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THE TAXONOMIC SIGNIFICANCE OF THE MICRO-MORPHOLOGY AND PHYTOCHEMISTRY OF *AGELANTHUS DODONEIFOLIUS* (DC.) POLH. & WIENS IN RELATION TO ITS HOSTS

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ABSTRACT

Microscopic, phytochemical and chromatographic studies were carried out on the leaves of the plant *Agelanthus dodoneifolius* (DC.) Polh. & Wiens 163 (1992), synonym *Tapinanthus dodoneifolius* (DC) Danser 111 (1935), an African mistletoe, occurring on four different host plants. This is to determine the reliability of micro-morphological and phytochemical characters in the taxonomy of this parasite and the phytochemical relationship between the parasite and the hosts. The microscopic examination showed similarities in epidermal characters of the parasite growing on the different hosts studied. They have stomata index of 17.7% to 20.5% on the upper surface while the lower surfaces have stomata index of 16.3% to 19.1%. Phytochemical screening showed presence of various secondary metabolites in the parasite and these varied from host to host, but are intricately related to the phytochemical profile of the host plants. The TLC fingerprinting of *A. dodoneifolius* leaf extracts also correlated with this variation. This study indicates that *A. dodoneifolius* present on different hosts might have similar micro-morphological but different chemical characteristics. Therefore, chemical characters might be useful in delineating parasitic taxa in isolation of the host. This will, however, not lead to any good taxonomic conclusion except these chemical characters are supported by characters from other systematic lines of evidence. Meanwhile, such chemical variation might justify the consideration of the parasite on a particular host in the treatment of certain disease(s) by Traditional Medicine Practitioners (TMPs).

Keywords: *Agelanthus dodoneifolius*, Micro-morphology, Chemotaxonomy, TLC fingerprinting

INTRODUCTION

Agelanthus dodoneifolius (DC.) Polh. & Wiens 163 (1992), synonym *Tapinanthus dodoneifolius* (DC) Danser 111 (1935) (Polhill, 1989), belongs to the family Loranthaceae of which members are commonly known as mistletoes. It is a semi-parasitic plant found on a wide range of hosts. Although *A. dodoneifolius* seems to have some preference for leguminous trees, it is also recorded to be frequently parasitizing *Vitellaria paradoxa* Gaertn.f. (Shea butter tree) (Burkill, 1995). The plants are attached to their host by means of modified roots called haustoria. They have chlorophyll and thus photosynthesize but entirely depend on their hosts for water

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and mineral salts and for most of their carbohydrates (Burkill, 1995; Polhill and Wiens, 1998; Bako *et al.*, 2001; Boussim *et al.*, 2004). The plants are generally semi-woody with persistent and leathery leaves, inflorescences are usually brightly coloured (Burkill, 1995).

The mistletoes are of immense economic importance because they are known to parasitize cultivated plants and tended plants e.g *Parkia biglobosa* Benth. and *Vitellaria paradoxa,* which pose serious threat to plantation in Africa (Gill and Onyike, 1990; Sall´e *et al.*, 1991, Boussim *et al.*, 1993). In Africa, mistletoes are said to hold magical and fetish values because of their remarkable habit of parasitism (Burkill, 1995). *Agelanthus dodoneifolius* has been recorded to be extensively used as medicinal plant in traditional medicine. It is used in the treatment of cholera, asthma, hypertension and diabetes (Obatomi, 1991; Obatomi, 1996; Boussim, 2002). Its use against gynecologic disturbances, digestives disorders and nervous confusions has also been documented (Nacoulma/Ouédraogo, 1996). In Northern Nigeria, *Tapinanthus sp.* is used ethnomedicinally to treat many human and animal ailments (Deeni, 1989; Hussain and Karatela, 1989) which include cancer and gastrointestinal tract and wound infections. Some of these medicinal claims have also been confirmed (Cepeleanu *et al.,* 1994; Deeni and Sadiq, 2002; Ouédraogo *et al.*, 2005). The vegetative anatomy of *Tapinanhus. dodoneifolius* has been studied (Bako *et al.*, 2003). Chemical analyses of different extracts from *A. dodoneifolius* yielded components such as triterpenes, sterols, carotenoides, saponosides, anthracenosides, anthocyanosides and tannins (Traoré, 2000).

