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Distribution and DNA Conservation of Sapindaceae Juss. in Western Africa

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Abstract: Generally, biodiversity is being threatened globally by climate change as well as human activities and this has aroused concerns about the conservation status. This study was designed with the aim of searching for existing, new and unrecorded plant species of the family Sapindaceae in West Africa so as to better understand the extent of diversity and distribution of the species in the family remaining in existence and conserve them for maximum use. The methodology employed include: field sampling, preservation of voucher specimens in secured repositories and DNA conservation of the collected samples. It was observed that the family Sapindaceae are represented by 26 genera and 104 species in western Africa. The most species rich regions are Nigeria (47 taxa), Cameroon (45 taxa) and Ghana (25 taxa). Southern highlands of Nigeria have the highest number of species followed by western river banks of Ghana. Taxa shared are highest between Nigeria and Ghana and endemism is highest in the western regions with 9 species endemic to the mountains and coasts. High quality genomic DNA were obtained and deposited in the DNA bank at the Royal Botanic gardens Kew. This research can be seen as a key step in the conservation of the family Sapindaceae as it reveals that most of the plants are endangered mainly due to deforestation and agricultural practices in forest reserves across West Africa.

Key words: Biorepositories, DNA bank, electrophoresis, IUCN

INTRODUCTION

Sapindaceae Juss. (Soapberry family) is a family of flowering plant belonging to the order Sapindales. It comprises about 1900 species with a predominantly pan-tropical distribution though some taxa occur in temperate areas (Buerki *et al.*, 2009). It includes trees and shrubs and a few climbers. Many of the members of the family grow in the under storey of forests and are on the borderline between shrubs and trees. Members can be found in South America, Africa and Australia however, the majority of the species are native to Asia (APG, 2003). Members include maple, horse chestnut and lychee but the largest genera are *Serjania*, *Paullinia*, *Acer* and *Allophylus*. They serve as important sources of nuts, beverages (*Paullinia cupana*), oils (*Schleichera trijuga*) and drugs (*Blighia sapida*) as well timber trees. They are common ingredients in traditional herbal remedies in rural and urban Africa (Odugbemi and Akinsulire, 2006; Sofidiya *et al.*, 2007, 2008; Adesegun *et al.*, 2008; Antwi *et al.*, 2009; Muanya and Odukoya, 2008; Ripa *et al.*, 2010; Pendota *et al.*, 2008). Several species contain saponins in their fruits, seeds and other tissues hence they serve as soap substitute (e.g., *Sapindus saponaria*). Many other members are grown for their edible fruits (e.g., *Melicocca bijuga*) and aril (e.g., *Pometia pinnata*) *Blighia sapida*, akee is a fruit from West Africa, with an edible aril but poisonous if not

eaten at the correct stage of ripeness. In Africa, 25 genera are represented in the East with 61 species between them; 14 species are regarded as endemic to the area while about 18 (Hutchinson and Daziel, 1958) to 22 (Burkill, 2000) genera are represented in West with only about 13 genera found widely spread throughout Nigeria (Keay *et al.*, 1964). Conservation through DNA technology constitutes a powerful tool for *ex situ* conservation programmes especially for species with reduced populations. Essentially, for long term persistence of species, it is important to minimize the probability of their being lost as well as maximize their representation in places where they are currently present (Pressey *et al.*, 2004). Although, varieties of protocols have been developed for proficient means of extracting DNA of both higher quality and yield, the fundamentals of DNA extraction remains the same (Tiwari *et al.*, 2012). According to the IUCN (2008), many members of the family Sapindaceae are categorised as threatened. Apart from over-exploitation by humans, droughts and land clearance for mining, dams and construction are other threats to the existence of members of Sapindaceae in Africa, hence the need for adequate conservation strategies. Although, DNA and tissue banks have been shown to have great potential as tools for biodiversity conservation, only few have been established (Savolaninen *et al.*, 2006). Also, the need to study the germplasm of crops using molecular methods in addition

to quantitative methods has been stressed by several authors including: Samal *et al.* (2003) and Taamalli *et al.* (2006) and there has been such studies as Kumar *et al.* (2006) on the family Sapindaceae however, there is no record of the genomic conservation of members of the family in West Africa. Therefore, this study was designed to search for existing, new and unrecorded plant species of the family Sapindaceae in West Africa and conserve their DNA for future use.

