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Research Paper

TAXONOMIC PROPERTIES OF *Musa paradisiaca* L. of MUSACEAE

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Abstract

This research is set to investigate the taxonomic properties of *Musa paradisiaca* L., a monocot, belonging to the family Musaceae, commonly called plantain, used mainly as food and sometimes for administering curative remedies. It is a perennial gigantic herbaceous plant which can grow up to 10m or more in height. The suckers arise from the rhizomes. Sheaths of young leaves, arising from stem are rolled upon one another and occupy central position at apex of stem from where flower inflorescence rooted from the rhizome also arise. There are numerous axillary flowers suspended on large spathaceous bracts which often fall off. The calyx and two anterior petals form a tube while the posterior petal is free which gradually splits open. Ovary is 3-locular containing the ovules and 5 stamens surrounding it, the fruits are berries consisting of mealy non fertile seeds. The leaves have petioles, with a remarkable central mid-rib, parallel venation with spiral phyllotaxy up to 120cm long and about 45cm wide. The stem is large but not woody rather gray to brownish in color. The micromorphology showed tetracytic stomata which is amphistomatic, and more numerous in the abaxial than the adaxial surface. Qualitative phytochemical studies showcased the following as present: alkaloids, flavonoids, tannins, phlobatannins, cyanogenic glycosides, phenol, saponins, terpenoids and steroids respectively. Proximate investigation revealed 55±1.13 % moisture, 1.02±0.07 % ash, 1.20±0.10 % lipid, 2.33±0.30 % proteins, and 34.12±2.26 % carbohydrate and 2.23±0.24 % fiber respectively. The information contained in this research, would further improve on existing literature of *Musa paradisiaca* L.

Key words: *Musa paradisiaca*, micro-morphology, anatomy, phytochemistry, morphology.

INTRODUCTION

The family Musaceae has about 35 species palaeotropically distributed, and worth of note that about 200 different forms of *Musa* are cultivated all over the world (1). Stems

are formed by the imbricates bases of the petioles, erect (2). Leaves of most monocots are Linear with parasitic venation (3). (4) reported tetracytic stomata in *Musa* spp. The most important of the phytochemical bioactive compounds of plants are alkaloids, flavonoids, tannins and phenolic compounds (5). Ethno medicinal study of the flowers of *Musa* spp. Showed that it could be used to alleviate menorrhea, dysentery, diabetes mellitus (6), heart pain, diarrhea, infantile malnutrition, (7). It has been reported that extracts of the flower possess bioactive properties for remedying diabetes mellitus, anemia (8) and malaria (9). Phenolic compounds are the largest group of phytochemicals which account for most of the antioxidants activity of plants or plants products (10).

Thus the relevance of the research is based on the fact that *Musa paradisiaca* L. is known worldwide as a very palatable food source and has lots of therapeutic values to humans, but obviously has more under exploited benefits, hence the objectives focus on the taxonomic properties of the plant.

MATERALS AND METHODS

Geographic Location

Agricultural Development Program, Rumuodumaya, ObioAkpor Local Government Area, Rivers State, Nigeria.

Morphological Studies

The meter rule was used to confirm the plant height from the root-collar to the terminal bud and the leaf length from the leaf tip to the petiole base. The measurement of the leaf width is done across the leaf lamina, from one margin to another at the widest region.

Micro-morphological (Epidermal) Studies

A very young sucker was harvested and the leaves were peeled following the method of (11) and subjected to alcohol solutions in the ratio of 30%, 50%, 70%, 95% and that of absolute alcohol. The cleared abaxial and adaxial epidermal layers obtained were stained with safranin for 5 minutes washed and counter stained with Alcian blue for same time interval, washed and temporarily mounted in aqueous glycerol solution. Photomicrographs were taken from good preparations. The method of (12) was adopted in the measurements involving stomata and trichomes. The stomatal index [S.I.] was obtained using the formula:

$$S.\ I. = \frac{S}{S + E} \times \frac{100}{1}$$

Where S and E are mean numbers of stomata and epidermal cells respectively within the particular area under investigation. Likewise trichome Index (T.I) was obtained using:

$$T.\ I. = \frac{T}{T + E} \times \frac{100}{1}$$

Where T and E are trichomes and epidermal cells respectively within the study area.