The taxonomy of these parasites, especially the West African species has been poorly studied. The characters used by Hutchinson and Dalziel (1954) for the delimitation of the family Loranthaceae are overlapping either between the genera or within the species because of their similarities in appearance or habit. Burkill (1995) noted most of the variability and confusion that might occur in the identification of this group of parasites. Polhill &Wiens (1998) stated that many aspects of mistletoe biology particularly in the tropics are still poorly known and also the tropical African Loranthaceae pose serious challenge because the names available for most of the plants at generic and specific level are uncertain. These are also true for herbarium specimens which have made identification of the family in Nigeria difficult, as evidenced also by the inability of the majority of the producers of herbal medicine in Nigeria to properly label their drugs by writing the correct botanical name of the mistletoe used in their preparation instead of just writing the common general name 'mistletoe' which refers to over 1,000 species. Therefore, there is a strong need for adequate means of identification of members of this important family. The aim of this study is to examine the micromorpholgical features and phytochemical characters of *A. dodoneifolius* on different hosts. This is with a view to determining the extent to which the different hosts contribute to the variability within the species and the implication to its taxonomy as well as to determine the phytochemical relationship between the different hosts and the parasite. The present study is part of a broad based systematic investigation of the family Loranthaceae in Nigeria undertaken in the Department of Botany and Microbiology, University of Ibadan, Ibadan and the National Institute for Pharmaceutical Research and Development, Garki, Abuja.

MATERIALS AND METHODS

Plant Collections

Specimens of *Agelanthus dodoneifolius* were collected from four different hosts, *Vitellaria paradoxa, Parkia biglobosa, Piliostigma thoninngii* (Schum.) Milne-Redhead and *Lannea kersthingi* Engl. & Krause in Chaza village, Suleija LGA of Niger State in May, 2007. Voucher specimens are deposited at the Herbarium of National Institute for Pharmaceutical Research and Development with voucher numbers:

A. dodoneifolius on *P. thoninngii*: NIPRD/H/6159
A. dodoneifolius on *V. paradoxa*: NIPRD/H/6158
A. dodoneifolius on *P. biglobosa*: NIPRD/H/6157

A. dodoneifolius on *L. kerstingii*: NIPRD/H/6160

The fresh leaves collected were air-dried and powdered for phytochemical screening and thin-layer chromatographic (TLC) studies.

Microscopy

Epidermal peels preparation: Fresh leaves of the specimens were cut at the median portions. These were soaked in concentrated Nitric acid for 24 to 36hours depending on the texture of the leaves. The appearance of air bubbles indicated the readiness of the epidermises to be separated. The samples were then transferred to Petri dishes containing water and with the use of fine forceps and dissecting needle; the upper and lower epidermises were separated. These were cleared with camel hair brush in water and transferred to 50% ethanol in storage bottles. The epidermal layers were later washed in water and stained with safranine, and then washed with water again to remove excess stain. It was then dehydrated through series of alcohol and finally in xylene. These were then mounted on microscope slides using DPX mountant. The slides were observed and studied using the Leica CM E light microscope. Photomicrographs were taken using Leica CM E with Digital Microscope Eyepiece attachment and Photo Explorer 8.0 SE Basic software. Mean, range and Standard Error were calculated for all the quantitative variables based on twenty measurements using micrometer eye piece on light microscope. Terminologies are based on Stace (1965) and Dilcher (1974). The Stomata Index (SI) was calculated using the formula of Salisbury (1927).

$$SI = \frac{S}{S + E} \times 100\%$$

Where: S = No. of stomata per unit area
E = No. of epidermal cells in the same unit area

Phytochemical Screening

Phytochemical screening for various constituents such as carbohydrate, saponins, alkaloids, tannins, flavonoids, sterols, phenols, glycosides, resins and anthraquinones were carried out on the powdered leaf samples using standard methods (Sofowora, 1982; Trease and Evans, 1987). Each of the tests was qualitatively expressed as negative (-) or positive (+).

Preparation of plant extract and TLC Finger printing

The dried powdered samples were successively extracted in hexane, ethylacetate and methanol by maceration under room temperature. The extract was concentrated and spotted on a normal TLC plates. The spots were allowed to dry and develop in a tank containing the designed solvent system. After development, they were also observed under UV light and iodine tank for spots that cannot be seen with the ordinary eye. The Retention Factor (RF) values were calculated for all the spots.

