academicJournals

Vol. 8(7), pp. 343-352, July 2014
DOI: 10.5897/AJPS2014.1161
Article Number: FECF47D46355
ISSN 1996-0824

http://www.academicjournals.org/AJPS

African Journal of Plant Science

Full Length Research Paper

Chemical profiles as chemotaxonomic tools for Loranthaceae in Nigeria

Jemilat Aliyu Ibrahim[1]*, Henry Omoreige Egharevba[1], Ibrahim Iliya[2], Florence Tarfa[3] and Abiodun Emmanuel Ayodele[4]

[1]Department of Medicinal Plant Research and Traditional Medicine, National Institute for Pharmaceutical Research and Development, PMB 21, Garki, Abuja, Nigeria.
[2]Department of Pharmacy. University of Maiduguri, Maiduguri, Borno State, Nigeria.
[3]Department of Medicinal Chemistry and Quality Control, National Institute for Pharmaceutical Research and Development, PMB 21, Garki, Abuja, Nigeria.
[4]Department of Botany, University of Ibadan, Ibadan, Oyo State, Nigeria.

Received 10 February, 2014; Accepted 26 June, 2014

The Loranthaceae species are widespread throughout most regions of the world, and are used for various medicinal and ethnopharmacological purposes. However, the species vary in their pharmacological activity, sometimes in correlation with the species from same ecological region or host plant, due to variation in the chemical profiles. This has led to great emphasis on caution in identification and collection for use. The wide array of secondary metabolites in Loranthaceae species are believed to be of chemotaxonomic importance. In this study, the leaves of seven Nigeria species from different ecological locations were screened for the profiles of their secondary metabolites with a view towards establishing chemotaxonomic significance. The results show the complete absence of alkaloid from all the species. Over 80% of the species tested positive for balsam, flavonoids and phenols, more than 70% tested positive for tannins, 60% for saponins and about 50% tested positive for glycosides and volatile oils. Resins, phlobatannin, terpenes, sterols and anthraquinones were present in less than 50% of the species. Some metabolites were completely absent in one or more species. The patterns displayed could be of chemotaxonomic importance for Loranthaceae in Nigeria.

Key words: Loranthaceae, chemotaxonomy, secondary metabolites, Nigeria.

INTRODUCTION

Mistletoes are widespread throughout Africa, North America, Asia, Europe, Australia and Malaesia, with the American mistletoe (*Phoradendron serotinum*) and the European mistletoe (*Viscum album*) particularly well known. Different species growing on different hosts may synthesize toxic compounds and protein such as lectins

*Corresponding author. E-mail: sadiqoyene@yahoo.com. Tel: +2348058293853.

and alkaloids with varying pharmacological activities (Preston et al., 2010). Thus, both the mistletoe and its host have shared responsibility in determining the pharmacological activity of the species. The distributions of these compounds or metabolites in different parts of a plant also vary (Preston et al., 2010). These pharmacological effects are due to variation in the chemical profiles especially the profiles of secondary metabolites. Secondary metabolites are proteins, glycosides, phenolics, steroids, saponins, terpenes, alkaloids and other chemical substances. Takhtajan (1973) suggested that secondary metabolites are compounds that may have taxonomic relevance.

Eighty percent or more of the world's population is estimated to depend primarily on traditional medicine for the treatment of ailments (Cunningham, 1993), and as a matter of fact, the use of medicinal plants is the main means of treatment by traditional healers. Also, many useful compounds, which are today used for treatment of life threatening diseases, were isolated from medicinal plants e.g. Artemisinin from *Artemisia annua* L. and Vincristine from *Catharantus roseus* (L.) G. Don (Dana, 2012; Aslam et al., 2010). The Loranthaceae, a parasitic family with mistletoes members are often considered useful as medicinal plants. It has been documented that mistletoes have immeasurable medicinal and traditional uses (Burkil, 1995; Erturk et al., 2003). The biological activities of immunomodulatory and antitumor effect of some mistletoe may be attributed to the presence of metabolites like lectins, viscotoxins and alkaloids found in the parasites (Stirpe et al., 1982; Bussing et al., 1996; Fernandez et al., 1998; Stein et al., 1999; Mengs et al., 2002).

The wide array of secondary metabolites in Loranthaceae sp. is believed to be of chemotaxonomic importance. Chemotaxonomic studies of 12 Loranthaceae and Viscaceae species namely, *Viscum rotundifolium* L.f., *Viscum capensis* L.f., *Viscum combreticola* Engl., *Viscum obovatum* Harv., *Viscum obscurum* Thunb., *Viscum verrucosum* Harv., *Loranthus dregei* Eckl. & Zehy., *Loranthus minor* Sprague, *Loranthus oleifolius* (Wendl.) Cham. & Schltdl., *Loranthus rubromarginatus* Engl., *L. zeyheri* Harv. and *Loranthus* sp. were carried out in South Africa (Tilney and Lubke, 1974), and chlorogenic acid was found in all the species. Gedalovich-Shedletzky et al. (1989) analyzed and compared the chemical composition of viscin mucilage from three mistletoe species. Chemical analyses of different extracts from *Agelanthsu dodoneifolius* yielded components such as triterpenes, sterols, carotenoides, saponosides, anthracenosides, anthocyanosides and tannins (Traoré, 2000). However, chemotaxonomic information on the West African or Nigerian species is unavailable. To clarify the status of Loranthaceae in the region, a revision of the Nigerian species was carried out recently and about 15 species were documented for the region (Ibrahim and Ayodele, 2011). This study aimed to determine the profile of some basic secondary metabolites in the Nigerian species, which could be of chemotaxonomic significance.

MATERIALS AND METHODS

All reagents used were of analytical grade and were purchased from Zayo-Sigma Abuja, Nigeria. TLC plates used were also from the same source.

Plant collection and preparation

Twenty-seven specimens belonging to seven species were collected from the field through a field survey across host plant species and geographical location (Table 1). The specimens include *Agelanthus dodoneifolius* (4), *Globimetula braunnii* (4), *Phragmanthera capitata* (2), *Phragmanthera nigritana* (1), *Tapinanthus bagwensis* (4), *Tapinanthus cordifolius* (4) and *Tapinanthus globiferus* (8). Vouchers specimens were deposited at the University of Ibadan Herbarium (UIH)

The leaves of each specimen were air-dried for one week at ambient temperature, and then pulverized using a mortar and pestle. The powdered leaf samples were used for the phytochemical screening and thin layer chromatographic (TLC) profiling.

