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TAXONOMIC IMPLICATIONS OF FOLIAR EPIDERMAL ANATOMY OF *Jatropha tanjorensis* J.L. Ellis & Saroja AND ITS PUTATIVE PARENTS

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ABSTRACT

This study was aimed to determine the relationship among three *Jatropha* taxa for their reliable identification. Data from reviews showed that *J. curcas* and *J. gossipifolia* are the putative parents of *J. tanjorensis*. Standard method of using Premier Light Microscope, concentrated Trioxonitrate (V) acid, Petri dishes, Methyl-blue and glycerol was employed to carry out the study. Results of the study showed that the three taxa possessed paracytic stomata on both surfaces except in *J. gossipifolia* where the stomata were only observed on abaxial surface. The cell shape was oblong in *J. tanjorensis* with undulate anticlinal wall patterns. In *J. curcas* and *J. gossipifolia*, the cell shapes and anticlinal wall patterns were irregular and straight, respectively. The stomatal length of the taxa ranged from 11.2 µm to 43.0 µm while the cell length was from 25.0 µm to 84.0 µm. The oblong cell shape and undulate anticlinal walls of *J. tanjorensis* are its diagnostic characters while the irregular cell shape and amphistomatic leaves are the diagnostic features of *J. curcas*. Absence of stomata on the adaxial surface with irregular cell shape is unique to *J. gossipifolia*. The data obtained could be used in conjunction with other characters for reliable identification of the three taxa.

Key words: *Jatropha*; epidermal anatomy; stomata; putative parents; identification.

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INTRODUCTION

The genus *Jatropha* L. contains about 225 species and belongs to the family Euphorbiaceae (Govaerts *et al*., 2000). *Jatropha* species are mostly shrubs and small succulent trees distributed in the tropical and subtropical regions of the world (Nwokocha *et al.*, 2011). Hutchinson and Dalziel (1958) recognised eight species of the genus in West Africa. In Nigeria, Odugbemi *et al.* (2008) reported 3 species as medicinal plants while Aigbokhan (2014) recognised six species in South-western Nigeria. The leaf types of *Jatropha* species are mainly simple and palmately lobed with a maximum of eleven segments (Abdulrahaman and Oladele, 2010). Agarwal and Agarwal (2007) and Akbar *et al.* (2009) noted the economic importance of *Jatropha* species, especially *Jatropha curcas* which yields oil of high marketable biodiesel value. It has great potentiality in the rehabilitation of degraded soil (Damisa *et al*., 2008; Kumar and Sharma, 2008; Koyejo *et al.*, 2010). The succulent feature of some species of *Jatropha* makes them drought-resistant plants with wide adaptability to varied climate and soils. Extracts from different parts such as leaves, stem, bark and roots of *Jatropha* species have been used in ethno-medicine for a long time (Nwokocha *et al.*, 2011). This study focused on three species of *Jatropha* which are *J. tanjorensis*, *J. curcas* and *J. gossipifolia*.

Jatropha tanjorensis is a natural hybrid between *J. curcas* and *J. gossipifolia* (Prabakaran and Sujatha, 1999). It is an exotic plant species found in India, Africa and America commonly known as 'hospital-is-too-far', 'Catholic vegetable' or 'Reverend Father's vegetable (Iwalewa *et al.*, 2005; Arum *et al.*, 2014). Leaves of *J. tanjorensis* are common vegetables used to make delicious soup in many parts of southern Nigeria. In ethnomedicine, *J. tanjorensis* is known to possess antibacterial and anti-hypertensive properties (O'Hara *et al*., 1998). Olayiwola *et al.* (2004) reported that *J. tanjorensis* could be used in the treatment of diabetes. Studies carried out on the nutraceutical values of this plant showed the abundant presence of bioactive phytoconstituents like flavonoids (3.69%) and alkaloids (1.89%) and essential minerals such as calcium (5.69%), magnesium (4.22%) and potassium (2.15%) (Arum *et al*., 2014).