Solvent systems used are:		
	Hexane extract:	Hexane 4 : 1 Ethylacetate
	Ethylacetate extract:	Hexane 3 : 2 Ethylacetate
	Methanolic extract:	Ethylacetate 3 : 2 Methanol

RESULT

Epidermal leaf microscopy

The leaf epidermal cells of all the samples were mostly isodiametric, some are polygonal and elongated (Plate 1). The anticlinal cell walls were straight in all the specimens of *A. dodoneifolius* studied (Plate 1). The epidermises of the upper and lower surfaces of all specimens are striated. Paracytic types of stomata are present both on the upper and lower surfaces of all the samples accessed.

The quantitative epidermal cell and stomata characters are shown in Table 1.

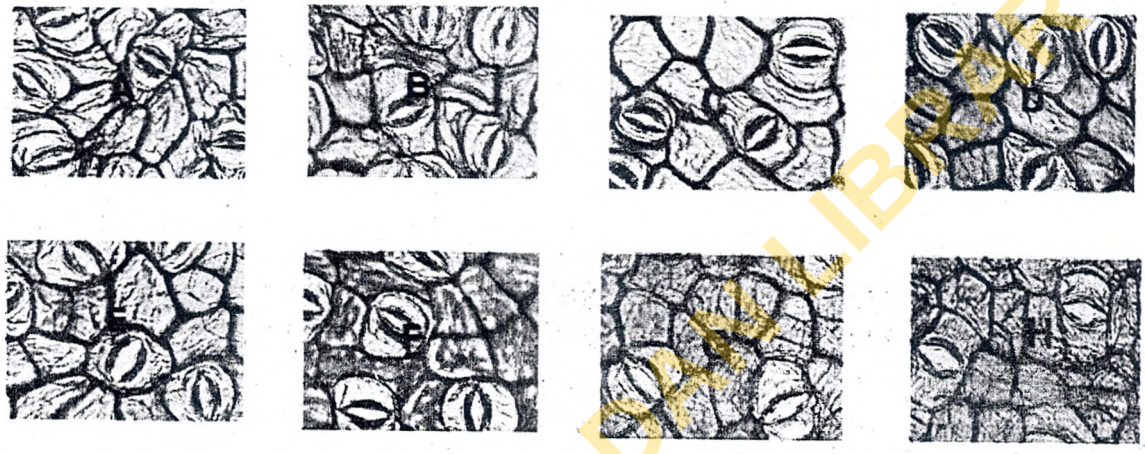

Plate 1: **Photomicrographs of the Epidermal Layers of *Agelanthus dodoneifolius* on four Different Hosts: *Piliostigma thoninngii*, *Vitellaria paradoxa*, *Parkia biglobosa* and *Lannea kersthingii*)**

Mag × 400

A: Adaxial surface of *Agelanthus dodoneifolius* on *Piliostigma thonningii*. **B:** Abaxial surface of *Agelanthus dodoneifolius* on *Piliostigma thonningii*. **C:** Adaxial surface *of Agelanthus dodoneifolius* on *Vitellaria paradoxa*. **D:** Abaxial surface of *Agelanthus dodoneifolius* on *Vitellaria paradoxa*. **E:** Adaxial surface *of Agelanthus dodoneifolius* on *Parkia biglobosa*. **F:** Abaxial surface *of Agelanthus dodoneifolius* on *Parkia biglobosa*. **G:** Adaxial surface *of Agelanthus dodoneifolius* on *Lannea kersthingii*. **H:** Abaxial surface *Agelanthus dodoneifolius* on *Lannea kersthingii*.

Table 1: **Quantitative Epidermal Characters of *Agelanthus dodoneifolius* on Four Different Hosts(*Piliostigma thoninngii*, *Vitellaria paradoxa*, *Parkia biglobosa* and *Lannea kersthingii*)**