Phytochemical screening

The presence of basic secondary metabolites including saponins, alkaloids, tannins, flavonoids, sterols, phenols, glycosides, resins, balsam, volatile oil, phlobatannin, terpenes and anthraquinones were determined using standard methods (Evans, 2002; Sofowora, 1993; Brain and Turner, 1975; Segelman et al., 1971).

TLC profiling

Twenty-four specimens representing seven species were examined. The specimens are: *T. globiferus* (9), *T. bangwensis* (2), *T. cordifolius* (2), *P. capitata* (2), *P. nigritana* (1), *G. braunnii* (4) and *A. dodoneifolius* (4). A list of specimens and their corresponding numbers on the TLC plates are presented in Table 3.

Two grams of powdered leaf samples of each specimen were macerated in 20 ml of acetone for 24 h and filtered using filter papers. The extracts were spotted on three different pre-coated silica gel normal-phase TLC plates of dimension 12.5 by 8.5 cm. The dry spots were developed in a TLC tank of solvent system of ethylacetate : chloroform : methanol : water, in the ratio of 15:8:4:1. The developed spots were visualized by spraying the first plate with Vanillin in sulphuric acid reagent, the second plate with Gibbs reagent and the third plate with Dragendoff reagent for detection of terpenoids, phenolics and alkaloids, respectively. The retention factors (R_F values) were calculated for all the spots as distance moved by spot from the origin divided by distance moved by solvent front (Table 2).

RESULTS

Phytochemical screening

The result of the phytochemical screening for secondary

Table 1. Preliminary phytochemical screening of secondary metabolites from Loranthaceae species in Nigeria including taxa, hosts, localities, collection numbers and metabolites studied.

Taxa	Host	Locality/No.	Gly	Rsn	Blm	Fla	Tnn	Akd	V.oil	Ptn	Spn	Tep	Str	Phn	Atq
Agelanthus dodoneifolius	*Parkia biglobosa*	Jos 65		-	+	-	+	-		-	+	-	-	+	++
Agelanthus dodoneifolius	*Parkia biglobosa*	Suleija 77	+	-	-	+	+	-	+	-	-	-	+	+	
Agelanthus dodoneifolius	*Casuarina* sp.	Yola 119		+	+	+	+	-		-	+	-	+		-
Agelanthus dodoneifolius	*Vitellaria paradoxa*	Yola 118	-		+	+	+	-	-	-	+	+	-	+	
Globimetula braunnii	*Persea americana*	Calabar 90		-	+	-	+	-		-	+	-	-	+	-
Globimetula braunnii	*Cola* sp.	Calabar 92		-	+	-	+	-		-	++	-	-	+	+
Globimetula braunnii	*Cola* sp.	Ibadan 97	+	-	+	+	-	-	+	-	+	+	-		-
Globimetula braunnii	*Theobroma cacao*	Ibadan 102	-		+	+	-	-	-	-	+	+	-	-	
Phragmanthera capitata	*Persea americana*	Calabar 93		+	+	-	+	-		-	+	-	-	+	+
Phragmanthera capitata	*Persea americana*	Calabar 89		-	+	+	+	-	-	-	-	+	-		-
Phragmanthera nigritana	*Citrus* sp.	Chaza 78	-		+	+	+	-	-	-	+	+	-	+	
Tapinanthus bangwensis	*Newboldia leavis*	Ibadan 46		+	-	-	-	-		-	-	-	-		-
Tapinanthus bangwensis	*Citrus medica*	Ibadan 40	+	-	-	+	-	-	-	-	-	-	+	-	-
Tapinanthus bangwensis	*Cola acuminata*	Ibadan	-	-	+	+	-	-		-	+	+	+	+	-
Tapinanthus bangwensis	*Theobroma cacao*	Ibadan	-	-	+	+	-	-		-	+	-	-	+	-
Tapinanthus cordifolius	*Citrus auranthifolia*	Jos 63	+	+	+	+	+	-	+	-	-	-	-	+	
Tapinanthus cordifolius	*Cassia* sp.	Jos 86	-		+	+	+	-	-	-	+	+	-	+	
Tapinanthus.cordifolius	*Syzygium eucalyptoide*	Jos	+	+	+	+		-	+	-	+	+	+		-
Tapinanthus cordifolius	*Ficus sp.*	Jos	+	+		+		-	+	+	+	+	+		-
Tapinanthus globiferus	*Piliostigma thoninngii*	Kano 29		-	+	+	+	-		-	-	-	-	+	+
Tapinanthus globiferus	*Azadirachta indica*	Yola116		-	+	+	+	-		-	-	-	-	+	-
Tapinanthus globiferus	*Tectona grandis*	Kano 33		-	+	+	+	-		-	+	-	-	+	-
Tapinanthus globiferus	*Parinari curattelifolia*	Kano34	+	+	+	+	+	-	+	-	-	-	+	+	
Tapinanthus globiferus	*Zyzyphus* sp.	Yola 115		-	+	+	+	-		-	-	-	+		-
Tapinanthus globiferus	Unknown	Kano 27	+	-	+	+	+	-	+	-	-	-	-	+	
Tapinanthus globiferus	*Vitex doniana*	Suleija 73	-		+	+	+	-	-	-	+	+	-	+	
Tapinanthus globiferus	*Gmelina arborea*	Suleija 71		+	+	+	+	-		-	+	-	+		-

+ = Present; - = absent; ++ = abundant; Gly = glycoside; Rsn = resins; Blm = balsam; Fla = flavonids; Tnn = tannins; Akd = alkaloids; V.oil = volatile oil; Ptn = phlobatannin; Spn = saponin; Tep = terpenes; Str = sterols; Phn = phenols; Atq = anthraquinone.

metabolites of species of Loranthaceae on different hosts from different localities is presented in Table 1. Alkaloids were absent in all the species of Loranthaceae screened. Flavonoids were present in all except few specimens, *A. dodoneifolius* on *Parkia biglobosa* from Jos, the two specimens of *G. braunii* collected on an unidentified host from Calabar, *P. capitata* on *Persea americana* from Calabar and *Tapinanthus bangwensis* on *Citrus medica* from Ibadan (Table 1). Balsams occurred in all the specimens of the Loranthaceae species except few species like *A.*

Table 2. R_F values of phenolic spots from TLC profile of Loranthaceae species in Nigeria.

