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SPORE MORPHOLOGY IN THE FAMILY ADIANTACEAE FROM PARTS OF SOUTH EASTERN NIGERIA.

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ABSTRACT

The fern spore is the main source of dispersal in ferns. Studies on spore morphology of 6 species of Adiantaceous ferns collected in the study area were carried out. The spores in all the species investigated were tetrahedral except for Ceratopteris cornuta and Acrostichum aureum which had large spores. Only Pteris atroviresn lacked a perispore. The findings confirm the relatedness of this varied group of plants.

Key Words: Spore, Adiantacea, genera, morphology

INTRODUCTION

The fern spore is the main source of dispersal in ferns. It's protoplasmic contents are surrounded by a thin inner layer covered by a think impervious outer layer. The latter sometimes has an additional skin-like layer. These three layers are commonly referred to as the intine, exine and perine respectively. Gastony and Tryon (1976) citing Lugardon (1971), suggested that these terms be restricted to pollen material while the terms perispore, exospore and endospore respectively, be used in the context of pteridophytes and bryophytes.

The exospore, according to Tryon (1990) is the initial and main part of the wall. It consists of sheaths that are enveloped in amorphous sporopolenin. This layer is overlaid by the perispore which is the outer part of the wall and is derived from tapetal materials. The perispore is often folded or spinose, cracked or ruptured. Sometimes it very closely surrounds the exospore. Gastony (1974) reported that the perispore becomes degraded by the process of acetolysis. He also proposed the sodium hydroxide assay technique for determining the presence of the perispore. Sufficient treatment of the spores with sodium hydroxide removes the perispores and exposes the exospore for scanning electron microscopy or light microscopy.

Fern spores are of two types, bilateral monolete and tetrahedral trilete. The latter is more common, especially in warmer regions (Verma and Khullar, 1978).

Sporederm ornamentation has been used in solving taxonomic problems (Verma and Khullar, 1978). The adaptive significance of the sculpturing on spore walls is still largely unknown (Moore and Webb, 1978). Moy-Tavera and Hilson (1983) used spore characteristics to show relationship among species and genera of ferns and in some cases, delimited taxonomic groups.

Gastony and Tryon (1976) emphasised the use of mature specimens for spore investigations. Ranker (1989) based the relative age of spores on the developmental stages of the sporangia. He observed that spores increased in their amber pigmentation with maturation.

The aim of this work was to examine the morphological characteristics of the spores of members of the Adiantaceae which is the largest and most diverse group of ferns recorded in Nigeria.

MATERIALS AND METHODS

The study area of this work included the four coastal States of the South Eastern part of Nigeria. They are Akwa Ibom, Cross River, Rivers and Bayelsa States. Most of the Adiantaceous ferns had been recorded from these areas (Alston, 1959) before the present level of environmental changes caused by oil pollution, poor waste management and deforestation.

Fresh samples of the species were collected at random from parts of the study area. They were identified and confirmed at the Forestry Research Institute of Nigeria (FRIN) herbarium, Ibadan. Voucher specimens are in the University of Port Harcourt and University of Uyo Herbaria. *Pteris atrovirens, Adiantum capillus-veneris* and *A. Phillipense* were grown in earthen pots. *Acrostichum aureum, Ceratopteris cornuta, Pityrogramma Callomelanos* and *coniogramme africana* failed to adapt once removed from their natural habitat. Visits were rather made to such locations to check for fertile fronds. Spores were obtained from the lowest pinnae/pinnules on the fronds. There had more mature sporangia.

Acetolysis technique as modified by Nyananyo (1992) was used. Spore shape was determined according to Katiyar (1982) using the formular $\frac{P \times 100}{E}$

where P = Polar diameter
and E = Equatorial diameter.

Spore size was estimated according to Erdtman (1969). The equatorial and polar diameters were obtained from 15 acetolysed spores for each specimen. Ten unacetolysed spores were also measured for each specimen. The presence or absence of a perispore layer was determined using Gastony's (1974) sodium hydroxide treatment for 4 minutes. Measurements were carried out using an ocular micrometer under a light microscope.