Characters	Leaf surfaces	Parasite/Hosts			
		P1	P2	P3	P4
No of epidermal	Upper surface	42 (62 ± 3) 81	42(65 ± 3)90	42 (61 ± 3) 88	42 (60± 3)81
cells per field of view (X400)	Lower surface	42 (59 ± 4) 90	48 (67 ± 2) 90	43 (66± 3) 89	36 (63 ± 4) 90
Cell width (µm)	Upper surface	19 (27.5 ± 1.3) 40	21(26.0 ± 1.0) 35	18 (27.6 ± 1.6) 42	17 (25.9 ± 1.3) 39
	Lower surface	21 (27.4 ± 1.2) 44	21 (26.8 ± 0.2)35	16 (24.8 ± 1.2) 35	17 (23.8 ± 1.0) 32
Cell wall	Upper surface	1 (1.7 ± 0.13) 3	1 (1.9 ± 0.2) 3	2 (2.2 ± 0.1) 3	1 (1.6 ± 0.1)2
thickness (µm)	Lower surface	1 (2.1 ± 0.46) 3	1 (2.05 ± 0.14) 3	1(1.8 ± 0.1)3	1 (2.3 ± 0.5) 3
No of stomata	Upper surface	12 (16 ± 0.5) 20	11 (14 ± 0.4) 17	11 (13.5 ± 0.4)15	10(13 ± 0.4) 16
per Field of view(X400)	Lower surface	11 (14 ± 0.4) 17	11 (13 ± 0.4) 16	11 (14 ± 0.5) 19	11 (13 ± 0.3) 15
Length of	Upper surface	16 (18.1 ± 0.42)22	14(16.5 ± 0.4) 18	16 (18.1 ± 0.3)20	11 (15.9 ± 0.4) 19
stomata (µm)	Lower surface	16(18.3 ± 0.33) 20	15 (16.2 ± 0.5) 19	16(18.0 ± 0.4) 22	14 (14.0 ± 1.2) 19
Width of	Upper surface	6 (7.5 ± 0.29) 10	6 (7.8 ± 0.3) 11	7 (8.4 ± 0.2) 10	7 (10.2 ± 0.5) 12
stomata (µm)	Lower surface	6 (7.0 ± 0.38) 11	7 (8.0 ± 0.2) 10	5 (6.7 ± 0.2) 9	8 (10.1 ± 0.4) 12
Stomata index	Upper surface	20.5	17.7	18.7	17.8
(%)	Lower surface	19.1	16.3	17.5	17.1

All measurements are in microns, minimum (mean ± standard error) maximum.

KEY: P1: *Agelanthus dodoneifolius* on *Piliostigma thoninngii;* **P2**: *Agelanthus dodoneifolius* on *Vitellaria paradoxa;* **P3:** *Agelanthus dodoneifolius* on *Parkia biglobosa;* **P4**: *Agelanthus dodoneifolius* on *Lannea kersthingii*

Phytochemical Analysis

The phytochemical results indicate the presence of carbohydrate, tannin, saponins, terpenes, flavonoids and phenol in all the samples of the parasite tested. Alkaloids were absent in all the samples. Anthraquinones, sterols and resins were absent in *A. dodoneifolius on Vitellaria paradoxa* (P2) while saponin glycosides were absent in *A. dodoneifolius on Parkia biglobosa* (P3) and *P. thoninngii* (P1). Cardiac glycoside was only present in *A. dodoneifolius on Vitellaria paradoxa* (P2) (Table 2). The presence of metabolites in the different parasite's hosts in comparison with their associated parasite is shown in Table 3.

Chromatographic Analysis

The TLC fingerprinting of the hexane extract revealed 6 spots for P1 (*A. dodoneifolius* on *P. thonningii*), 6 spots for P2 (*A. dodoneifolius on V. paradoxa*), 7 spots for P3 (*A. dodoneifolius on P. biglobosa*) and also 6 spots for P4 (*A. dodoneifolius on L. kersthingii*) Table 4. The Ethylacetate extract reveals 4 spots for P1, 5 spots for P2, 4 spots for P3 and 5 spots for P4. The methanolic extract also revealed 5, 6, 6 and 6 spots for P1, P2, P3 and P4, respectively (Table 4).