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
														0.06	0.06		0.04	0.04			0.06			0.04
						0.07	0.10							0.09	0.10	0.07	0.09							
				0.12				0.14			0.14					0.14		0.13	0.14			0.12	0.12	0.13
						0.16						0.16	0.16				0.17					0.16	0.16	
				0.20			0.19																	
															0.23	0.25	0.25	0.25	0.25			0.25	0.23	0.26
	0.29	0.30		0.27	0.29	0.30	0.30	0.30	0.29	0.27	0.29	0.27	0.29	0.29	0.29	0.29	0.29	0.29	0.29		0.29	0.30		0.30
				0.32								0.32											0.32	
	0.36			0.37							0.35	0.36	0.36	0.36	0.35	0.35	0.35	0.35					0.37	0.37
							0.39					0.40			0.40					0.40		0.39		
											0.46							0.43	0.43			0.43		
$R_{F\ values}$ of spots	0.49		0.48	0.50		0.49	0.50	0.50	0.49			0.49	0.49			0.49		0.49	0.49	0.48	0.49	0.50	0.50	0.49
	0.53		0.53			0.52	0.53		0.52		0.53	0.52				0.53	0.52	0.53		0.53				
	0.56			0.55		0.56			0.55			0.56	0.56			0.56			0.55					
	0.59		0.59	0.58			0.59	0.59				0.59	0.58		0.58		0.59							
									0.63					0.63				0.63	0.63	0.63				
	0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.65				0.66	0.66			0.65	0.65				0.65			
												0.68						0.68	0.68	0.68		0.69	0.69	0.68
	0.73	0.73	0.73	0.72	0.72	0.72	0.72	0.72	0.72	0.71	0.71		0.71	0.71	0.71	0.71	0.71	0.72	0.71	0.71	0.71	0.73	073	
												0.78				0.76								0.75
								0.84									0.84	0.84	0.84	0.84		0.85	0.84	0.84
								0.91	0.91	0.91	0.92	0.91					0.91	0.91	0.91					
No. of spots	8	3	5	10	3	8	9	8	7	3	7	13	8	6	8	11	12	13	11	7	5	10	9	9

Key: See Table 3.

dodoneifolius on *P. biglobosa* from Suleija and *T. bangwensis* on *N. laevis* and *C. medica* (Table 1). Each of the four specimens of *T. bangwensis* on different host plants from Ibadan lacked tannins and also the two specimens of *G. braunii* from Ibadan lacked tannin (Table 1). Phenolics were also found to occur in most of the specimens screened except *G. braunii* on *Theobroma cacao* and *T. bangwensis* on *C. medica* (Table 1).

Figure 1 shows percentage response of the specimens to the metabolites screened. From this study, none of the metabolites occurred in all specimens or even all species (Figures 1 and 2). Figure 2 present the percentage of species responding to metabolites in each location while Figure 3 shows the percentage response to metabolites by the species. Generally, about 90% of the species tested positive for balsam and phenols, while 76% tested positive for tannins, 63% for saponins and less than 5% for phlobatannin (Figure 1). All the samples of *G. braunnii* tested positive to balsam and saponins, all *P. capitata* tested positive to balsams, flavonoids and tannins, *P. nigritana* tested positive to balsams, flavonoids, tannins, saponins, terpenes and phenols, while samples of *T. bangwensis* varied in their chemical profiles with no consistent positive indication for a particular metabolite. However, over 75% tested positive to balsams, flavonoids, and phenols, while about 75% also tested positive to glycosides, resins, balsams, volatile oils, saponins and terpenes. All samples of *T. globiferus* tested positive to balsam, flavonoids and tannins and 75% was positive to phenols.

TLC profiling

The TLC profiling of the specimens of

Table 3. List of specimens, hosts and their corresponding extract spot number on the TLC plates {(Figures 4-6) and Table 2}.

Specimen number on TLC plate	Name of Parasites	Name of Host	Host Family	Locality of collection/collection no.
1	*Tapinanthus globiferus*	*Piliostigma thoninngii*	Fabaceae-ceasalpinioideae	Kano 29
2	*T. globiferus*	*Azadirachta indica*	Meliaceae	Yola116
3	*T. globiferus*	*Tectona grandis*	Verbanaceae	Kano 33
4	*T. globiferus*	*Parinari curattelifolia*	Chrysobalanaceae	Kano34
5	*T. globiferus*	*Zyzyphus sp*	Rhamnaceae	Yola 115
6	*T. globiferus*	*Terminalia avicenoides*	Combretaceae	Kano 35
7	*T. globiferus*	-	-	Kano 27
8	*T. globiferus*	*Vitex doniana*	Verbanaceae	Suleija 73
9	*T. globiferus*	*Gmelina arborea*	,,	Suleija 71
10	*Tapinanthus bangwensis*	*Newboldia leavis*	Bignoniaceae	Ibadan 46
11	*T. bangwensis*	*Citrus medica*	Rutaceae	Ibadan 40
12	*Tapinanthus cordifolius*	*Citrus auranthifolia*	,,	Jos 63
13	*T. cordifolius*	*Cassia* sp.	Fabaceae-ceasalpinioideae	Jos 86
14	*Phragmanthera capitata*	*Persea americana*	Lauraceae	Calabar 93
15	*P. capitata*	*Persea americana*	,,	Calabar 89
16	*Phragmanthera nigritana*	*Citrus* sp.	Rutaceae	Chaza, Suleija 78
17	*Globimetula braunii*	*Persea americana*	Lauraceae	Calabar 90
18	*G. braunnii*	*Cola* sp.	Sterculiaceae	Calabar 92
19	*Globimetula braunnii*	*Cola* sp.	,,	Ibadan 97
20	*G. braunnii*	*Theobroma cacao*	,,	Ibadan 102
21	*Agelanthus dodoneifolius*	*Parkia biglobosa*	Fabaceae-mimosoideae	Jos 65
22	*A. dodoneifolius*	*Parkia biglobosa*	,,	Suleija 77
23	*A. dodoneifolius*	*Casuarina* sp.	Casuarinaceae	Yola 119
24	*A. dodoneifolius*	*Butryospermum parkii*	Sapotaceae	Yola 118