Anatomical Study

The harvested stems, leaves and roots were dehydrated in alcohol solutions of 50 %, 75 %, absolute alcohol and thereafter passed through alcohol chloroform series in the ratio of 3:1 of alcohol chloroform series, 1:1, 1:3 and pure chloroform respectively for five minutes in each. This was there after rehydrated following same procedure to 50 % alcohol before staining with safranin for 5 minutes, counter stained with Alcian blue for same time interval. Free hand section was done using a systematic arrangement of 5 razor blades as described by (13) was also adopted. Microphotographs were taken from good preparations using Sony camera of 7.2 Mega pixels having 2.411 LCD monitor and High sensitivity ISO 1250.

Qualitative Phytochemical Study

Leaves of the plant specimen studied were sun dried for 72 hours (3 days) and weighed. Fifty grammes (50 g) of the dried leaves were macerated in 96 % ethanol using a pestle and a mortar. The extract was filtered and evaporated to dryness (constant weight) using a rotary evaporator set at 45^0 C. Residue yields were observed and a portion was used for the phytochemical screening.

Test for Saponins

Frothing tests was done following the method described by (14). Complete haemolysis of red blood cells around the disc after 6 hours was taken as further evidence of presence of saponins.

Test for alkaloids

This was carried out using 0.5 g of the plant extract which was stirred with 5ml of 1% aqueous hydrochloric acid on a steam bath; 1ml of the filtrate was treated with a few drops of Mayer's reagent and a second 1ml portion was treated similarly with Dragendorff's reagent. Turbidity or precipitation with either of these reagents was

taken as preliminary evidence for the presence of alkaloids in the extract being evaluated (15) and (16). A modified form of the tin-layer chromatography (TLC) method as described by (17) was used. A positive reaction on the chromatograms (indicated by an orange or darker colored spot against a pale yellow background) was confirmatory evidence that the plant extract contained alkaloid.

Test for tannins

Five grammes (5 g) of each portion of plant extract was stirred with 10 mls of distilled water, filtered, and 5 % ferric chloride reagent added to the filtrate. A blue-black, green, or blue-green precipitate was taken as evidence for the presence of tannins (18).

Test for phlobatannins

The deposition of a red precipitate when an aqueous extract of the plant part was boiled with 1% aqueous hydrochloric acid was taken as evidence for the presence of phlobatannins (16).

Test for flavonoids

Shinoda reduction test: 5 g of the pulverized sample was boiled in 5 mls of distilled water for 5 minutes on water bath and filtered while hot. Magnesium (Mg) was added to the filtrate and few drops of conc.H_2SO_4 were carefully introduced into the mixture. The formation of orange, red, crimson or magenta was taken as evidence of preliminary presence of flavonoid.

Lead acetate test: 5 g of pulverized sample was boiled in 5 mls of distilled water for 5 minutes in water bath and filtered while hot. 2 mls of 10 % lead acetate was added to the filtrate and observed. Yellow precipitate indicated presence of flavonoids.

Test for cardiac glycosides

Lieberman's test was used in which 0.5 g of the extract was dissolved in 2 mls of acetic anhydride and cooled in ice. One milliliter (1 ml) of Sulphuric acid was carefully added in drops until a color change from violet to blue to green indicated the presence of a steroidal aglycone portion of the cardiac glycoside (18).

Steroids and Terpenoids

Salkowski's Test: 2 g of plant sample was pulverized and macerated in 5 mls of chloroform and filtered. 2 mls of H_2SO_4 was carefully added to the filtrate and observed. A reddish brown colour at the interface indicated presence of steroidal substances.

Libermann-Burchard's Test: 2 g of plant sample was pulverized and macerated in 5mls of chloroform and filtered. 1 ml of acetic anhydride was added to the filtrate followed by 2 mls of conc.H_2SO_4 to form a layer. Color change from violet to blue to green at interface showed the presence of terpenoids.

PROXIMATE PROPERTIES

Proximate properties were done following the methods of [19].

Proteins (Kjeldahl method)

Stage 1: 0.1 g of sample was weighed into a clean conical flask 250ml capacity, 3g of digestion catalyst was introduced into the flask and 20ml conc. Sulphuric acid added and heated to digest. Color change from black to sky-blue cooled to room temperature and then diluted to 100ml with distilled water.

Stage 2: 20ml diluted digest was measured into a distillation flask and held in place on hot plate. The distillation flask was attached to a Liebig condenser connected to a receiver containing 10ml of 2 % boric acid indicator. 40 mls NaOH was injected into the digest which became strongly alkaline, and heated to boiling and the distilled ammonia gas via the condenser into the receiver beaker. The color of the boric acid change from purple to green as ammonia distillate was introduced into the boric acid.