Table 2: **Phytochemical Analysis of *Agelanthus dodoneifolius* on Four Different Hosts(*Piliostigma thoninngii*, *Vitellaria paradoxa*, *Parkia biglobosa* and *Lannea kersthingii*)**

Parasite	Carbohydrate	Tannin	Anthraquinone	Saponins	Saponins glycosides	Cardiac glycosides	Terpenes	Sterols	Flavonoid	Phenol	Resins	Alkaloid
P1	+	+	+	+	-	-	+	+	+	+	+	-
P2	+	+	-	+	+	+	+	-	+	+	-	-
P3	+	+	+	+	-	-	+	+	+	+	+	-
P4	+	+	+	+	+	-	+	+	+	+	+	-

KEY: P1: *Agelanthus dodoneifolius* on *Piliostigma thoninngii;*
P2: *Agelanthus dodoneifolius* on *Vitellaria paradoxa;*
P3: *Agelanthus* on *Parkia biglobosa;*
P4: *Agelanthus dodoneifolius* on *Lannea kersthingii*;
+ = present; - = absent

Table 3: **Comparative Phytochemical Analysis of *Agelanthus dodoneifolius* and its Hosts, *Piliostigma thonningii*, *Vitellaria paradoxa*, *Parkia biglobosa* and *Lannea kersthingii***

Parasite /host	Carbohydrate	Tannin	Anthraquinone	Saponin	Saponins glycosides	Cardiac glycosides	Terpenes	Sterols	Flavonoid	Phenols	Resins	Alkaloid
P1	+	+	+	+	-	-	+	+	+	+	+	-
P.t1	+	+	-	+	+	+	-	-	-	+	-	-
P.t2	-	-	+	-	-	-	+	-	+	+	+	-
P.t3	-	+	-	+	+	-	+	+	+	+	+	+
P2	+	+	-	+	+	+	+	-	+	+	-	-
V.p1	+	-	-	+	-	-	+	+	-	+	+	-
V.p2	+	+	+	+	-	-	-	-	+	+	-	+
V.p3	+	+	+	+	+	+	-	+	+	-	+	+
P3	+	+	+	+	-	-	+	+	+	+	+	-
P.b1	+	-	-	+	+	+	+	-	+	+	-	+
P.b2	-	+	-	+	+	-	-	-	+	-	+	-
P.b3	+	++	+	-	-	-	-	-	-	+	-	-
P4	+	+	+	+	+	-	+	+	+	+	+	-
L.k1	+	-	-	+	+	-	-	-	-	+	-	-
L.k2	-	+	-	-	-	-	+	-	-	+	NA	+

KEY: **P1**: *Agelanthus dodoneifolius* on *Piliostigma thonningii;*, **P2**: *Agelanthus dodoneifolius* on *Vitellaria paradoxa;* **P3**: *Agelanthus s dodoneifolius* on *Parkia biglobosa;* **P4**: *Agelanthus dodoneifolius* on *Lannea kersthingii;* **P.t1**: *Piliostigma thonningii* leav; **P.t2**: *Piliostigma thonningii* stembark; **P.t3**: *Piliostigma thonningii* rootbark; **V.p1**: *Vitellaria paradoxa* leaves; **V.p2**: *Vitellaria paradoxa* stembark; **V.p3**: *Vitellaria paradoxa* rootbark; **P.b1**: *Parkia biglobosa* leaves; **P.b2**: *Parkia biglobosa* stembark; **P.b3**: *Parkia biglobosa* rootbark; **L.k1**: *Lannea kersthingii* leaves; **L.k2**: *Lannea kerasthingii* stembark

Table 4: **The RF (Retention Factor) Values of *Agelanthus dodoneifolius* on Four Different Hosts (*Piliostigma thoninngii*, *Vitellaria paradoxa*, *Parkia biglobosa* and *Lannea kersthingii*)**

Hexane Extract				Ethylacetate Extract				Methanolic Extract			
P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
-	0.14	0.14	-	0.12	0.12	0.12	0.12	0.23	0.23	0.23	0.23
0.39	0.39	0.41	0.39	-	0.50	-	-	-	0.59	0.60	0.59
0.50	-	0.51	0.50	-	-	-	0.82	0.66	0.66	0.66	0.66
0.60	0.57	0.57	0.57	0.87	0.87	0.88	0.89	0.75	0.78	0.78	0.78
0.74	0.71	0.71	0.71	0.93	0.93	0.94	0.95	0.81	0.84	0.85	0.88
0.89	0.89	0.89	0.89	0.99	0.99	0.99	0.99	0.90	0.90	0.91	0.93
0.99	0.99	0.98	0.98	-	-	-	-	-	-	-	-
Total number of spots											
6	6	7	6	4	5	4	5	5	6	6	6