MATERIAL AND METHODS

Source of plant materials: Herbarium dried and fresh leaves were used for the study. Plant material used for DNA extraction was obtained from field, botanical garden, forest reserves sources in Cameroon, Ghana, Nigeria and Togo and this was complemented with herbarium samples. These were dried and stored in silica gel prior to DNA isolation. From herbarium specimens, 0.5 cm² of plant tissue was removed and either stored in plastic tubes or used immediately.

Identification of the plant samples: Voucher specimens were prepared and sent to the Forestry Herbarium, Ibadan for authentication. These were then deposited at the University of Lagos Herbarium for reference purpose.

DNA extraction: Total genomic DNA was extracted using the 2-cetyltrimethylammonium bromide (CTAB) procedure of Doyle and Doyle (1987) with minor modifications followed by additional purification.

Gel electrophoresis: This involved quality check of the DNA samples on 1% agarose gel. The gel was run on 0.5X Tris Borate EDTA (TBE) buffer at 75 V for 1 h 30 min. The gel was visualized by staining with 10 mg mL⁻¹ ethidium

bromide under Ultraviolet (UV) light and photographed with the gel documentation system (UVitec).

Quantification of DNA samples: This involved the determination of the concentration and relative absorbance of each of the DNA samples using a biophotometer. It was achieved by measuring 55 µL of the diluent i.e., sterile water into a cuvette followed by 2 µL of the DNA sample. The cuvette was then placed in a biophotometer and readings were documented.

RESULTS

Sapindaceae is represented by a hundred and four species distributed in 26 genera i.e., *Allophylus*, *Aporrhiza*, *Blighia*, *Cardiospermum*, *Chytranthus*, *Cupania*, *Deinbollia*, *Dodonaea*, *Eriocoelum*, *Glenniea*, *Harpullia*, *Haplocoelum*, *Laccodiscus*, *Lecaniodiscus*, *Lepisanthes*, *Lychnodiscus*, *Majidea*, *Melicoccus*, *Nephelium*, *Pancovia*, *Paullinia*, *Placodiscus*, *Radlkofera*, *Sapindus*, *Schleicheria* and *Zanha*. They are widely distributed throughout western Africa and the highest number of taxa was recorded in Nigeria (47 taxa). Other countries assessed include Cameroon (45 taxa), Ghana (25 taxa), Ivory Coast (23 taxa), Sierra Leone (19 taxa), Togo (13), Liberia (12 taxa) and Guinea (10 taxa). Taxa shared are highest between Nigeria and Ghana. In Tropical West Africa the southern highlands of Nigeria have the highest number of species followed by the Western and Eastern River banks in Ghana and Ivory Coast. Endemism was highest in the western regions of Nigeria and Ghana with 9 species endemic to the mountains and coasts. Deoxyribonucleic Acid (DNA) samples were extracted from all the samples collected and deposited in the DNA bank at the Royal Botanic Gardens Kew, London (Table 1). All the 104

