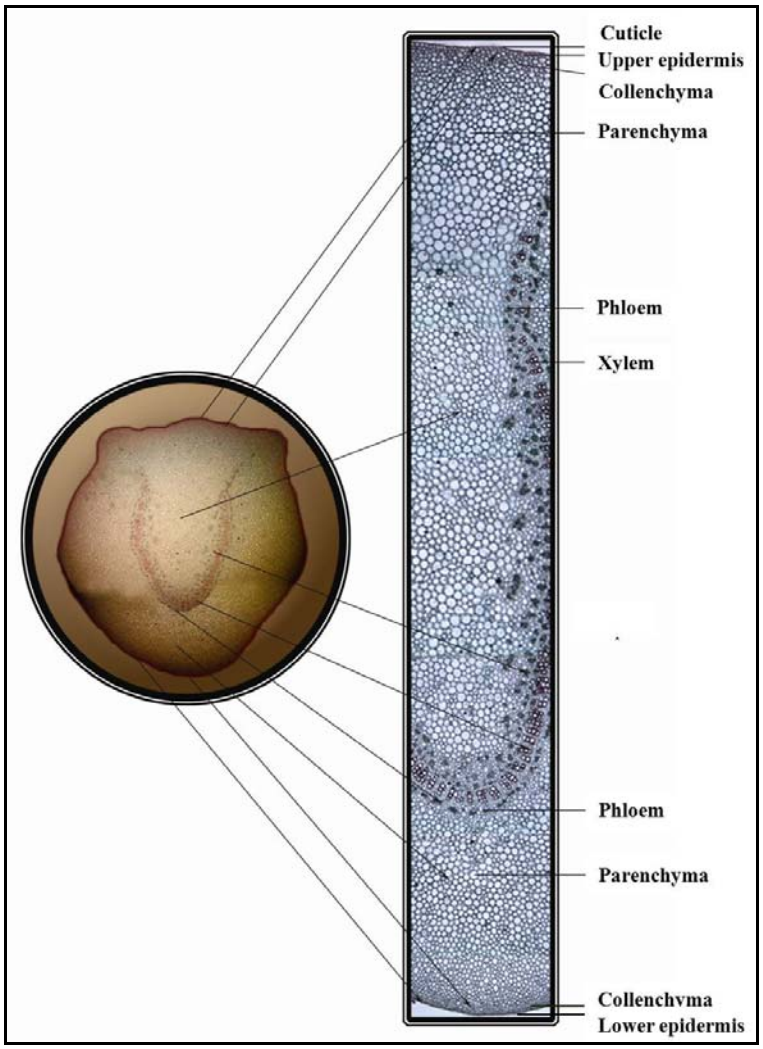

Fig 7: T.S. in the petiole (x 40).

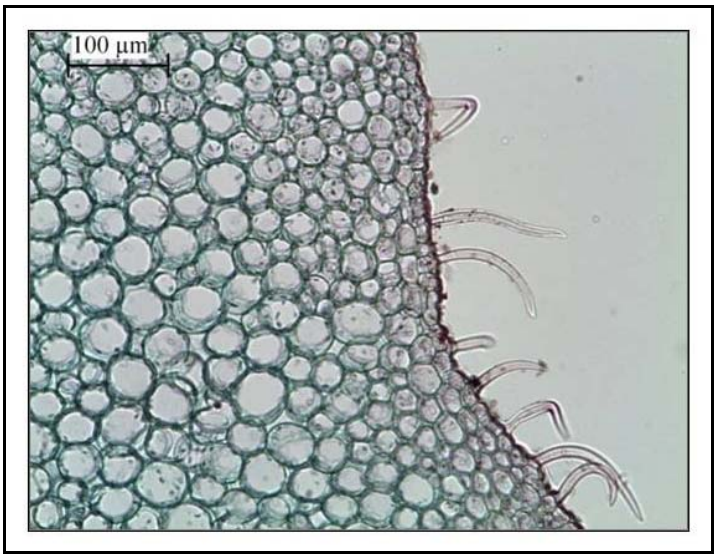

Fig 8: Non-glandular unicellular hairs on the ridge of the petiole (x 100).

4.2.3 Leaf powder

It is dark green in color having a hard texture with a faint odor and a slightly bitter taste. The elements of the powdered stem are shown in [Figure 9].