KEY: P1: *Agelanthus dodoneifolius* on *Piliostigma thoninngii;* **P2**: *Agelanthus dodoneifolius* on *Vitellaria paradoxa;* **P3:** *Agelanthus dodoneifolius* on *Parkia biglobosa;* **P4**: *Agelanthus dodoneifolius* on *Lannea kersthingii*

DISCUSSION

The qualitative and quantitative epidermal leaf characters of all the samples of *A. dodoneifolius* on *Piliostigma thonningii, Vitellaria paradoxa, Parkia biglobosa* and *Lannea kersthingii* observed were similar with little or no variations (Table 1). The number of epidermal cells per field of view, sizes of the cells, cell wall thickness, number of stomata per field of view, length of stomata, width of stomata and the stomatal indices were all almost similar both on the upper and lower surfaces of the four samples of *A. dodoneifolius* studied (Table 1). The elongated and isodiametric epidermal cells with straight anticlinal cell walls and the paracytic stomata observed in all the samples assessed conformed to an earlier work (Bako *et al.*, 2003), where similar characters were noted for *A. dodoneifolius* on *Albizia lebbeck* Benth collected from Zaria.

The similarities observed in the epidermal characters of this parasite found on different hosts in this present study and on an earlier work (Bako *et al.*, 2003) shows that epidermal characters are stable and might be reliable in the taxonomy of the species. The taxonomic importance of epidermal characters is well documented in botanical literature (Ayodele & Olowokudejo, 1997; Sheteolu & Ayodele, 1997; Ayodele, 1999; Ayodele *et al.*, 1999; Ayodele, 2000; Ogundipe & Ayodele, 2000; Ayodele & Olowokudejo, 2005; Ibrahim *et al.*, 2006).

The absence of anthraquinone, sterols and resins only in *A. dodoneifolius* on *Vitellaria paradoxa* and the absence of saponins and glycosides only in *A. dodoneifolius* on *P. thonningii* and *P. biglobosa* are worth noting taxonomically and medicinally. This is also applicable to the differences noted on the number of spots and RF values produced in the TLC fingerprinting of the parasites on its different hosts. These variations indicate that the same species occurring on different hosts in the same locality might have differences in their

metabolites. This variation in metabolites had been observed by ealier workers (Deeni and Sadiq, 2002), where *A. dodoneifolius* on eleven different hosts were screened for metabolites. The differences noted in the chemical constituents of this parasite present on different hosts might justify why the host is as important as the parasite in Pharmacognosy(Burkill, 1995) and why the use of this parasite in the treatment of an ailment is usually dependent on a particular or specific host (Adodo, 2002; Olapade, 2002). Metabolites are known to be useful taxonomically in classifying plants either by scoring them as either present or absent for the various metabolites quantitatively or qualitatively (Harborne, 1968; Takhtajan, 1973). However, this might not be applicable in this group of parasites under study because of the variation noted in the metabolites present in the same species on different hosts.

Such variation in the type of metabolites present in a parasite and its associated host might indicate, to some extent, that the parasite can metabolize on its own, even though, it depends on its host for water and mineral salts (Davidson *et al.*, 1989; Parker and Riches, 1993; Bako *et al.*, 2001; Bako *et al.*, 2003). Nevertheless, the influence of environmental factors prevailing in the localities of the host plants may to a large extent determine the variability observed. This will be the subject of a forthcoming paper on the mistletoes in Nigeria.

CONCLUSION

The similarities of qualitative and quantitative epidermal cells and stomatal characters observed in *Agelanthus dodoneifolius* on the four different hosts, *P. thonningii, V. paradoxa, P. biglobosa* and *L. kersthingii* are similar to those of earlier works (Bako *et al.*, 2001) and show that although, there might be variations in the physical appearance of specimens of this parasite, they are the same microscopically. When this study is extended to other taxa in the family, it might be possible to ascertain if epidermal cells and stomatal characters will be useful and reliable in delineating the genera in the family Loranthaceae. This assertion may be unlikely for chemical characters at the species level at least from this preliminary investigation. However, the group is working on determining a phytochemical marker for the family Loranthaceae which includes *A. dodoneifolius*.

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REFERENCES

Adodo, A. (2002). Nature Power: *A Christian approach to Herbal Medicine*. D M Bosco Training Center, Akure, Nigeria 207pp.