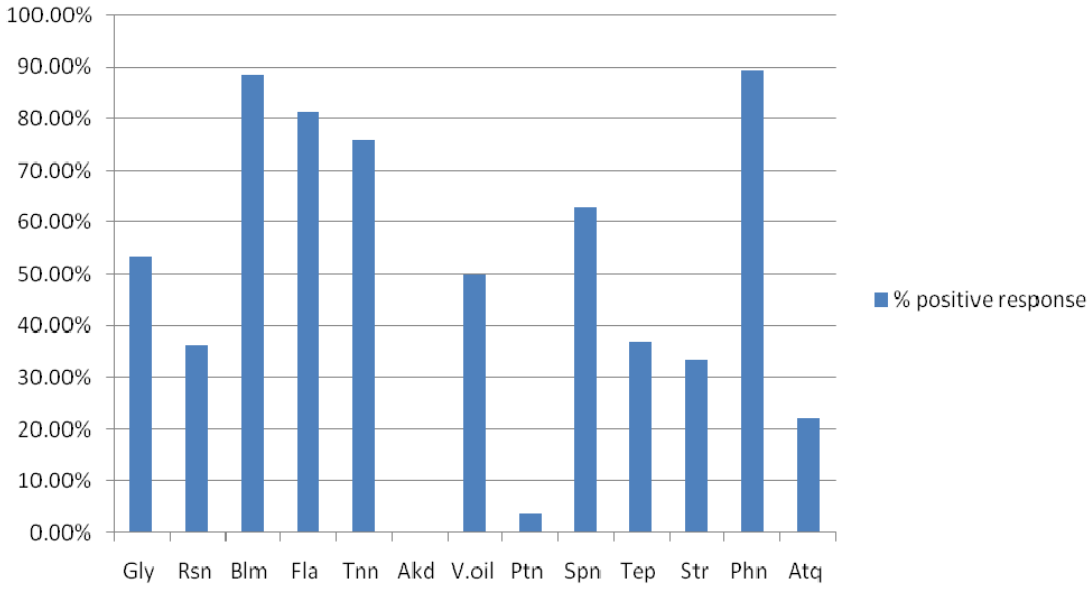

Figure 1. Percentage response of the total specimens of Loranthaceae species in Nigeria to presence of secondary metabolites. Gly = Glycoside; Rsn = Resins; Blm = Balsam; Fla = Flavonids; Tnn = Tannins; Akd = Alkaloids; V.oil = Volatile oil; Ptn = Phlobatannin; Spn = Saponin; Tep = Terpenes; Str = Sterols; Phn = Phenols; Atq = Anthraquinone

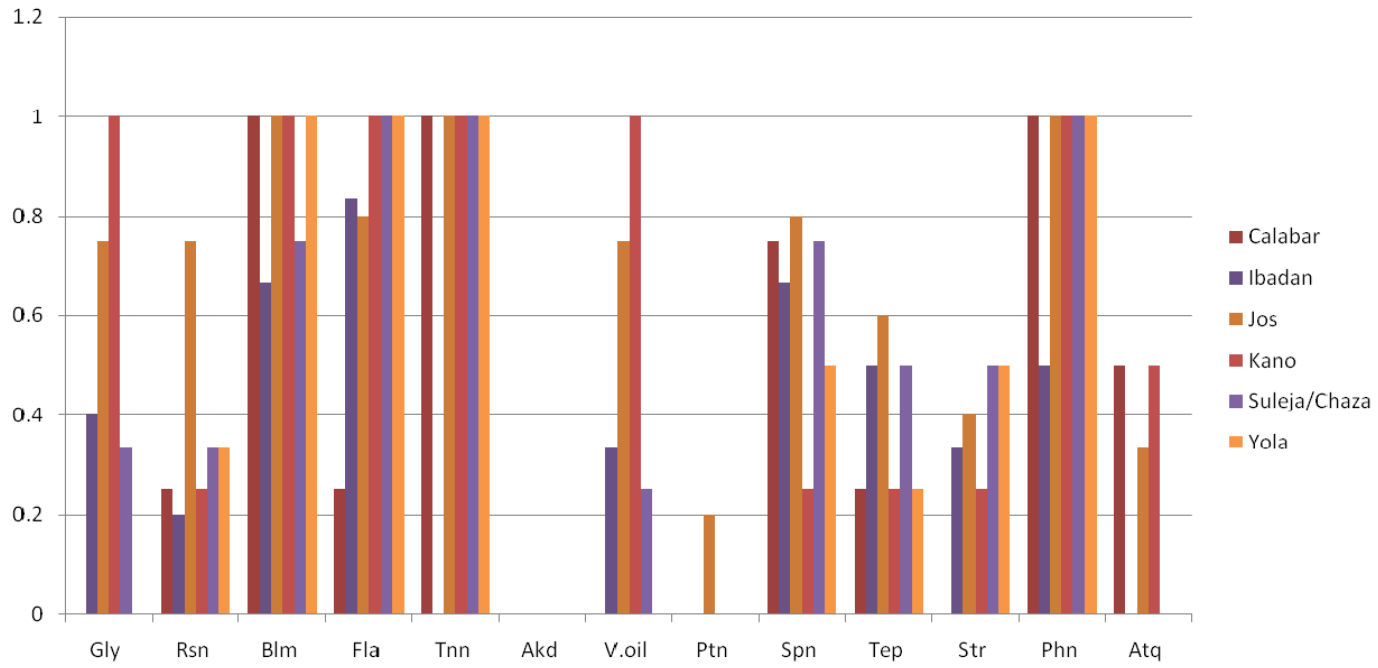

Figure 2. Percentage of species of Loranthaceae in Nigeria responding to secondary metabolites by location. Gly = Glycoside; Rsn = resins; Blm = balsam; Fla = flavonids; Tnn = tannins; Akd = alkaloids; V.oil = volatile oil; Ptn = phlobatannin; Spn = saponin; Tep = terpenes; Str = sterols; Phn = phenols; Atq = anthraquinone.