Stage 3: The distillate was titrated with standard 0.1 N HCl solution back to purple from greenish. The volume of HCl added to effect this change was recorded as titre value. Thus,

$$\% \text{ Organic Nitrogen} \quad \frac{\text{Titre value x 1.4 x 100 x100}}{1000 \text{ x } 20 \text{ x } 0.1}$$

Where 1.4 = Nitrogen equivalent to the normality of HCl used in the titration, 0.1N

100 = the total volume of digest dilution.

100 = percentage factor.

0.1 g of the sample

1000 = conversion from gram to milligram

20 = Integral volume of digits analyzed or distilled

0.1 = the weight of sample in gram digested

Carbohydrate (Cleg Anthrone Method)

0.1 g of the sample was weighed into a 25ml volumetric flask, 1ml distilled water and 1.3 ml of 62 % perchloric acid was added and stirred for a period of 20 minutes to homogenize completely. The flask was made up to 25ml mark with distilled water. The

solution formed was filtered through a glass filter paper or allowed to sediment and decanted. 1ml of the filtrate was collected and transferred into a 10 mls test tube which was diluted to volume with distilled water. 1ml of working solution was pipette into a clean test tube and 5 mls anthrone reagent was added. 1ml distilled water was added and 5mls anthrone reagent mixed. Similarly, the whole mixture read at 630nm wavelength using the 1ml distilled water and the 5 mls anthrone reagent prepared as blank. 0.1 ml glucose was also prepared and was treated as the sample with anthrone reagent.

Absorbance of the standard glucose was read and the value of carbohydrate as glucose was calculated as shown below:

$$\% \text{ CHO as glucose} = \frac{25 \times \text{absorbance of sample}}{\text{Absorbance of standard glucose} \times 1}$$

Moisture (Air Oven Method)

1 g of the sample was weighed into a clean dried porcelain evaporating dish. This was placed in an oven set at 105^0 C for 6 hours. The evaporating dish was cooled in the desiccator to room temperature and reweighed. Thus the calculation of % moisture was as shown below:

$$\% \text{ Moisture} = \frac{\text{Weight of fresh sample} - \text{Weight of dried sample}}{\text{Weight of sample used}} \times \frac{100}{1}$$

Lipid (Soxhlet Extraction Method)

2 g of sample was inserted into a filter paper and was placed into a soxhlet extractor. The extractor was placed into a pre-weighed dried distillation flask. Then the solvent (acetone) was introduced into the distillation flask via the condenser end attached to the soxhlet extractor. The set-up was held in place with a restored stand clamp, cooled water jet was allowed to flow into the condenser and the heated solvent was refluxed as a result. The lipid in the solvent chamber was extracted in the process of continuous refluxing. When the lipid was observably extracted completely from the sample, the condenser and the extractor were disconnected and the solvent was evaporated to concentrate the lipid. The flask was then dried in the air oven to constant weight and re-weighed to obtain the weight of the lipid as thus calculated below:

$$\% \text{ Lipid} = \frac{\text{Weight of flask and extract} - \text{Weight of empty flask}}{\text{Weight of sample extracted}} \times \frac{100}{1}$$

Ash (Furnace Method)

1 g of the dried sample was weighed into porcelain crucible which was previously preheated and weighed. The crucible was inserted into a muffle furnace set at 630^0 C for

3 hours and allowed to cool to room temperature and reweighed. Thus % ash was calculated as shown below:

$$\% \text{ Ash} = \frac{\text{Weight of crucible + Ash sample} - \text{Weight of crucible}}{\text{Weight of sample}} \times \frac{100}{1}$$

Crude Fibre

Crude fibre represents the insoluble, combustible organic residue which remained after a sample has been treated with light petroleum ether, dilute acid and alkali (19)

About 2 g of sample was extracted with petroleum ether (W_1). Sample was boiled under reflux for 30 minutes with 200 mls of dilute HCl and filtered. The residue was thoroughly washed with water until acid-free. The residue was transferred into a beaker and boiled for about 30 minutes with 200 mls of dilute NaOH solution, filtered and transferred into ignition crucible. The residue was washed 3 times with 20 mls ethanol and 2 times with 10ml ether. The residue dried in an oven and cooled and weighed (W_2). The dried residue was transferred into a furnace and ignited, cooled and weighed (W_3). Thus %crude fibre was calculated as shown below:

$$\% \text{ Crude Fibre} = \frac{W_2 - W_3}{W_1} \times \frac{100}{1}$$

RESULTS

The Geographic location

The geographic location of the parent plants is Port Harcourt, and Rivers State, Nigeria.