Katagi *et al.* (2017) reported that organic and water fractions of EtOAc and MeOH extracts from defatted *J. curcas* seed residue were effective inhibitors of hepatocellular and breast cancer cell growth. According to Arum *et al*. (2014) and Asep *et al.* (2017), *J. tanjorensis* and *J. gossipifolia* are good anticancer plant species. The *Jatropha* taxa also have many other uses. For instance, the roots have detoxification capacity (Sahidin *et al*., 2011), the root bark showed antiproliferative activity on human liver cancer cell line (HepG2) (Thomas *et al.*, 2008), the latex for its antibacterial activity, and the leaves for their antipyretic and analgesic effects (Zhang *et al.*, 2012). *Jatropha*, which possesses its own suppressive mechanism against these tumor-promoting properties, contains great potential in its seed residue for antitumor/anticancer treatment. The present study is necessary because there is limited information on foliar epidermis of *J. tanjorensis* and its relationship with its putative parents; even the available information was poorly reported. This study was aimed to evaluate the relationship of the three taxa based on foliar epidermal anatomy as well as providing additional data to macro-morphology for their reliable delimitation.

MATERIALS AND METHODS

Fresh specimens of *J. tanjorensis* Ellis & Saroja, *J. curcas* L. and *J. gossipifolia* L. were collected from Abakaliki metropolis, Ebonyi State, identified at Ebonyi State University Herbarium (EBSU-H) and authenticated at Forest Research Institute of Nigeria (FRIN), Jerico Ibadan, Oyo State, Nigeria.

Foliar epidermal study: Epidermal preparation method followed the method used by Nwankwo and Ayodele (2017). The standard median portions of the leaves obtained by cutting with razor blade were soaked in concentrated trioxonitrate (v) acid for about 10 to 15 minutes to soften the mesophyll layers for separation. The appearance of air bubbles on the surfaces of the leaves indicated their readiness for separation. They were transferred into some water in the Petri dish with a pair of forceps. Both epidermises were carefully separated by teasing them apart and pulling the epidermis back on itself using camel hair brush. The camel hair brush was also used to remove the adhering tissue debris. The separated epidermal surfaces were rinsed in distilled water and then transferred into 50% ethanol for about two to three minutes to harden. They were rinsed again in distilled water and stained with methyl blue for about five minutes and excess stains were washed off in water. They were mounted in 25% glycerol on slides with the edge of the cover slips sealed with nail varnish to prevent dehydration. The slides were labelled appropriately and examined under the Premier light microscope while photomicrographs of each slide were taken at magnification ×400, using Canon digital camera fixed to Premier light microscope and connected to personal computer.

RESULTS

Jatropha curcas and *J. tanjorensis* were observed to have paracytic stomata on both adaxial and abaxial surfaces while the paracytic stomata were only observed on the abaxial surface of *J. gossipifolia*. Cell shapes were irregular except in *J. tanjorensis* where it was oblong. Results of the study are summarised in Tables 1 and 2 while the photomicrographs of the three species are shown in Figure 1.

Table 1: Qualitative characters of *Jatropha* species

Species / Foliar epidermal features	*J. curcas*		*J. gossipifolia*		*J. tanjorensis*	
	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface
Stomatal type	paracytic	paracytic	Absent	paracytic	paracytic	paracytic
Cell shape	Irregular	Irregular	Irregular	Irregular	Oblong	Oblong
Anticlinal wall	Straight	Straight	Straight	Straight	Undulate	Undulate

Table 2: Quantitative foliar epidermal features of *Jatropha* species

Species / Foliar epidermal features	*J. curcas* (μm)		*J. gossipifolia* (μm)		*J. tanjorensis* (μm)	
	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface
Stomata length	19.6(33.0±0.3)42.0	22.4(30.2±0.5)42	Absent	11.7(31.1±0.4)43	12.6(32.1±0.4)44	11.6(30.1±0.4)43
Stomatal width	14.0(18.5±0.2)28.0	16.8(21.5±0.2)28	Absent	8.0(18.9±0.2)30.0	14.3(18.9±0.3)30.0	15.7(20.5±0.4)29
Cell length	56.0(72.8±0.4)84.0	33.6(52.6±0.3)70	28(52.1±1.0)70.0	29.1(53.0±1.1)71.2	25(47.1±1.0)60.0	26.1(43.0±1.0)61
Cell width	47.6(53.8±0.2)58.8	22.4(35.3±0.5)47.6	16.8(30.2±0.3)42.0	17.1(30.5±0.3)43.2	14.8(27.2±0.2)37.0	12.0(28.5±0.1)39

Legend: The stomata length: 19.6 (33.0±0.3) 42.0; 19.6 μm is the smallest value of stomatal length on adaxial surface of *J. curcas*, 33.0 is the mean value of the stomatal length, 0.3 is the standard error. 42.0 μm is the highest value of the stomatal length of *J. curcas*. This clarification could be used to understand other values in Table 2