RESULTS

All the species samples had tetrahedral and trilete spores. The exospore morphology in *Acrostichum aureum* was granulose (Fig. 1a). In *Ceratopteris cornuta* the exine consisted of parallel ridges (Fig. Id). An equatorial flange was observed in *Pityrogramma calomelanos* and *Pteris atrovirens* (Fig. 1e & f). Broad, rounded anibs were observed in spores of *A. phillipense, P. calomelanos, Adiantum capillus-veneris* and *A. phillipense.* Ridges parallel to the equatorial flange were observed on the distal face of the spores of *P. calomelanos* (Fig. 1e).

All but one of the species sampled in this work showed a differential swelling of an outer spore layer in response to alkaline treatment. Only *Pteria atrovirensi* lacked an inflated outer layer after the alkaline treatment. The level of inflation varied among the general sampled. In *Adiantum capillus - veneris, A. phillipense* and *Pityrogramme calomelanos* the perispore was quite obvious (Fig. 2b, c & e) respectively. In *Acrostichum aureum* the outer layer seems ruptured although there is some inflation (Fig. 2a). In *Ceratopteris cornuta* spores had the perispore apparently just detaching from the exospore (Fig. 2d).

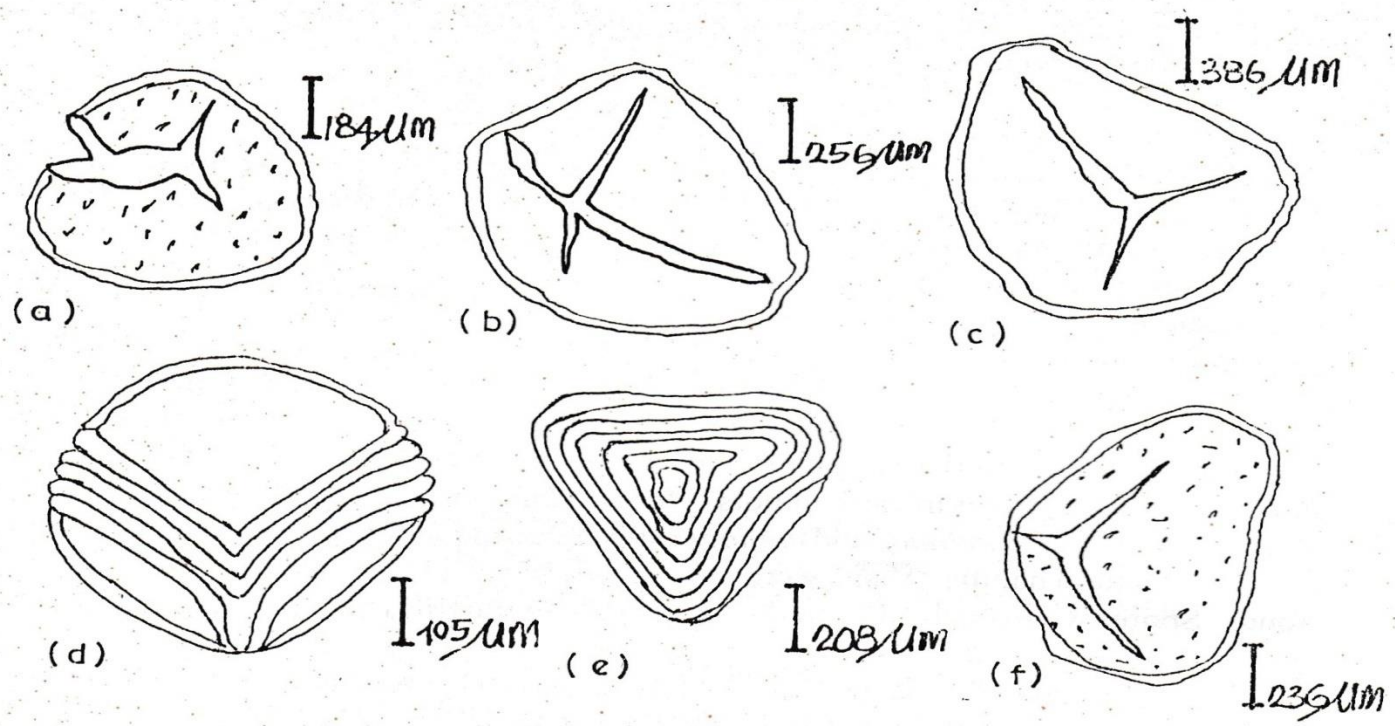

Fig. 1: **External morphology and shape of acetolysed spores (a) *Acrostichum aureum* (b) and (c) *Adiantum capillus - veneris*, (e) *Pityrogramma calomelanos*, (f) *Pteris atrovirens.***

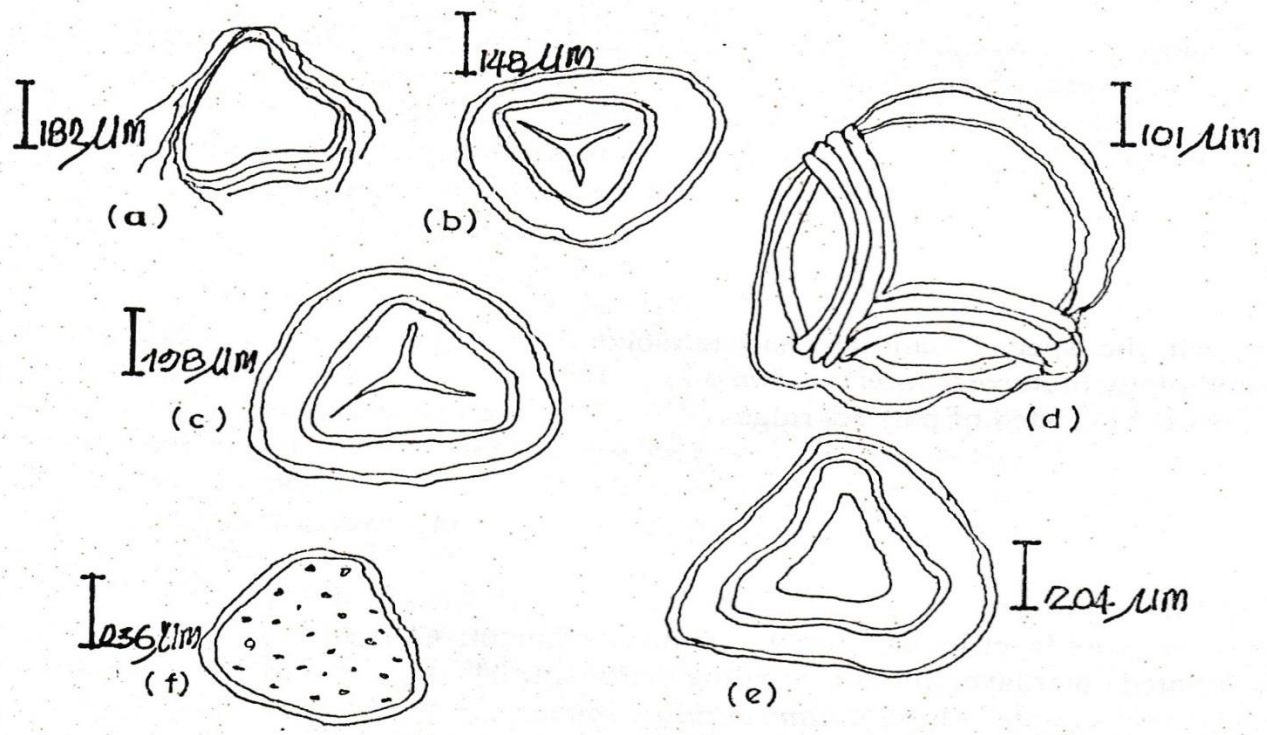

Fig. 2: **Inflated outer perispore layer after sodium hydroxide treatment for 4 minutes (a) *Acrostichum aureum* (damaged penispore), (b) and (c) *Adiantum capillus-veneris* and *A. phillipense* (d) *Ceratopteris cornuta* (inflation just starting) (e) *Pityrogramma calomelanos*, (f) *Pteris atrovirens* (no inflated outer layer).**

Measurements of both acetolysed and unacetolysed spores showed that the former became inflated after acetolysis but did not lose their shape (Table 1). Large spores were found in *Acrostichum aureum* and *Ceratopteris cornuta*. The other species had medium-sized spores (Table 1).