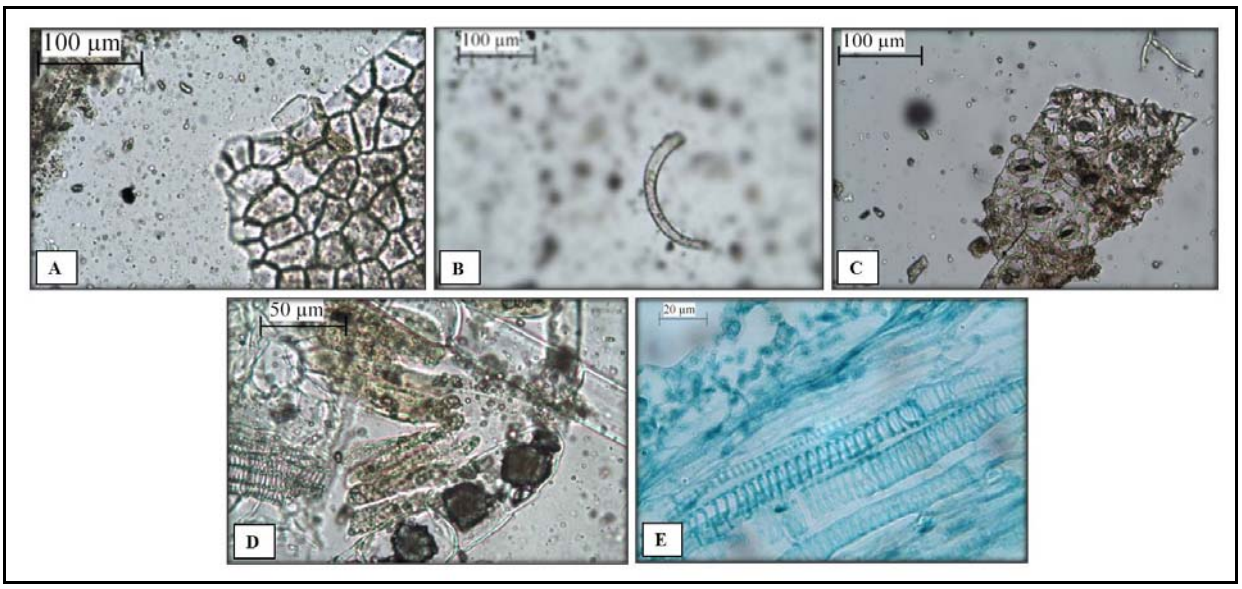

Fig 9: The leaf powder **A**-The upper epidermis (x 100), **B**-Non-glandular unicellular hairs (x 100), **C**-Lower epidermis showing anomocytic stomata (x 100), **D**-Parenchyma cells containing clusters of Caox (x 200) and **E**-Spiral xylem vessels (x 400).

Table 1: Microscopical dimensions of different structures of *P. lamerei* leaf (µm).

Item	Length	Width	Height	Diameter
Upper epidermis	54-62-65	23-38-46	13-16-19	
Lower epidermis	36-39-43	25-29-32	9-13-16	
Non-glandular unicellular hair	71-114-179	7-11-14		
Stomata	79-89-93	61-71-79		
Palisade cells	75-81-94			
Spongy parenchyma of lamina				46-69-100
Cluster crystals of Caox				18-25-29
Collenchyma				19-25-31
Parenchyma (above the vascular bundles)				25-34-53
Parenchyma (below the vascular bundles)				22-31-47
Xylem vessels				10-12-14
Wood parenchyma	23-31-38	15-23-31		

5. Conclusion

Inspection of the different macroscopical and microscopical features of the leaf of *P. lamerei* Drake, family Apocynaceae represents a tool in the identification and authentication of the plant. These features could be useful in identifying the plant prior to its use in any herbal formulations.

6. Acknowledgement

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7. References

1. Burge DO. Diversification of Pachypodium. Cact Succ J 2013; 85(6):250-258.
2. Burge DO, Mugford K, Hastings AP, Agrawal AA. Phylogeny of the Plant Genus Pachypodium (Apocynaceae). Peer J 2013; 11-20.
3. Darwin CR, Hooker JD, Jackson BD. Index Kewensis: an Enumeration of the Genera and Species of Flowering Plants. London, Glasgow, New York, Toronto, Melbourne, Wellington, Bombay, Calcutta, Madras, Karachi, Kuala Lumpur, Cape Town, Ibadan Nairobi, Accra, Oxford University press, Amen House, Edn 3, 1977, 2, 399.
4. Lebeda A, Mieslerova B, Dolezalova I. The First Record and Characterization of Powdery Mildew (*Erysiphe pachypodiae* sp. nov.) on *Pachypodium lamerei* (Apocynaceae). J Phytopathol 2002; 150(3):149-154.
5. Quattrocchi U. CRC World Dictionary of Plant Names. Boca Raton, London, New York, Washington, D.C., CRC Press, III M-Q, 2006, 1930.
6. Willis JC. A Dictionary of the Flowering Plants and Ferns. London, New York, New Rochelle, Melbourne, Sydney, Cambridge University Press, Edn 8, 1985, 841.
7. Metcalfe CR, Chalk L. Anatomy of the Dicotyledons. Oxford, The Clarendon Press. II, 1950, 913-917.
8. Lee DG. Notes on the Anatomy and Morphology of *Pachypodium namaquanum* Welw. Ann Bot 1912; 3:929-942.
9. ITIS Integrated Taxonomic Information System, http://www.itis.gov/servlet/SingleRpt/SingleRpt, (Retrieved 23.01.2014).
10. Sennblad B, Bremer B. Classification of Apocynaceae s.l. According to A New Approach Combining Linnaean and Phylogenetic Taxonomy. Syst Biol 2002; 51(3):389-409.
11. Voltolini CH, Reis A, Santos M. Leaf Morphoanatomy of Rheophyte *Dyckia distachya* Hassler (Bromeliaceae). Rev Bras de Biocienc 2009; 7(4):335-343.