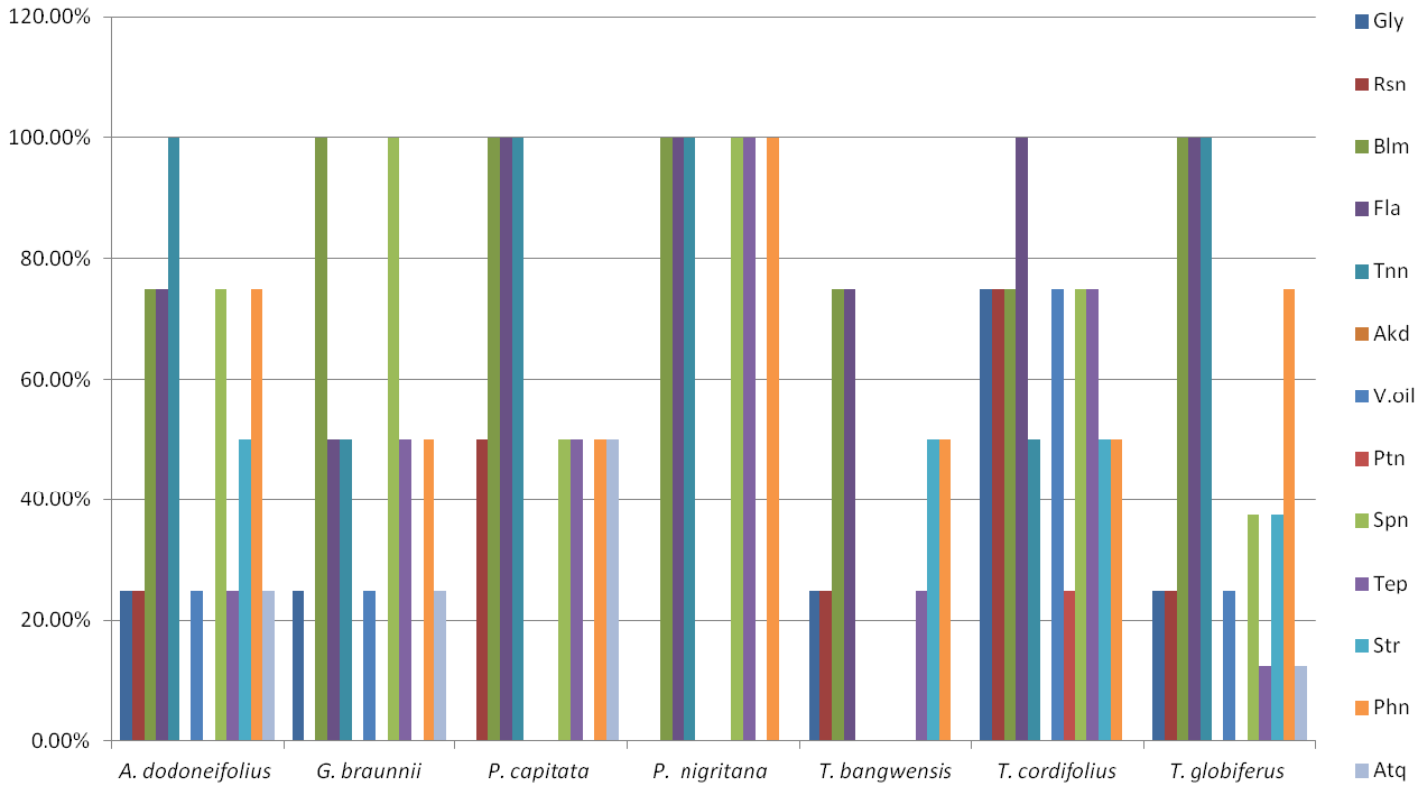

Figure 3. Percentage response of Loranthaceae species to secondary metabolites by species. Gly = Glycoside; Rsn = resins; Blm = balsam; Fla = flavonids; Tnn = tannins; Akd = alkaloids; V.oil = volatile oil; Ptn = phlobatannin; Spn = saponin; Tep = terpenes; Str = sterols; Phn = phenols; Atq = anthraquinone.

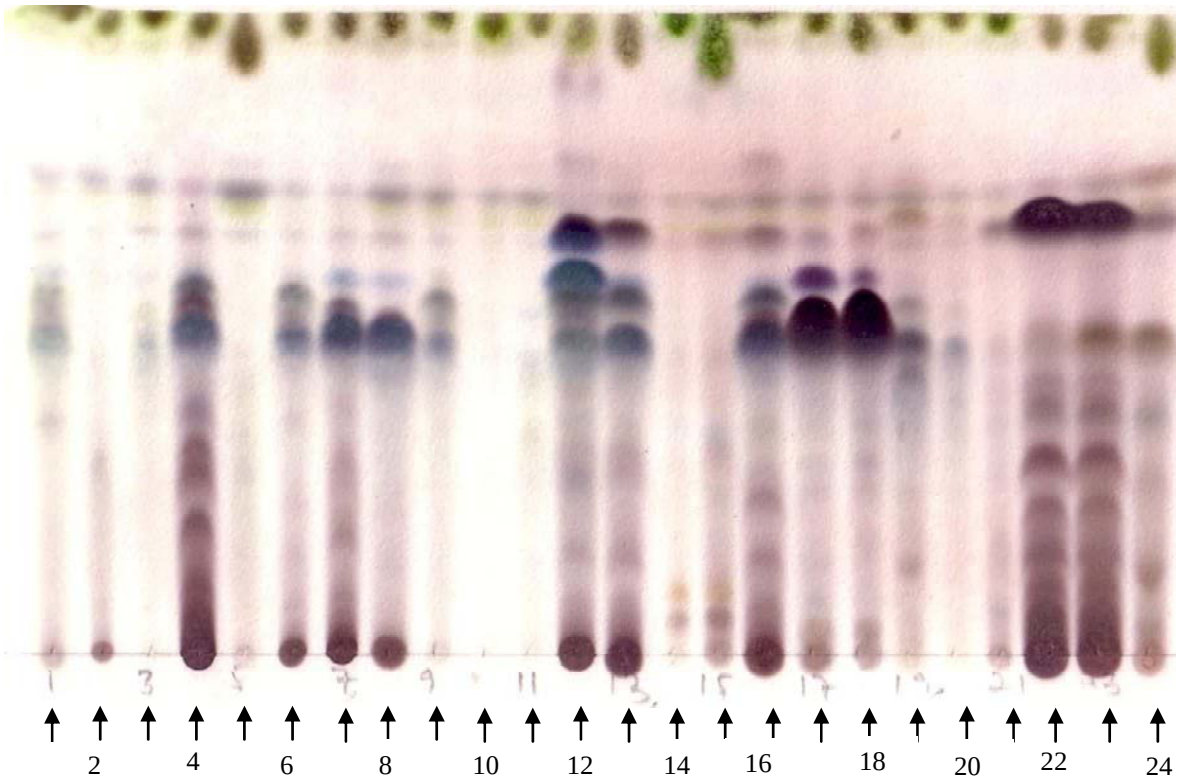

Figure 4. TLC profile of Loranthaceae specimens sprayed with Gibbs reagent.

Loranthaceae sp. using Gibbs, vanillin-sulphuric acid and Dragenddoff spray reagents for TLC are shown in Figures 4, 5 and 6, respectively. In Figures 4, 5 and 6, Gibbs reagent were used for visualizing phenolics, vanillin in sulphuric acid for terpenoids, while Dragendoff reagent was used to see if alkaloids were present on the TLC plate, respectively. Table 2 shows the R_f values of spots found on the TLC plate in Figure 4, which reveals that all the specimens had phenolics in them although to varying degree judging from the numbers of spots. *T. cordifolius* on *Cassia* sp. from Jos (spot 12), *G. braunii* on *P. americana* (spot17) and *G. braunii* (spot 18) from Calabar have the highest number of spots of 13, 13 and 12, respectively (Table 2). An intermediate number of spots were found in *T. globiferus* on *P. curattelifolia* from Kano (spot 4), *P. nigritana* on *Citrus* sp. from Suleija (spot 16) and *G. braunii* on *Cola* sp. from Ibadan (spot 19) with 10, 11 and 11 spots respectively (Table 2). The lowest spots are found in *T. globiferus* on *A. indica* (spot 2), *T. globiferus* on *Tectona grandis* (spot 3), *T. globiferus* on *Zyzyphus* sp. (spot 5), *T. bangwensis* on *Newboldia laevis* (spot 10) and *Agelanthus dodoneifolius* on *P. biglobosa* (spot 21) with 3, 5, 3, 3 and 5, respectively (Table 2). Spots with R_F values of 0.29 - 0.32 and 0.71 - 0.73 are found to be present in over 90% of the specimens. In Figure 5, terpenoids were only observed in some of the specimens. Alkaloids were absent from all the specimens studied (Figure 6).