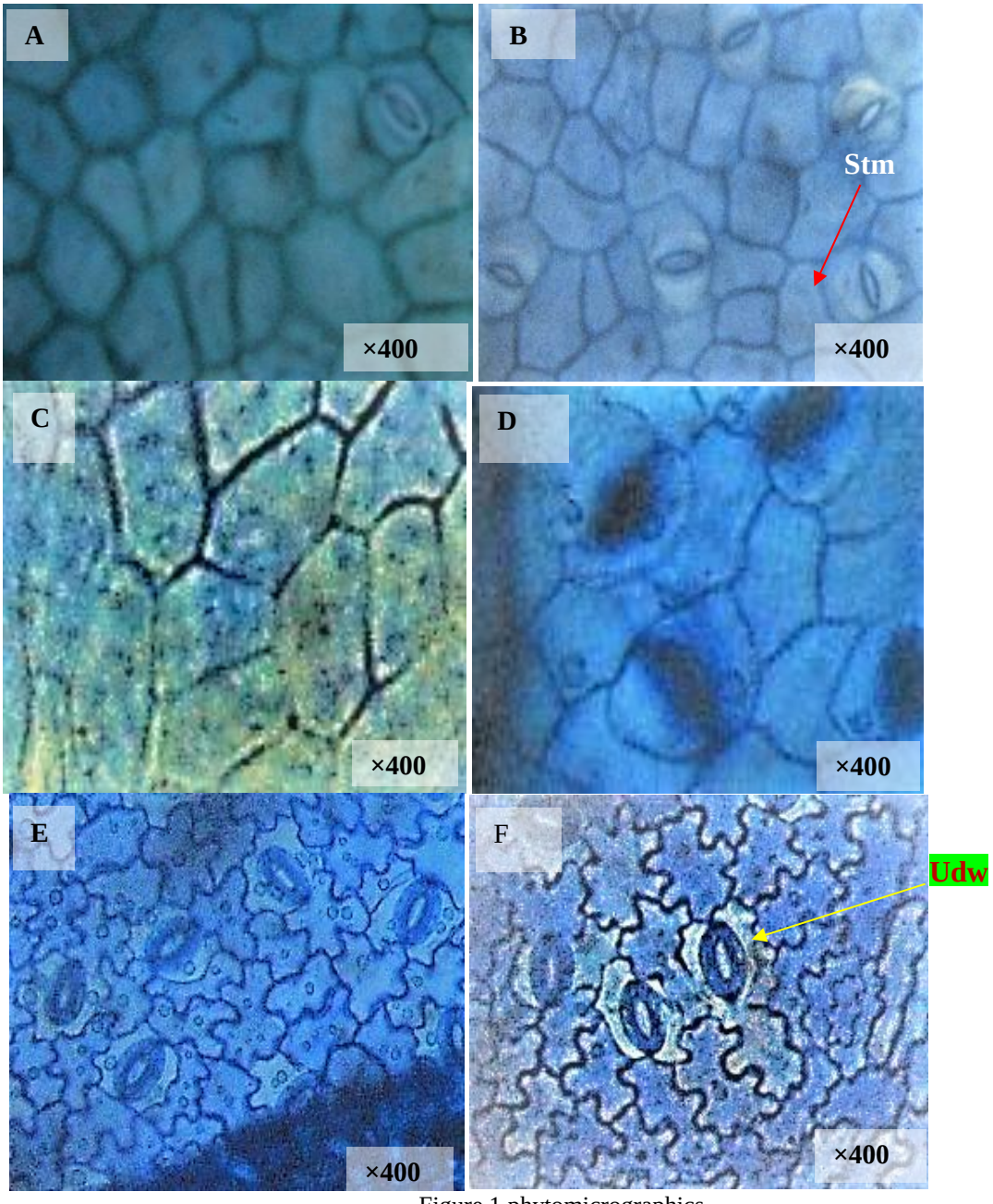

Figure 1 phytomicrographics

Figure 1: Photomicrographs of the *Jatropha* species studied, where **A**: Adaxial surface of *J. curcas;* **B:** Abaxial surface of *J. curcas;* **C:** Adaxial surface of *J. gossipifolia;* **D:** Abaxial surface of *J. gossipifolia*; **E:** Adaxial surface of *J. tanjorensis;* **F:** Abaxial surface of *J. tanjorensis*
Legend: Stm: Stomata; **Udw**: Undulate anticlinal wall