Table 1: Information on spores

S/N	Species	Nature Type	Type	Equatorial Diameter (UM) ± SD	Polar Diameter (UM) ± SD	Shape	Description	Perispore	Exospore	Size
1.	*Acrostichum aureum*	UA AC	Tetrahedral Trilete	54.67±0.32 67.76±1.08	42.35±0.53 55.95±1.80	77.46 82.57	Subspheroidal	+	granulpse with rounded amb	Large
2.	*Adiantum capillus-veneris*	UA AC		48.50±0.95 50.10±0.84	38.50±0.67 40.50±0.50	79.39		+	equatorial flange with rounded amb	Medium sized
3.	*A. phillipense*	UA AC		44.66±0.63 50.31±1.19	39.27±0.32 41.01±0.72	87.93 81.63		+	"	"
4.	*Ceratopteris cornuta*	UA AC		98.56±0.79 150.92±0.99	81.62±0.97 131.4`±0.88	82.81 87.07		+	with parallel ridges	Large
5.	*Pityrogramma calomelanos*	UA AC		41.58±0.52 43.12±0.51	33.60±0.50 36.45±0.70	80.81 84.53		+	Equatorial flange present ridged distally	Medium sized
6.	*Pteris atrovirens*	UA AC		42.35±0.53 44.15±0.46	35.93±0.71 37.99±0.59	84.84 86.05		-	With equatorial flange	Medium sized

UA = Unacetolysed
AC = Acetolysed
SD = Standard Deviation
+ = Perispore present
- = Perispore present

DISCUSSION

Tryon (1990) reported that spores are usually trilete in the Pteridaceae confirming the findings in this work. Granulose exospores morphology in *Acrostichum aureum* was also observed by Bir (1976). Tryon *et al.* (1990) also reported ridges parallel to the equatorial flange in spores of *P. Calomelanos*.

Rankers (1989) observation confirms the presence of an inflated outer spore layer after treatment with sodium hydroxide in some genera of the Adiantaceae. The absence of such a layer in *Pteris atrovirens* is conformed by BirSastony and Tryon (1976) however noted that absence of an inflatable perispore layer may actually be an indication that the spores were collected and dried in an immature condition. The perispore layer, they stated, is laid down late in the process of spore development.

Following the definition of a perispore by Gastony and Tyon (1976), it may be deduced that the perispore in *A. aureum* is the cracked or ruptured type. However, the rupture may have been caused by prolonged alkaline treatment. Probably a time limit less that 4 minutes might have given a good inflation. Gastony (1974) observed that prolonged treatment with sodium hydroxide removed the perispore layer in *Naphelea cuspida*. That the perispore was just detaching from the exospore in *Ceratopteris cornuta* implied that a longer period would be needed for the sodium hydroxide treatment to produce a good inflation. Ranker (1989) observed that the length of time required to produce a good inflation varies among species.

Erdtman (1969) observed that spore size may be influenced by chemical treatment. This accounts for increased sizes of the spores after acetolysis. Following his classification, only two different size grades were obtained in this work. Tryon (1986) observed that the observed here in *C. cornuta*.

Katiyar (1982) stated that spores above 76 and less than 133 were subspheroidal. All the spores examined here fell into this category.

In conclusion, tetrahedral trilete spores that are subspheroidal are common to the Adiantaceae. They are mainly medium-sized and often have a perispore except in a few cases where they may be lacking. These characters show the relatedness of this varied group of plants. The need for studies on fern spores cannot be over-emphasized. Fern spores play an important role in any strategy to conserve ferns as an important component of the forest or estuarine ecosystem. More work in the areas of dormancy and viability of the fern spores are also necessary.

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