DISCUSSION

The phytochemical analysis and the TLC profiling showed variation in the constituent secondary metabolites among various species irrespective of their host and ecological location (Table 1; Figures 4 and 5). Variation in secondary metabolites among the same mistletoe species occurring on different host plants have been observed in earlier studies (Deeni and Sadiq, 2002; Ibrahim et al., 2009). The only consistent pattern from this study was the lack of alkaloids from all the specimens analyzed (Table 1; Figures 1, 2 and 6). It is a known fact that quantitative and qualitative information on secondary metabolites is useful for taxonomic classification of plants (Harborne, 1968; Takhtajan, 1973). Hence absence of alkaloids, and the number of species testing positive for balsam and phenols appears to be of chemotaxonomic significance among the species in Nigeria. Alkaloids were not recorded for any of the Nigerian Loranthaceae specimens studied but Sanchez-Areola et al. (2004) recorded the presence of alkaloids in *Psittacanthus calyculatus,* a New World Loranthaceae endemic to Mexico (Kuijt, 2009).

The TLC R_f in Table 2 shows that there were similar phenolic compounds (R_f values of 0.29 - 0.32 and 0.71 - 0.73) present in most of the specimens, over 90% of the species and this further reinforced the fact that phenolics could be a source of analytical marker compound(s) for

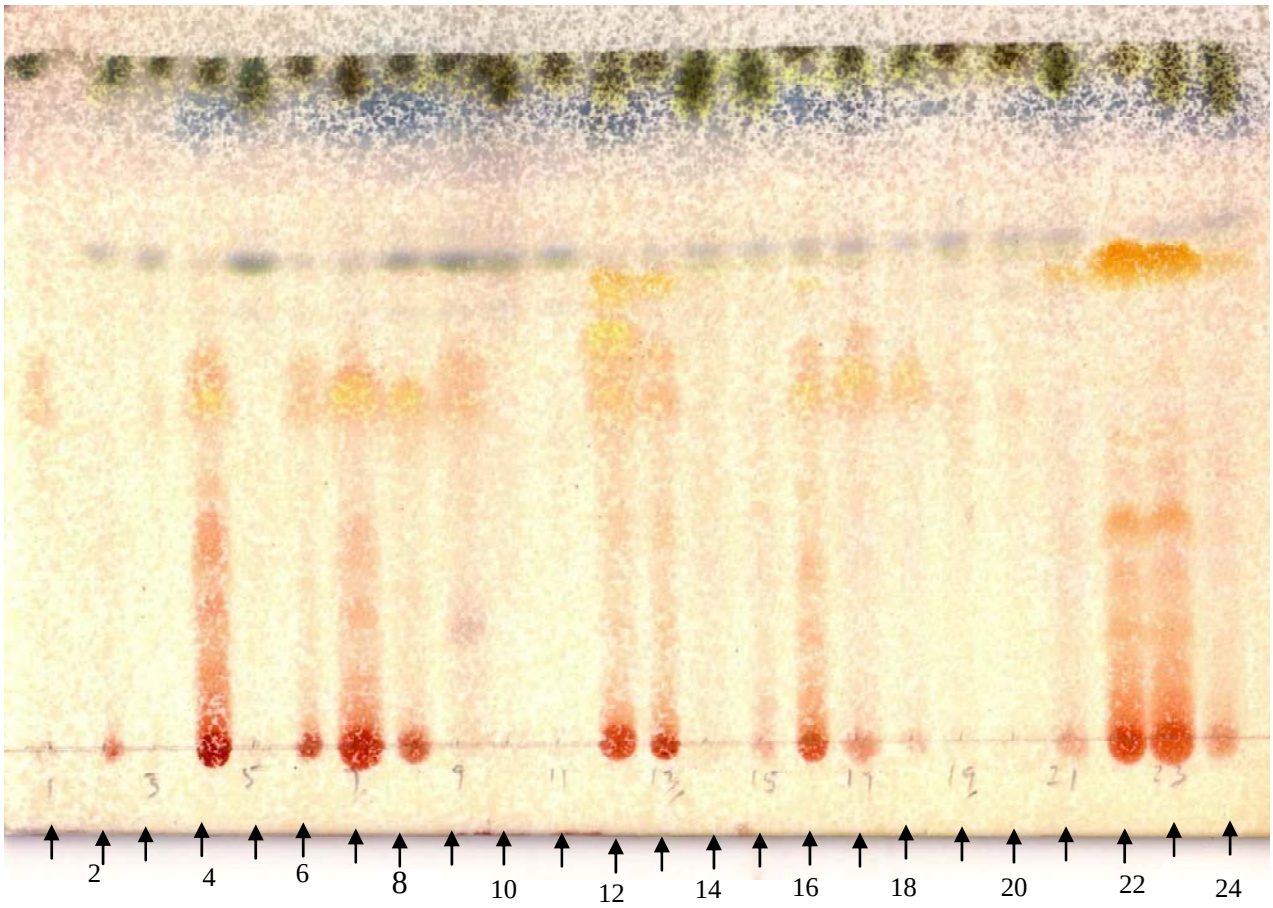

Figure 5. TLC profile of Loranthaceae specimens sprayed with Vanillin-sulphuric acid reagent.

standardization of herbal preparations from these species. High amounts of phenolics have long been known to be a phytochemical feature of parasitic flowering plants and they are said to occur at a level that is generally higher than the host plant (Khanna et al., 1968; Salatino et al., 1993). The study reveals that *G. braunii* specimens irrespective of their hosts or locations are rich in phenolic compounds as compared to other species while *T. globiferus* and *T. bangwensis* are depauperate in phenolics as compared to other species. Also of note is the absence of glycosides in the *Phragmanthera* species and total absence of tannins from all the specimens from Ibadan. These findings may be of chemotaxonomic importance. Thus, the presence of balsams and phenols could be used in specific combination with morphological characteristics and bio-geographical distribution ranges for the delineation of genera and species in the family (Crockett and Robson, 2011).