DISCUSSION

The stomatal types of the three species of *Jatropha* studied, which were all paracytic, are in agreement with the report of Soyewo *et al.* (2015), although *J. tanjorensis* was not included in their report. *Jatropha gossipifolia* is hypostomatic as the stomata were restricted only to the abaxial surface (Table 1); this information on hypostomatic feature of *J. gossipifolia* was vaguely reported by Soyewo *et al.* (2015). The size range of the stomata was 33.0 ± 0.3 µm × 18.5 ± 0.2 µm on both surfaces. Considering the qualitative characters in Table 1 which are more conservative, *J. tanjorensis* differs greatly in cell shape and anticlinal walls. From Tables 1 and 2, the three species of *Jatropha* related mostly in their stomatal types and differed in their cell shapes and anticlinal wall patterns. There were no significant differences in the mean values of the stomatal length and width, cell length and width of *J. tanjorensis* and its supposed putative parents. Studies by Baranova (1992) on epidermal structure and other anatomical features of angiosperm leaves showed that paracytic stomata are primitive and plesiomorphic characters on which other types of stomata are derived.

The foliar epidermal features presented in this study showed the relationship among the three taxa without clear information to support the claim of Prabakaran and Sujatha (1999) of natural hybridisation of *J. tanjorensis* from *J. curcas* and *J. gossipifolia* as the three taxa have a common type of stomata and the supposed hybrid (*J. tanjorensis*) possesses oblong cell shape with undulate anticlinal wall pattern (Figure 1), which is common in the primitive plant family Pteridaceae (Shah *et al.,* 2019).

CONCLUSION

The leaf epidermal features did not provide convincing data to infer evolutionary trend among the three species of the genus *Jatropha* examined in this work. The data presented here are not fully novel as there have been reports on two of the three species, but our data have specifically stated the relationship between *J. tanjorensis* and its putative parents which the previous reports lack.

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REFERENCES

Abdulrahaman, A.A. and Oladele, F.A. (2010). Stomatal complex types, stomatal density and stomatal index in some *Jatropha* species L. (*Euphorbiaceae*). *Nigerian Journal of Pure and Applied Sciences*, 23:2160-2163.

Agarwal, D. and Agarwal, A.K. (2007). Performance and emission characteristics of *Jatropha* oil (preheated and blends) in a direct injection compression ignition engine. *Applied Thermal Engineering*, 27(13):2314 - 2323.

Aigbokhan, E.I. (2014). *Annotated Checklist of Vascular Plants of Southern Nigeria - a quick reference guide to the vascular plants of southern Nigeria: systematic approach.* Press, Benin City, Nigeria. Pp. 167 – 168.

Akbar, E., Yaakob, Z., Kamarudin, S.K. and Ismail, M. (2009). Characteristic and composition of *Jatropha curcas* oil seed from Malaysia and its potential as Biodiesel Feedstock. European Journal of Scientific Research, 29(3): 396 – 403.

Arum, P.K., Rajesh, S.S., Sundaram, S.M., Sivaraman, T. and Brindha, P. (2014). Structural characterisation of lead anticancer compounds from the methanolic extracts of *Jatropha tanjorensis*. *Bangladesh Journal of Pharmacology,* 9: 452 – 465.

Asep, S., Hening, H., Gemap, S., Gigihi, S., Widya, M. C. and Sahidin, (2017). Anticancer Activity of Jatrophone, an Isolated Compound from *Jatropha gossypifolia* plant against hepatocellular cancer cell hep G2 1886. *Biomedical and Pharmacology,* 10(2): 667 – 673.

Baranova, M. (1992). Principles of stomatographic studies of flowering plants. *The Botanical Review*, 58(1): 49 – 99.

Damisa, D., Ameh, J.B. and Umoh, V.I. (2008). The effect of changes in management concentrations on cellulose yield from biogases fermented with mutagenised strain of *Aspergilus niger* AHZ. *International Journal of Biological and Chemical Science,* 2(3):363-367.

Govaerts, R., Frodin, D.G., Radclffe-Smith, A. and Carter, S. (2000). *World checklist and bibliography of Euphorbiaceae (with Pandaceae).* Royal Botanic Garden, Kew, UK, 1622 p.

Hutchinson, J. and Dalziel, J. M. (1958). *Flora of West Tropical Africa. Volume 1, Part 2. Second Edition. Keay, R. W. J. (Ed.).* Crown Agents for Overseas Governments and Administrations, Millbank London, 533p.