Table 1: Sources of materials used for the study

Species	Collectors	Collection date	Country	Exact site	Voucher location	Field number	DNA bank number
<i>Allophylus abyssinicus</i>		16-Jan-64		Trinderet forest	FHI 20336	ATO 038	MWC39915
<i>Allophylus africanus</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbia forest reserve	LUH 1194	ATO 001	MWC39910
<i>Allophylus bullatus</i>	Adeyemi, T.O	22-Sep-09	Cameroon	Buea Mountain	LUH1185	ATO 002	MWC39911
<i>Allophylus cobbe</i>	Bos, J.J	19-Dec-69	Cameroon	Buea Mountain	FHI 103688	ATO 039	MWC39916
<i>Allophylus conraui</i>	Chapman,	12-Feb-72	Nigeria	Mambilla Plateau	FHI 78107	ATO 040	MWC39917
<i>Allophylus didymanaeus</i>					FHI 75205	ATO 041	MWC39918
<i>Allophylus grandifolius</i>	Letouzey, R.	26-Aug-83	Cameroon	Muyuka	HNC 50596	ATO 042	MWC39919
<i>Allophylus hirtellus</i>	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 1190	ATO 003	MWC39912
<i>Allophylus macrobotrys</i>	Reekmans,	04-Jan-79	Cameroon	Limbe Botanic Gardens	FHI 95067	ATO 044	MWC39921
<i>Allophylus megaphyllus</i>	Thomas, D.W.	24-Nov-86	Cameroon	Ndian	HNC 64379	ATO 045	MWC39922
<i>Allophylus nigericus</i>	Olorunfemi, J	27-Jun-79	Nigeria	Calabar	FHI 92242	ATO 046	MWC39923
<i>Allophylus rubifolius</i>	Reekmans,	24-Nov-86	Cameroon	Ndian falls	FHI 98646	ATO 047	MWC39924
<i>Allophylus spicatus</i>	Adeyemi, T.O	08-Jul-08	Nigeria	Olokemeji Forest Res.	LUH 3442	ATO 005	MWC39914
<i>Allophylus sp.</i>	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 3441	ATO 004	MWC39913
<i>Allophylus talbotii</i>	Letouzey, R	25-Jul-60	Cameroon	Yaoundé	SFRK 28391	ATO 052	MWC39927
<i>Allophylus zenkeri</i>	Letouzey, R	14-Apr-62	Cameroon	Batouri	SFRK 6261	ATO 053	MWC39928
<i>Aporrhiza nitida</i>	Ernwiogbon	21-Jan-79	Nigeria	Sakponba	FHI 63061	ATO 054	MWC39947
<i>Aporrhiza talbotii</i>	Amshoff, G	11-May-78	Nigeria	Cross river	FHI 87370	ATO 056	MWC39948
<i>Aporrhiza wrophylla</i>	Alexandria, C.P.	29-Dec-65	Sierra Leone		FHI 6969	ATO 057	MWC39949
<i>Blighia sapida</i>	Adeyemi, T.O	14-Feb-10	Nigeria	Oshodi Expressway	LUH 1196	ATO 007	MWC39951