Research on dwarf mistletoes (Viscaceae) in North America indicates that plant chemistry, particularly secondary metabolites, plays an important role in determining interactions between host and parasite (Snyder, 1996). This may not be applicable to Nigerian Loranthaceae because of the variation noted in the metabolites present in the same species on different hosts. Differences in chemical profiles of the various species studied underscore why the specific choice of species for the treatment of a particular ailment is very important. This study has shown that some species may not possess a particular metabolite that is common in other species. For instance, the absence of glycosides in *Phragmanthera* species or tannins and saponins in *T. bangwensis* may result in major pharmacological differences. Although the correlation between host and chemical profile of the species was not clearly defined in this study, it is believed that the host could play a role in the observed chemical profile of the plant or species. The influence of host chemistry on the chemical constituents of the parasite on different hosts might justify why the host is as important as the parasite in pharmacognosy, ethnopharmacology and ethnomedicine, and why the use of these Loranthaceae in the treatment of an ailment is often dependent on a particular or specific host (Burkill, 1995; Snyder 1996; Adodo, 2002; Olapade, 2002; Preston et al., 2010), for instance, in Brazil, where there is preference for *Cladocolea micrantha* growing on cashew tree (*Anacardium occidentale*) for the treatment of tumors

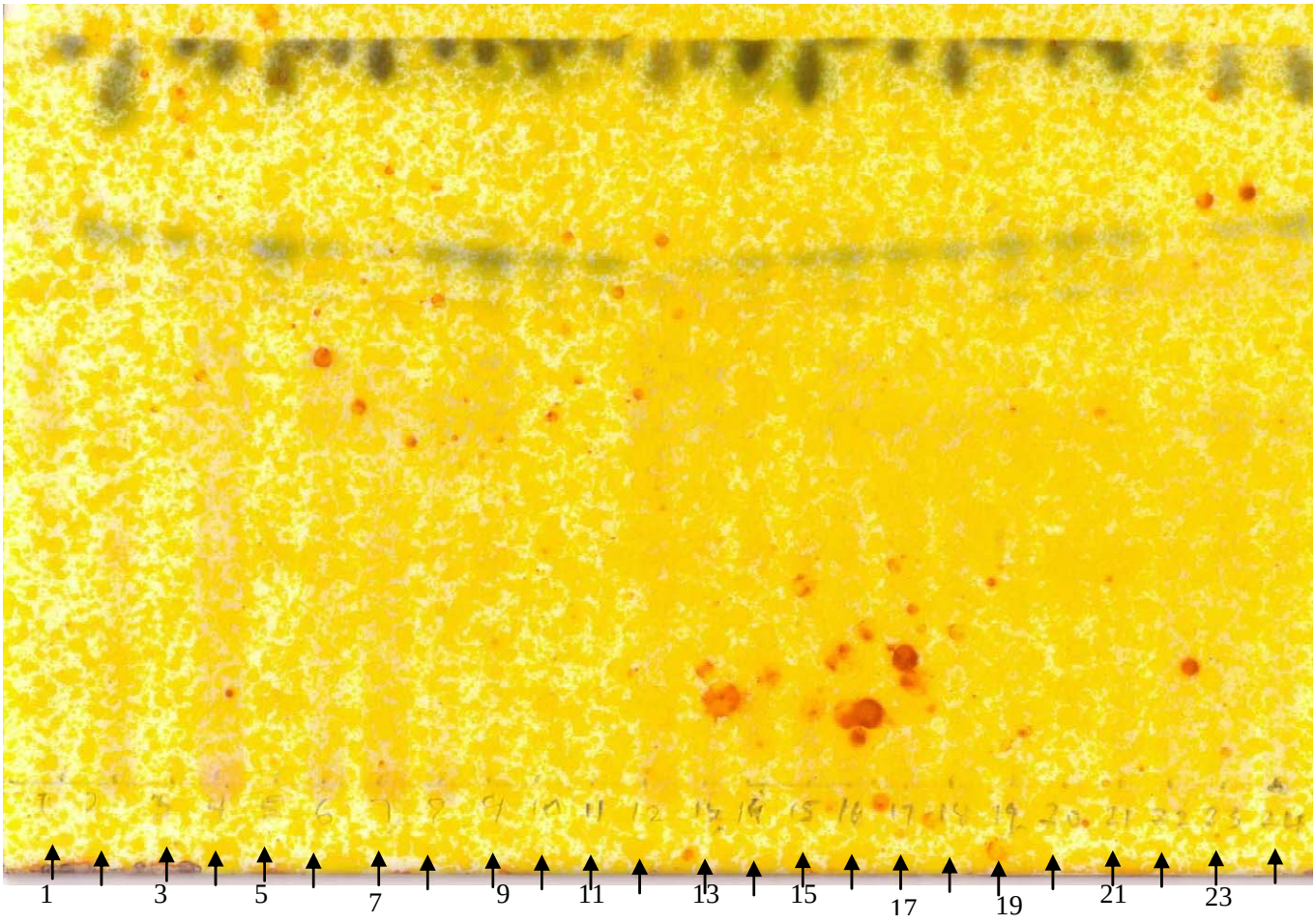

Figure 6. TLC profiling of Loranthaceae specimens sprayed with Dragendoff reagent.

and inflammatory diseases (Adodo, 2002; Olapade, 2002; Guimaraes et al., 2007).

Conclusion

From this investigation, species of Loranthaceae in Nigeria might not be delineated by scoring presence or absence of their secondary metabolites qualitatively or quantitatively due to variations which occur on same species form different hosts but the occurrence of similar metabolites like phenolics and balsam in most, if not all the species irrespective of the host and locality is useful taxonomically as a marker for the group. It is therefore our recommendation that caution should be exercised in the use of Loranthaceae as phytomedicine because of the chemical variations which exist in the same species found on different hosts. The same species collected from two different hosts might have different pharmacological effects in the body. The group is currently working on determining a phytochemical marker for the family Loranthaceae in Nigeria.

Conflict of Interests

The author(s) have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors are grateful to the following people who rendered assistance during field trips for specimen collection: Dr Theresa Omara-Achong, Oyepeju M.K.O, Baba Nafi of Keji village, Pastor Frank of University of Calabar, Dr. Colman Goji, Muazzam Ibrahim, Tanko Garba, Mrs. Sumbo Wahab and Mr. Owolabi; also Mr. John Apev, who assisted in the laboratory analysis.