Ayodele, A. E. and Olowokudejo, J. D. (1997). Systematic importance of leaf and epidermal characters in West African species of family Myrtaceae. *Boletin da Sociedade Broteriana* 68: 35-75.

Ayodele, A.E. (1999). Epidermal Morphology of Nigerian species of *Synsepalum* (A.DC)Daniell (Sapotaceae) *Journal of Science Research* 5(1): 43-48.

Ayodele, A. E.; Garba, B. B. and Chukwuka, K. S. (1999). Comparative epidermal Morphology of Nigerian species of *Alchornea* (Euphorbiaceae). *Journal of Science Research*. 5(1): 38-42.

Ayodele, A. E. (2000). Foliar Epidermal Characteristics of the Genus *Plumbago* Linn. (Plumbaginaceae) in Nigeria. *Nigerian journal of Science* 34(1): 9-13.

Ayodele, A.E. and Olowokudejo, J.D. (2006). The family Polygonaceae in West Africa: Taxonomic Significance of Leaf Epidermal Characters. *South African Journal of Botany.* 72: 442-459.

Bako, S.P; Onwuchekwa, B.N; Bako, L.S.P and Iortsuun, D. N, (2001). Physiology of African Mistletoes (*Tapinanthus dodoneifolius* (DC.) Danser.) and its influence on the metabolism of two Hosts (*Albizia lebbeck* Benth and *Citrus sinensis* L.) in Nigeria. *Journal of Agriculture and Environment* 2 (10): 81-92.

Bako, S.P, Bello, R.A and Bako, L.S.P. (2003). Vegetative Anatomy of the Loranthacean Mistletoes (*Tapinanthus dodoneifolius* (DC) Danser). *Nigerian Journal of Botany*. 16: 98-104.

Boussim, I. J.; Sall´e, G.; Guinko, S. (1993). *Tapinanthus* parasite dkarit´e au Burkina Faso. *Bois For. Trop*, 238: 45–65.

Boussim, I.J. (2002). Les phanérogames parasites du Burkina Faso : Inventaire, taxonomie, écologie et quelques aspects de leur biologie. Cas particulier des loranthacées parasites du karité. Thèse de doctorat ès-sciences. *Univ. Ouaga*. p. 62.

Boussim, I. J.; Guinko, S., Tuquet, C., Sall´e, G. (2004). Mistletoes of the agroforestry parklands of Burkina Faso. *Agrofor. Syst.* 60: 39–49.

Burkill, H. M. (1995). *The Useful Plants of West Tropical Africa. Edition 2. Vol. 3*. Families J-L Royal Botanic Gardens. Kew. 857pp.

Cepleanu, F., Hamburger, M. O., Sordat, B., Msonthi, J. D., Gupta, M. P., Saadou, M. and Hostettmann, K. (1994). Screening of tropical medicinal plants for molluscicidal, larvicidal, fungicidal and cytotoxic activities and brine shrimp toxicity. *International Journal of Pharmacology.* 323: 294-307.

Davidson, N.J.; True and Pate J.S (1989). Water Relations of the Parasite; Host Relationship between the mistletoes *Anyema linophyllum* (Fenzl.) Tieghem and *Casuarina obesa* Mia. *Oecologia* 80: 311-330.

Deeni, Y.Y. (1989). Plants in Kano Ethnomedicine: Screening for Antimicrobial Activity and Alkaloids, Bayero University, Kano, Nigeria, M.Sc. thesis.

Deeni, Y.Y. and Sadiq, N.M. (2002). Antimicrobial properties and phytochemical constituents of the leaves of African mistletoe (*Tapinanthus dodoneifolius* (DC) Danser) (Loranthaceae): an ethnomedicinal plant of Hausaland, Northern Nigeria. *Journal of Ethnopharmacology* 83: 235-240

Dilcher, D.L. (1974). Approaches to the identification of angiosperm leaf remains. *Botanical Review. 40*:1-157

Gill L. S. and Onyike, H. I. (1990). Mistletoes on rubber trees in Nigeria. *Haustorium*. 23: 1- 2.

Harborne, J. B. (1968). The use of secondary chemical characters on the systematics of higher plants In: J.G. Hawkes (Ed). *Chemotaxonomy and Serotaxonomy*. Academic Press London. 266pp.