Table 1: Continued

Species	Collectors	Collection date	Country	Exact site	Voucher location	Field number	DNA bank number
<i>Blighia unijugata</i>	Adeyemi, T.O	13-Dec-09	Nigeria	Sakponba Forest Res.	LUH 3443	ATO 008	MWC39952
<i>Blighia welwitschii</i>	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 1192	ATO 009	MWC39953
<i>Cardiospermum corindum</i>	Daramola, B.O				FHI	ATO 049	MWC39980
<i>Cardiospermum grandiflorum</i>	Adeyemi, T.O	14-Dec-09	Nigeria	Owena Community For.	LUH 1196	ATO 010	MWC39954
<i>Cardiospermum halicacabum</i>	Ohaeri, A.O. 947	29-May-75	Nigeria	Dumbi community	ABU 947	ATO 059	MWC39853
<i>Chytranthus angustifolius</i>	Gentry, A.L	20-Jul-81	Gabon	Makoku	FHI 102936	ATO 060	MWC39837
<i>Chytranthus atroviolaceus</i>	Hall, J.B	28-Mar-72	Ghana	Kade	GCH 43435	ATO 061	MWC39854
<i>Chytranthus carneus</i>	Abbiw and Hall, J.B.	26-Sep-76	Ghana	Bia National park	GCH 4650	ATO 064	MWC39855
<i>Chytranthus cauliflorus</i>	Abbiw and Hall, J.B.	05-Jan-74	Ghana		GCH 44715	ATO 079	MWC39836
<i>Chytranthus gillettii</i>	Mbamba, Ekitike	23-Aug-82	Cameroon	Mbalam	HNC 48253	ATO 066	MWC39883
<i>Chytranthus macrobotrys</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Limbe Botanic Gardens	LUH 1187	ATO 011	MWC39839
<i>Chytranthus setosus</i>	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 3444	ATO 012	MWC39838
<i>Chytranthus</i> sp. 1	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 3445	ATO 014	MWC39955
<i>Chytranthus</i> sp. 2	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 3446	ATO 015	MWC39956
<i>Chytranthus talbotii</i>	Adeyemi, T.O	14-Dec-09	Nigeria	Aponmu Forest Reserve	LUH 3447	ATO 013	MWC39877
<i>Deinbollia angustifolius</i>	Gentry A.L	20-Jul-81	Gabon	Makoku	FHI 84378	ATO 070	MWC39857
<i>Deinbollia grandifolia</i>	Hall, J.B.	09-Jun-79	Ghana	Bakwai	GCH 47068	ATO 071	MWC39884
<i>Deinbollia insignis</i>	Ariwaodo, J.O and Odewo, T.K.	18-Mar-86	Nigeria	Obudu	FHI 102216	ATO 072	MWC39858
<i>Deinbollia kilimandscharica</i>	De WILDE, J.J and De WILDE, B.E.	17-Aug-65	Ethiopia		GCH 7781	ATO 073	MWC39840
<i>Deinbollia maxima</i>	Thomas, D.W and Mcleod, H.L.	03-Jan-86	Cameroon	Bakossi mountain	HNC 56603	ATO 074	MWC39885
<i>Deinbollia mezilii</i>	De WILDE, J.J	24-Jun-75	Cameroon	Kribi	GCH 44613	ATO 075	MWC39859
<i>Deinbollia mollusca</i>	Abbiw and Hall	05-Nov-73	Ghana	Bonsa	GCH 45939	ATO 076	MWC39886
<i>Deinbollia pinnata</i>	Odewo, T.K.	17-Apr-89	Nigeria	Ondo	FHI 103697	ATO 077	MWC39887
<i>Deinbollia pycnophylla</i>	Letouzey, R.	30-Apr-62	Cameroon	Batouri	GCH 6226	ATO 078	MWC39888
<i>Deinbollia pynaertii</i>	Letouzey, R.	30-Apr-62	Cameroon	Batouri	GCH	ATO 068	MWC39945
<i>Deinbollia</i> sp.	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 3448	ATO 016	MWC39878
<i>Deinbollia voltensis</i>	Hall, J.B.	15-Jul-70	Ghana	Kpondai	GCH 40483	ATO 065	MWC39890
<i>Dodonaea viscosa</i>	Adeyemi, T.O	02-Jun-09	Nigeria	ABU, Zaria	LUH	ATO 037	MWC39860
<i>Eriocoelum kertstingii</i>	Ibhanesebhor	13-Nov-75	Nigeria	Mambilla Plateau	FHI 177683	ATO 080	MWC39891
<i>Eriocoelum macrocarpum</i>	Adeyemi, T.O	16-Sep-09	Cameroon	Limbe Botanic Gardens	LUH 1195	ATO 017	MWC39892
<i>Eriocoelum microspermum</i>	Cameroon			Limbe Botanic Gardens	FHI	ATO 069	MWC39879
<i>Eriocoelum oblongum</i>	Onyechuson	28-Mar-64	Nigeria	Calabar	FHI 154222	ATO 082	MWC39893
<i>Eriocoelum pungens</i>	De WILDE, J.J	29-Sep-63	Ivory coast	Abidjan	GCH 53159	ATO 083	MWC39894
<i>Eriocoelum racemosum</i>	Enti, A.A	Sep-59	Ghana	Benso	GCH 7306	ATO 084	MWC39895
<i>Ganophyllum giganteum</i>	Letouzey, R	2-Jul-63	Cameroon	Youkadouma	HNC 7361	ATO 087	MWC39897
<i>Glennia africanus</i>	Adeyemi, T.O	14-Dec-09	Nigeria	Aponmu Forest Reserve	LUH 3449	ATO 020	MWC39882
<i>Haplocoelum gallaense</i>	Letouzey, R	20-Jul-86	Cameroon		HNC 59423	ATO 088	MWC39861
<i>Harpullia zanguibarica</i>			Cameroon	Victoria	FHI 9291	ATO 086	MWC39896
<i>Laccodiscus pseudostipularis</i>	Florey, J.J.	Nov-72	Cameroon	Manfe	FHI 39252	ATO 085	MWC39899
<i>Lecaniodiscus cupanioides</i>	Adeyemi, T.O	13-Dec-09	Nigeria	Eruwa Express Road	LUH 3451	ATO 019	MWC39881
<i>Lecaniodiscus punctatus</i>	Hall, J.B.	25-Nov-77	Ghana	Kibi-Akwadum	GCH 46960	ATO 089	MWC39862
<i>Laccodiscus ferrugineus</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 1183	ATO 018	MWC39880
<i>Lepisanthes senegalensis</i>	Ohaeri, A.O.	13-Sep-88	Nigeria	Imo	ABU 2619	ATO 081	MWC39852
<i>Lychnodiscus brevibracteatus</i>	Letouzey, R	6-Jul-72	Cameroon	Yaoundé	SFRK 28388	ATO 090	MWC39900
<i>Lychnodiscus danaensis</i>	Enti, A.A	02-Mar-73	Ghana	Asukese	FHI 79666	ATO 091	MWC39863
<i>Lychnodiscus grandifolius</i>	Bos, J.J	15-Dec-69	Cameroon	Kribi	HNC 31755	ATO 092	MWC39864
<i>Lychnodiscus reticulatus</i>	Ariwaodo, J.O	18-May-77	Nigeria	Obubra	FHI 88761	ATO 093	MWC39865
<i>Majidea fosterii</i>	Adeyemi, T.O	16-Sep-09	Cameroon	Limbe Botanic Gardens	LUH 1718	ATO 025	MWC39959
<i>Melicoccus bijugatus</i>	Ogu	13-Apr-60	Cameroon	Victoria	FHI 52431	ATO 094	MWC39901
<i>Nephelium lappaceum</i>	Hall, J.B	14-Jul-76	Ghana	Kade	GCH 46110	ATO 095	MWC39866
<i>Pancovia atroviolaceus</i>	Adeyemi, T.O	17-Sep-09	Cameroon	Bakingili forest	LUH 1182	ATO 021	MWC39843
<i>Pancovia bijuga</i>	Jullick, R	06-May-77	Nigeria	Lagos	FHI 56562	ATO 096	MWC39902
<i>Pancovia floribunda</i>	Adeyemi, T.O	28-Mar-09	Nigeria	Calabar	LUH 12061	ATO 118	MWC39909
<i>Pancovia harmsiana</i>	Letouzey, R	20-Jan-60	Cameroon	Bertoua	SFRK 2926	ATO 097	MWC39903
<i>Pancovia laurentii</i>	Letouzey, R	21-Feb-62	Cameroon	Mesamena	SFRK 6223	ATO 098	MWC39904
<i>Pancovia sessiliflora</i>	Letouzey, R	16-Oct-73	Nigeria	Cross river	SFRK 72404	ATO 100	MWC39906
<i>Pancovia</i> sp. 1	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 1188	ATO 022	MWC39972
<i>Pancovia</i> sp. 2	Adeyemi, T.O	10-Sep-09	Cameroon	Bimbria forest reserve	LUH 1186	ATO 023	MWC39973
<i>Pancovia</i> sp. 3	Adeyemi, T.O	22-Sep-09	Cameroon	Buea	LUH 3453	ATO 024	MWC39974
<i>Pancovia turbinata</i>	Abbiw and Hall, J.B.	12-Aug-75	Ivory coast	Marone	GCH 45363	ATO 101	MWC39907
<i>Paullinia pinnata</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 1193	ATO 026	MWC39960
<i>Placodiscus attenuatus</i>	Hall, J.B	2-Mar-75	Ivory coast	Kissi	GCH 47087	ATO 102	MWC39932