REFERENCES

Adodo A (2002). Nature Power: A Christian approach to Herbal Medicine. St Benedict Monastery, Ewu-Esan, Edo State, Nigeria, pp. 207.

Aslam J, Khan SH, Siddiqui ZH, Fatima Z, Maqsood M, Bhat MA, Nasim SA, Ilah A, Ahmad IZ, Khan SA, Mujib A, Sharma MP (2010). *Catharanthus roseus* (L.) G.Don. An Important Drug: It's Applications

and Production. Pharmacie Globale (IJCP). 1(4):1-16.
Brain KR, Turner TD (1975). The practical evaluation of phytopharmaceuticals. Wright Scentechnica, Bristol, pp. 81-82.
Burkill HM (1995). The useful plants of West Tropical Africa. 2nd ed. Vol. 3. Families J-L. Royal Botanic Gardens. Kew, pp. 857.
Bussing A, Suzart K, Bergmann J, Pfeiller U, Schietzel M, Schweizer K (1996). Introduction of apoptosis in human lymphocytes treated with *Viscum album* L. is mediated by the mistletoe lectins. Cancer Lett. 99:59-72.
Crockett SL, Robson NKB (2011). Taxonomy and Chemotaxonomy of the Genus *Hypericum* (Invited Review). Med. Aromat. Plant Sci. Biotechnol. 5(1):1-13.
Cunningham AB (1993). Africa Medicinal Plants: Setting priorities at the interface between conservation and primary health care. People and plant working paper 1. Paris. UNESCO. http://unesdoc.unesco.org/images/0009/000967/096707e.pdf
Dana GD (2012). *Artemisia annua,* Artemisinin, ACTs & Malarial Control in Africa. Tradition, Science and Public Policy. Washington D.C, pp. 17-21. www.mmv.org/artemisinin
Deeni YY, Sadiq NM (2002). Antimicrobial properties and phytochemical constituents of the leaves of African mistletoe (*Tapinanthus dodoneifolius* (DC) Danser) (Loranthaceae): an ethnomedicinal plant of Hausaland, Northern Nigeria. J. Ethnopharmacol. 83:235-240
Erturk O, Hati H, Yayli N, Demirbag Z (2003). Antimicrobial activity of *Viscum album* L. subsp. *Abietis* (Wiesb). Turk. J. Biol. 27:255-258.
Evans WC (2002*). Trease and Evans Pharmacognosy,* 15th Ed., W.B. Sanders, London, pp.183-393.
Fernandez T, Wagner ML, Varela BG, Ricco RA, Hajos SE, Gurni AA, Alvarez E (1998). Study of an Argentine mistletoe, the hemiparasitic *Ligaria cuneifolia* (R.et P.) Tiegh. (Loranthaceae). J. Ethnopharmacol. 62:25-34.
Gedalovich-Shedletzky E, Delmer DP, Kuijt J (1989). Chemical composition of Viscin mucilage from three mistletoe species - a comparison. Ann. Bot. 64(3):249- 252.
Guimaraes AC, Kuster RM, Amaral ACF, Ferreira JLP, Sinia AC (2007). Histological study of the leaf and stem of the Amazonian medicinal mistletoe *Cladocolea micrantha* (Loranthaceae). Int. J. Bot. 3(2):218-221.
Harborne JB (1968). The use of secondary chemical characters on the systematics of higher plants. Chemotaxonomy and Serotaxonomy. J. G. Hawkes. Ed. Academic Press London
Ibrahim JA, Ayodele AE (2011). Taxonomic Revision of the Nigerian Loranthaceae. Nigerian J. Bot. 24(1):153-188.
Ibrahim JA, Ayodele AE, Okhale SE, Jegede AI, Kunle OF (2009). The taxonomic significance of *Agelanthus dodoneifolius* (DC.) Polh. & Wiens in relation to its hosts. Nigerian J. Bot. 22(1):89-101.
Khanna SK, Viswanathan PN, Tewari CP, Krishnan PS, Sanwal GG (1968). Biochemical aspects of parasitism by angiosperm parasites: phenolics in parasites and hosts. Physiologia Plantarum. 21:949-959.
Kuijt J (2009). Monograph of *Psittacanthus* (Loranthaceae). Systematic Botany Monographs. American Society of Plant Taxonomists, Ann Harbor. Vol. 86.
Mengs U, Gothel D, Leng-Peschlow E (2002). Mistletoe extracts standardized to mistletoe lectins in oncology: review on current status of preclinical research. Anticancer Res. 22:1399-1407.
Olapade EO (2002). The herbs for good health: the 50th Anniversary Lecture of the University of Ibadan. NARL Specialist Clinic, Ibadan, Nigeria, pp. 230.
Preston AL, An M, Watson DM (2010). Chemical profile differences in endemic parasitic weeds: a study of host-parasite chemical profiles in select mistletoe and *Eucalyptus* species. Seventeenth Australasian Weeds Conference.
Salatino A, Kraus JE, Salatino MLF (1993). Contents of tannins and their histological localization in young and adult parts of *Struthanthus vulgaris* Mart. (Loranthaceae). Ann. Bot. 72:409-414.
Sanchez-Areola E, Maiti RK, Trujillo-Perez B (2004). Morpho-anatomical characters and secondary metabolites from *Psittacanthus calyculatus* (Loranthaceae). Int. J. Exp. Bot. 53:119-121.
Segelman AB, Farnworth NR, Quimby MW (1971). Biological and physicochemical evaluation of plants III. False Negative saponin test results induced by the presence of tannins. Planta Medica. 19:304.
Snyder M, Fineschi B, Linhart YB, Smith RH (1996). Multivariate discrimination of host use by dwarf mistletoe Arceuthobium vaginatum subsp. cryptopodum: inter- and intraspecific comparisons. J. Chem. Ecol. 22:295-305.
Sofowora A (1993). Medicinal Plants and Traditional medicine in Africa. 2rd Ed., Spectrum Books Limited, Ibadan, Nigeria, pp. 145-148.
Stein GM, Pfufler U, Schietzel M, Bussing A (1999). Thionins from *Viscum album* L. influence of the viscotoxins on the activation of granulocytes. Anticancer Res. 19:1037-1042.
Stirpe F, Sandvig K, Olsnes S, Pihl A (1982). Action of viscumin, a toxic lectin from mistletoe on cells in culture. J. Biol. Chem. 257:1371-1377.
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.
Tilney PM, Lubke RA (1974). Chemotaxonomic study of twelve species of the family Loranthanceae. J. South Afr. Bot. 40(4):315-332.
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 d'Ouagadougou, Burkina Faso.