Macro-morphological Study

Plate 1a: *Musa paradisiaca* L. shoot. 1b: Plant bearing a bunch of plantain. Sometimes one plant may bear up to 2 bunches of plantain fruits at a time.

Table 1: Summary of morphological characteristics of *Musa paradisiaca* L.

Characters	
Habit	Evergreen herb.
Duration	perennial
Root	Fibrous Root system from rhizomes
Stem Description	Gray brownish, fleshy and gigantic herbs
Leaf type	Simple
Leaf organization	Simple and petiolate
Phyllotaxy	Spiral arrangement
Leaf outline or shape	Four to five times as long as wide, elliptic to lanceolate with acuminate apex and cuneate base.
Leaf margin	Even or smooth
Length of leaf (cm)	about 120 cm long
Range	60 to 120 cm long
Mean	85 ± 25 cm long
Breadth of leaf (cm)	About 45 cm wide
Range	15 to 45 cm wide
Mean	30 ± 15 cm wide
Flower description	axillary flowers suspended on large spathaceous bracts
Fruit description	Long berry fruit bearing numerous non-fertile seeds.

Micro-morphological studies

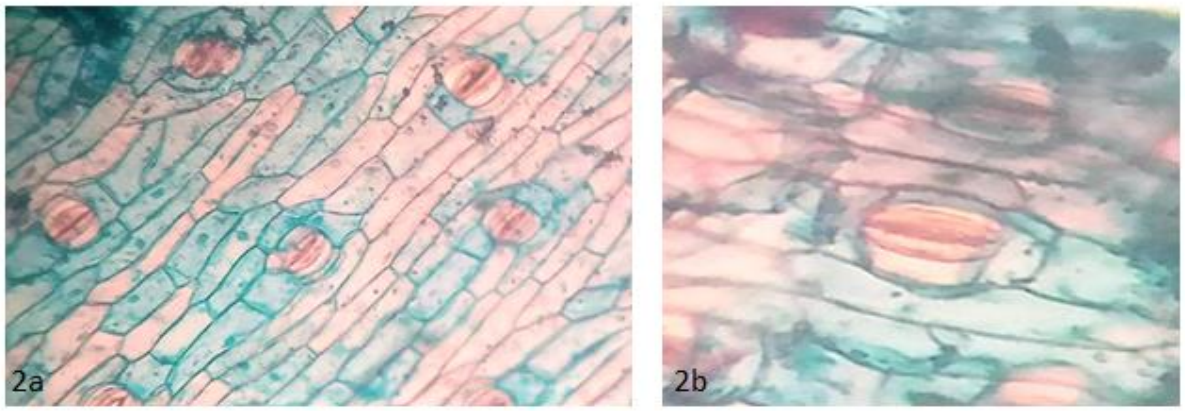

Plate 2a: *Musa paradisiaca abaxial* epidermis; 2b: *M. paradisiaca adaxial* epidermis.

Stomata are tetracytic and amphistomatic, more in the abaxial than the adaxial surface.