Table 1: Continued

Species	Collectors	Collection date	Country	Exact site	Voucher location	Field number	DNA bank number
<i>Placodiscus bacoensis</i>	Hall, J.B and Abbiw	6-Apr-76	Ghana	Yakossi	GCH 3193	ATO 103	MWC39933
<i>Placodiscus boya</i>	Letouzey, R	08-Feb-71	Cameroon	Yokadouma	SFRK 23551	ATO 104	MWC39934
<i>Placodiscus bracteosus</i>	Vigne, G	Jan-30	Ghana	Ashanti	GCH 2694	ATO 105	MWC39935
<i>Placodiscus cuneatus</i>	-	21-Nov-63	Cameroon	Yaoundé	HNC	ATO 107	MWC39937
<i>Placodiscus glandulosus</i>	Letouzey, R	8-Jan-72	Cameroon	Ndikinimiki	SFRK 28397	ATO 108	MWC39938
<i>Placodiscus leptostachys</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 3454	ATO 027	MWC39929
<i>Placodiscus letestui</i>	Latilo, A and Oguntayo	28-Feb-73	Nigeria	Cross river	FHI 67759	ATO 109	MWC39939
<i>Placodiscus oblongifolius</i>	Leeuwenberg, A.J.	23-Feb-59	Ivory coast	Beberi	GCH 2796	ATO 110	MWC39940
<i>Placodiscus pseudostipularis</i>	Hall, J.B and Abbiw	20-Aug-75	Ivory coast	Beberi	GCH 45568	ATO 112	MWC39941
<i>Placodiscus pynaertii</i>	Abbiw and Hall, J.B.	14-Sep-46	Congo	Congo	FHI 15475	ATO 113	MWC39942
<i>Placodiscus riparius</i>	Deighton, J.C.	17-Sep-51	Sierra Leone	Njala	FHI 39473	ATO 114	MWC39943
<i>Placodiscus</i> sp. 1	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 3455	ATO 028	MWC39930
<i>Placodiscus</i> sp. 2	Adeyemi, T.O	14-Dec-09	Nigeria	Aponmu Forest Reserve	LUH 3456	ATO 029	MWC39931
<i>Placodiscus turbinatus</i>	Odewo, T.K	3-Apr-88	Cameroon	Korup	FHI 10543	ATO 116	MWC39946
<i>Radlkofera calodendron</i>	Adeyemi, T.O	19-Sep-09	Cameroon	Bimbria forest reserve	LUH 3457	ATO 030	MWC39975
<i>Radlkofera</i> sp. 1	Adeyemi, T.O	14-Dec-09	Nigeria	Aponmu Forest Reserve	LUH 3458	ATO 031	MWC39976
<i>Radlkofera</i> sp. 2	Adeyemi, T.O	14-Dec-09	Nigeria	Owena Forest	LUH 3459	ATO 032	MWC39977
<i>Radlkofera</i> sp. 3	Adeyemi, T.O	22-Sep-09	Cameroon	Buea Mountain	LUH 3460	ATO 033	MWC39978
<i>Sapindus saponaria</i>	Adeyemi, T.O	16-Sep-09	Cameroon	Limbe Bot. Gardens	LUH 3461	ATO 034	MWC39958
<i>Sapindus trifoliatus</i>	Daramola, B.O.	31-Aug-68	Nigeria	Abeokuta	FHI 61564	ATO 117	MWC39905
<i>Schleichera trijuga</i>	De WILDE, J.J	14-Mar-34	Cameroon	Limbe Botanic Gardens	FHI 12061	ATO 115	MWC39979
<i>Zanha golugensis</i>	Adeyemi, T.O	08-Jul-08	Nigeria	FRIN, Ibadan	LUH 3462	ATO 035	MWC39961