Iwalewa, E. O., Adewumi, C. O., Omisore, N. O., Adebanji, A. O., Azike, C. K., Adigun, A. O., Adesina, O. A. and Olowoyo, O. G. (2005). Pro- and antioxidant effects and cytoprotective potentials of nine edible vegetables in southwest Nigeria. *Journal of Medicinal Food,* 8: 539-544.

Katagi, A., Sui, L., Kamitori, K., Suzuki, T., Katayama, T., Hossain, A., Noguchi, C., Dong, Y., Yamaguchi, F. and Tokuda, M. (2017). High anticancer properties of defatted *Jatropha curcas* seed residue and its active compound isoamericanol A. *Natural Product Communications*, 12(12): 1881-1884.

Koyejo, O. A., Okonkwo, H. O., Akpan, U. F., Afolarin, T. A. and Otorokpo, A. (2010). Harvesting, germination and early growth of *Jatropha curcas*. In: Akinlade, J. A., Ogunwale, A. B., Asaolu, V. O., Aderinola, O. A., Ojeiyi, O. O., Rafiu, T. A., Olayeni, T. B. and Yekini, D. O. (Eds). *Proceedings of the 44th Annual Conference of the Agricultural Society of Nigeria (ASN), LAUTECH, Oyo State, Nigeria* Pp. 1173 - 1175.

Kumar, A. and Sharma, S. (2008). An evaluation of multipurpose oil seed crop for industrial uses (*Jatropha curcas* L.): A review. *Industrial Crops and Products*, 28(1): 1 – 10.

Nwankwo, O. E. and Ayodele, A. E. (2017): Taxonomic studies of the genus *Indigofera* Linn. in Nigeria. *International Digital Organisation for Scientific Research*, 2(3): 10- 26.

Nwokocha, A. B., Agabagwa, I. O. and Okoli, B. E. (2011). Comparative phytochemical screening of *Jatropha* L. species in Niger Delta. *Research Journal of Phytochemistry,* 5:107-114.

Odugbemi, T., Akinwande, A. I., Magbagbeola, A. O., Aibinu, I., Olatunji-Bello, I. I., Fabeku, P. O., Akinsulire, O. and Adelowotan, T. (2008). *Outlines and pictures of medicinal plants from Nigeria.* University of Lagos press. 109p.

O'Hara, M. D., Kiefer, K., Farrell, T. and Kemper, K. (1998) A review of 12 commonly used medicinal herbs. *Archive of Family Medicine*, **7**: 523-536.

Olayiwola, G., Iwalewa, E. O., Omobuwajo, O. R., Adeniyi, A. A. and Verspohi, E. J. (2004). The antidiabetic potential of *Jatropha tanjorensis* leaves. *Nigerian Journal of National Productivity and Medicine*, 8: 55-58.

Prabakaran, A. J. and Sujatha, M. (1999). *Jatropha tanjorensis* Ellis & Saroja: A natural interspecific hybrid occurring in Tamil Nadu, India. *Genetic Resources and Crop Evolution,* 46:213-218.

Sahidin, N. S., Saxena, T. M., Ichwan, A. K. and Ardiyansyah, S. J. A. (2011). Antiproliferative activity of curcusone B from *Jatropha curcas* on human cancer cell lines. *Australian Journal of Basic and Applied Sciences*, 5: 47–51.

Shah, S. N., Celik, A., Ahmad, M., Ullah, F., Zaman, W., Zafar, M., Malik, K., Rashid, N., Iqbal, M., Sohail, A., and Bahadur, S. (2019). Leaf epidermal micromorphology and its implications in systematics of certain taxa of the fern family Pteridaceae from Northern Parkistan. *Microscopy Research Technique*, 82: 317 – 332.

Soyewo, L. T., Ayodele, A. E. and Adeniji, K. S. (2015). Leaf epidermal and pollen morphological studies of genus *Jatropha* L. (Euphorbiaceae) in Nigeria. *International Journal of Scientific and Technology Research*, 4(8):17 – 23.

Thomas, R., Sah, N. K. and Sharma, P. B. (2008). Therapeutic Biology of *Jatropha curcas*: a mini review. *Current Pharmaceutical Biotechnology*, 9: 315 – 324.

Zhang, X. Q., Li, F., Zhao, Z. G., Liu, X. L., Tang, Y. X. and Wang, M. K. (2012). Diterpenoids from the root bark of *Jatropha curcas* and their cytotoxic activities. *Phytochemistry Letters*, 5: 721-724.