Anatomical Studies

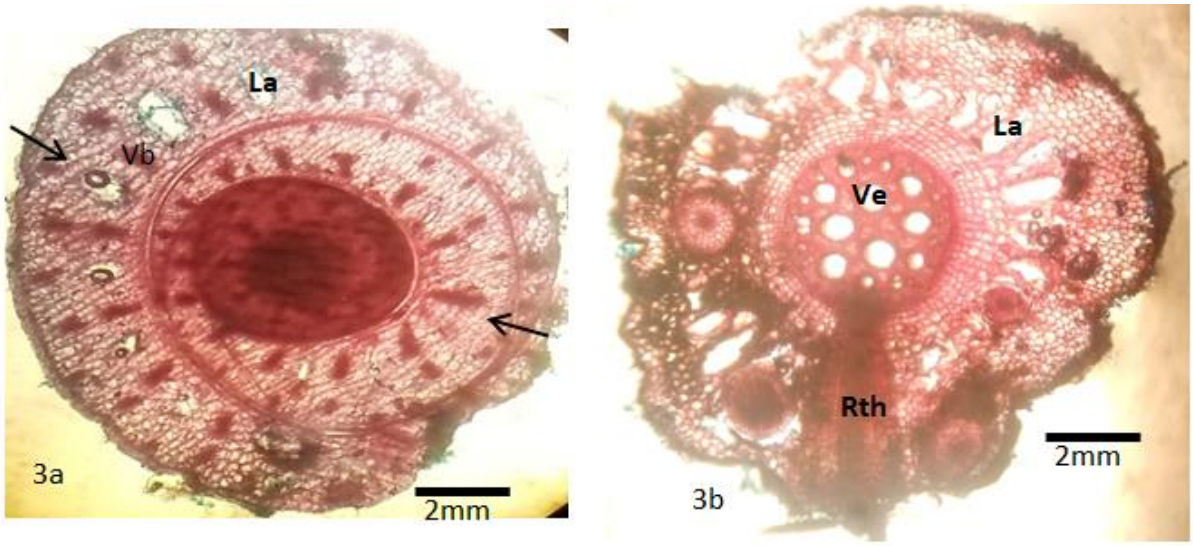

Plate 3a: *Musa paradisiaca* stem anatomy T.S.; 3b: *M. paradisiaca root section* T.S. Vb represents vascular bundle, Ve stands for vessel elements, arrow indicate stem formed by imbricate bases of petioles in erect structure forming a sort of spiral arrangement. Cell structure usually filled with tanniferous sap. La represents Lacuna, Rth stands for root hair from pericycle.

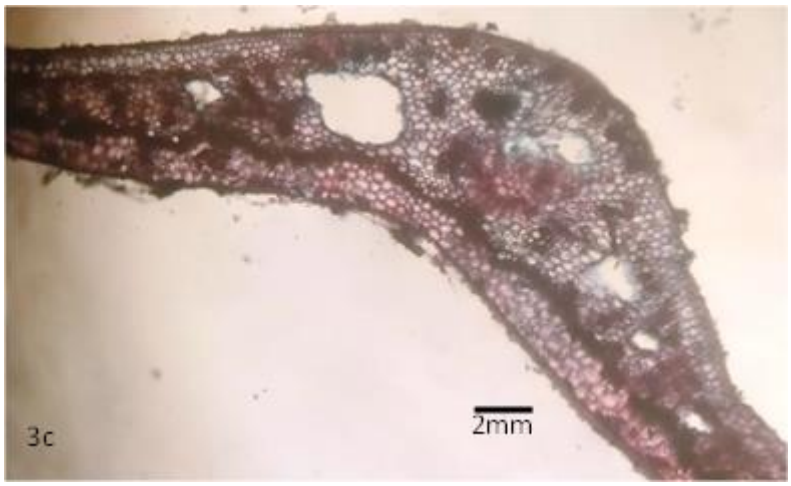

Plate 3c: *Musa paradisiaca* mid-rib anatomy T.S.

Qualitative Phytochemical Studies

The qualitative phytochemical investigations conducted revealed presence of the following: saponins, alkaloids, flavonoids, tannins, cyanogenic glycosides, phenols, terpenoids, and steroids.

These are shown in table 2.

Table 2: Qualitative Phytochemical Studies on *Musa paradisiaca* L.

Phychemicals tested in *M. paradisiaca*	Result
Saponins	+ve
Alkaloids	+ve
Tannins	+ve
Phlobatannins	+ve
Cyanogenic glycosides	+ve
Phenol	+ve
Flavonoids	+ve
Terpenoids	+ve
Steroids	+ve

Key: '+ve' revealed 'presence' while '–ve' showed 'absence'

Proximate Analysis

Table 3: Quantitative Chemical Estimations on *Musa paradisiaca* L using the unripe fruit.

Parameters	*M. paradisiaca* L.
% Carbohydrate	36.38 mg/Kg
% Proteins	2.63 mg/Kg
% Lipid	1.30 mg/kg
% Ash	1.09 mg/Kg
% Moisture	56.13 mg/Kg
% Fibre	2.47mg/Kg

DISCUSSION

Anatomical section of stem showed clearly that the stems are formed by the imbricates bases of the petioles, as supported by the work of (2). The micro-morphological study revealed tetracytic stomata on both sides of the leaf surfaces which is in consonance with the report of (4). It has been reported that extracts of the flower possess bioactive properties for remedying *diabetes mellitus*, anemia (8) and malaria (9) this may be true due to the fact that the most important phytochemicals investigated in *Musa paradisiaca* prove to be present in the plant including phenolic compounds which are the largest

group of phytochemicals and accounted for most of the antioxidants activities in plants or plants products which is in line with the research investigation conducted by (10).

CONCLUSION

Musa spp. Serve as good sources of food. The unripe bunches of fruits of *Musa paradisiaca* serve as remedy for diabetic patients and lots more. More research using the rhizomes, roots and fibre content should be encouraged for proper exploitation of the genus, not just limited to *Musa paradisiaca.*

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