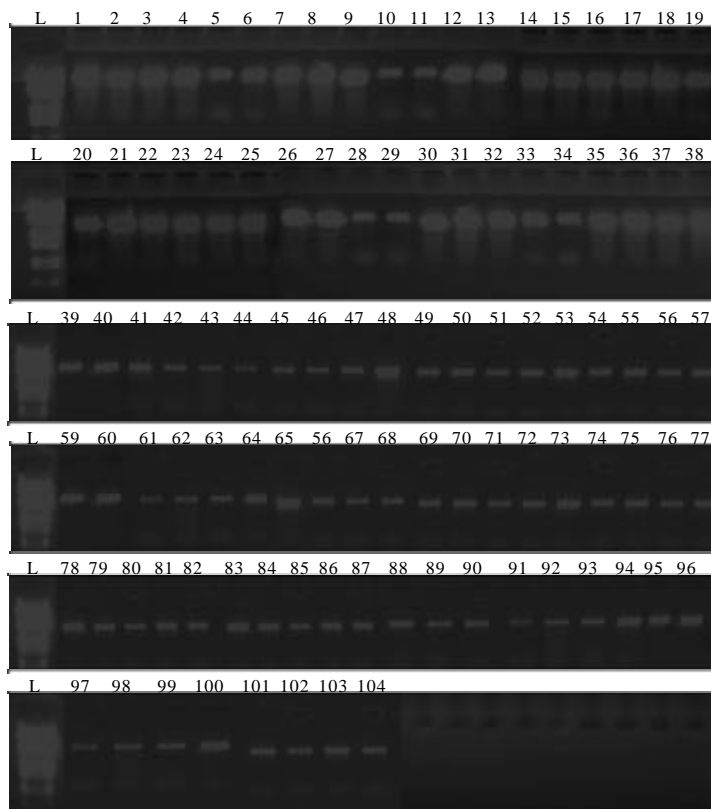


Fig. 1: Electropherogram of extracted DNA samples

samples had distinct bands showing the presence of DNA. The quality of extracted DNA samples was determined using agarose gel electrophoresis and this revealed that the cell constituents were properly released

into the buffer despite the total exclusion of the use of liquid nitrogen. Subsequently, DNA isolated are of high molecular weight bands (Fig. 1). The DNA samples were quantified using spectrophotometry and this revealed