Hussain, H.S.N.; Karatela, Y.Y. (1989). Traditional medicinal plants used by Hausa tribe of Kano State of Nigeria *International Journal of Crude Drug Research* 27: 211-216.

Hutchinson, J. and Dalziel, J. M. (1954). *Flora of West Tropical Africa*. Crown Agents for Overseas Government and Administration London Vol. 1.

Ibrahim, A.J.; Ayodele, A.E.; Jegede A.I. and Kunle, Y. F. (2006). Comparative Studies on *Khaya* A.Juss (Meliaceae) in Nigeria. *African Journal of Biotechnology.* 5(11): 1154-1160.

Nacoulma/Ouédraogo, O. G. (1996). Plantes médicinales et pratiques médicinales traditionnelles au Burkina Faso : cas du plateau central. *Thèse de doctorat ès-sciences. Université de Ouagadougou*, tomes II : 508-515.

Obatomi, D. K.; Bikomo, E. O. and Temple, V. J. (1991). Some Biochemical Physiological Changes in streptozotozin-indused diabetic rats on African mistletoes decoctions. *West African journal of Pharmacological Research*, 9: 19-24.

Obatomi, D. K.; Aina, V. O. and Temple, V. J. (1996). Effects of African mistletoe extract on blood pressure in spontaneously hypersensitive rats. *International journal of Pharmacognosy* 34: 124-127.

Ogundipe, O. T. and Ayodele, A.E. (2000). Foliar Epidermal Characters in the Genus *Brachystegia* Benth *Bioscience Research Communications.* 12 (1): 89-95.

Olapade, E. O. (2002). *The herbs for good health*: the 50th Anniversary Lecture of the University of Ibadan NARL Specialist Clinic, Ibadan, Nigeria. 230pp.

Ouédraogo, S., Traore, A., Some, N., Lompo, M., Guissou, I. P., Schott, C., Bucher, B. and Andriantsithohaina. R. (2005). Cardiovascular properties of *Tapinanthus dodoneifolius* (DC Danser). *African Journal of Traditional, Complimentary and Alternative Medicine* 2(1): 25-30.

Parker, C. and Riches, C. R. (1993). *Parasitic weeds of the world: Biology and their Control.* Cab International Willingford, Oxon Ox 108 De UK. Pp.225-253.

Polhill, R. M. (1989). Speciation patterns in African Loranthaceae. L. B . Holm-Nielsen, I. C. Nielsen & H. Balslev. eds., *Tropical Forests*. Academic Press, London. pp 221-236.

Polhill, R. and Wiens, D. (1998). *Mistletoes of Africa.* Kew: The Royal Botanic Gardens. Kew. 370pp.

Sall´e, G.; Boussim, J.; Raynal-Roques, A.; Brunck, F. (1991). Le karit´e une richesse potentielle, perspectives de recherche pour am´eliorer sa production. *Bois For. Trop.*, 228: 11–23.

Salisbury, E. J. (1927). On the cause and ecological significance of stomatal Frequency with special reference to the woodland Flora. Phil. *Transactions of the Royal Society of London.* Series B 216: 1 – 65.

Sheteolu A.O. and Ayodele, A.E. (1997). Epidermal Morphology of the Genus *Dialium* (Fabaceae Caesalpinioideae). *Feddes Repertorium.* 108: 151-158.

Sofowora, A. (1982). *Medicinal plants and Traditional Medicine in Africa.* Chichester. John Wiley and Sons Ltd. New York, 256pp.

Stace, A.C. (1965). Cuticular studies as an aid to plant taxonomy. ***The Bulletin of the Museum** (Natural History). Vol. 4, No. 1 of the Botany Series.* Trustees of the British Museum (Natural History).

Takhtajan A. (1973). The Chemical approach to plant classification with Special reference to the higher taxa of Magnoniales. In: *Chemistry in Botanical classification.* pp. 275-285.

Traoré, R. (2000). Etude pharmacologique chez l'animal de l'extrait aqueux de *Tapinanthus dodoneifolius* (DC). Danser (Loranthaceae) utilisée en tradithérapie anti-asthmatique au Burkina Faso. Thèse de pharmacie. *FSS. Université de Ouagadougou, Burkina Faso.* 94pp.

Trease, G. E.; Evans, W.C. (1987). *A Text Book of Pharmacognosy.* ELSB/Bailliere Tindal, Oxford, 1055pp.