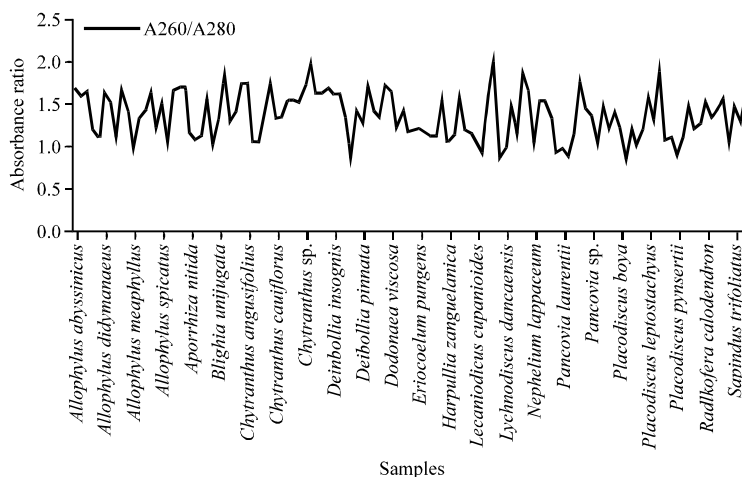


Fig. 2: Relative absorbance ratio of DNA samples

that the concentration of the DNA samples ranges from 20–2261 ng μL^{-1} . Also, purity of the DNA samples were measured at 260 and 280 nm and the absorbance ratio recorded ($A_{260/280}$) ranged from 0.87–2.01 (Fig. 2).

DISCUSSION

All over the world, over-exploitation of living resources takes place in order to meet short term needs but more often than not the process destroys exactly those resources on which the welfare of the inhabitants depends on the long term. Although members of the family Sapindaceae have been recorded to be widely distributed in Africa, their occurrence is being threatened by high rate of deforestation and agricultural practices leading to loss of forest and threatened status of members of the family as recorded in the IUCN (2008). However, our sampling revealed that there are twenty six genera and a hundred and four species in West Africa in contrast to the twenty two genera recorded by Burkill (2000). The other four genera include *Aphania*, *Ganophyllum*, *Haplocoelum* and *Laccodiscus*.

Members of the family were largely found in the lowland forest region with a few taxa located in the highland and mountains (*Allophylus bullatus*, *Schleichera trijuga*, *Sapindus saponaria*). In West Africa, the most species rich regions are Nigeria, western Cameroon and Ghana with forty seven, forty five and twenty five taxa, respectively. Endemism and No. of taxa shared are highest between Nigeria and Ghana with nine species endemic to the mountains and the coast, respectively.

It was observed that, some of the species earlier recorded in some of the reserves were no longer found

largely due to the high rate of deforestation and agricultural activities observed in the reserves. This could be attributed to the fact that the secondary forest remnants may lack key resources needed to maintain the species year-round and potentially the species has not been able to persist. Also, forest remnants in this area may be too few and too heavily impacted to retain the necessary resources to sustain the species over the long term.

A number of authors have shown the need to study the germplasm of crops using molecular methods in addition to quantitative methods including: Samal *et al.* (2003) and Taamalli *et al.* (2006). However, DNA extraction protocols are specific for different plant species though not always simple and reproducible (Pandey *et al.*, 1996; Porebski *et al.*, 1997). According to Vallejos (2007), preventing the oxidation of phenolic substances that can react with nucleic acids and proteins and eliminating polysaccharides that interfere with the enzymatic manipulations of DNA are some of the major challenges associated with DNA extraction protocols. This is further aggravated if green over matured tissues are used rather than etiolated leaves (Sharma *et al.*, 2000). In view of the foregoing, a modification of the CTAB protocol was used in this research. Genomic DNA was successfully extracted from all the collected samples and 48% of the samples had an absorbance ratio of 1.40–2.0. The low absorbance ratio values recorded in some of the taxa can be attributed to highly degraded quality of some of the extracted DNA samples especially as herbarium materials were also employed in the study (Savolainen *et al.*, 2000). No ultracentrifuge was used in this study rather a bench centrifuge of 4,000 rpm was used and the time of spinning was increased from 5–20 min however, genomic DNA was

successfully extracted from all the collected samples. All the samples have been assigned DNA bank number and deposited at the Royal Botanic Gardens Kew.

CONCLUSION

This study has helped in enumerating the number of species belonging to the family Sapindaceae represented in West Africa. Also, genomic DNA of varying concentration and molecular weight were obtained and this can be used for further molecular studies on the family. Therefore, this experiment would serve as a basis upon which further researches on the family could be based and as a valuable tool for geneticist and plant breeders.

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