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Pharmacognostic, Physicochemical and Phytochemical Profiles of *Euclea racemosa* (Ebenaceae)

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ABSTRACT

Background: *Euclea racemosa*, a member of the Ebeneceae family, has a long-established tradition of being used medicinally across several African nations to address diverse health issues. However, despite its recognized therapeutic benefits, there exists a notable lack of published information concerning its pharmacognostic, physicochemical, and phytochemical characteristics. Aims and Objectives: Therefore, the objective of this study was to assess the pharmacognostic, physicochemical, and phytochemical attributes of *E. racemosa*. Materials and Methods: Pharmacognostic evaluation involved assessing the organoleptic properties, macroscopy, and microscopy of leaves, stems, and roots. Standard methods were employed to determine various physicochemical parameters, including loss on drying, aqueous and alcohol extractive values via hot and cold maceration, and total ash content. Additionally, standard protocols were adopted to screen for phytochemicals in the root aqueous extracts of *E. racemosa*. Results and Conclusion: Results revealed that *E. racemosa* leaves exhibited light green coloration with a lamina length ranging from 92.5 to 95.5 mm and a lamina width of 23.4 to 26.9 mm. They emitted a non-distinct odor and exhibited bitterness and mucilaginous properties. Macroscopic examination highlighted opposite phyllotaxy, simple leaf types, obtuse leaf apexes, cuneate leaf bases, entire leaf margins, and smooth leaf surfaces. Venation displayed a reticulate pattern, with the midrib prominently visible on the lower surface. Microscopic analysis of the lower leaf epidermis showed an average stomatal cell density of 4.0 cells per square millimeter, an average epidermal cell density of 27±1.41 cells per square millimeter and stomatal Index of 14.87±0.66. Microscopic examination of *E. racemosa* leaf lamina, stem cross-sections, and root cross-sections revealed consistent structural features, including cortical parenchymal cells containing calcium oxalate crystals, lignified xylem, and non-lignified phloem in leaves, and single-layered cells forming the epidermis, secondary phloem, secondary xylem, and pith in stems. The moisture content of *E. racemosa* was measured at 42.5±0.17%. Cold maceration yielded water-soluble extractive values of 12.9±0.3%, while hot maceration produced values of 20.8±0.37%. For alcohol-soluble extracts, cold maceration resulted in 0.4±0.08%, and hot maceration in 15.5±0.78%. The total ash content was determined to be 5.52±0.34%. Qualitative phytochemical screening detected the presence of anthraquinone glycosides, coumarine glycosides, saponin glycosides, flavonoids, proteins, and tannins in abundance, with moderate levels of sugars. Alkaloids, cardiac glycosides, and steroids were not detected. This research contributes to the pharmacognostic standardization of E. racemosa, providing essential parameters for compiling monographs, aiding in plant identification, preventing adulteration, and ensuring therapeutic effectiveness.

Keywords: Ebenaceae, *Euclea racemosa*, Ethnobotanical information, Elgeiyo-Marakwet County.

INTRODUCTION

The Ebenaceae family commonly known as ebony comprises a diverse group of flowering plants primarily dispersed throughout the earth's tropical regions [1]. The members of the Ebeneceae family are classified into four main genera: *Euclea L., Diospyros L., Lissocarpa L., and Royena L*. [2]. There are sixteen recognized species in the genus Euclea, which are found worldwide, tropical and subtropical areas restricted to Africa including the Comoro Island, Arabia, Socotra and the and South East Asia [1]. Traditionally, species within the genus Euclea have been utilized for various ailments such as skin wounds, scabies, leprosy, tinea capitis, acne, warts, rheumatic pain, elephantiasis, milk curdling prevention, dental infections, eye conditions, headaches, spasms, and constipation [1]. The majority of Euclea species are concentrated in Eastern and Southern Africa [2]. *Euclea divinorum's* distribution spans across Botswana, South Africa, Namibia, Swaziland, Zimbabwe, Tanzania, Uganda, Sudan, Kenya, and Ethiopia [3]. *E. natalensis* is predominantly found along the eastern coast of southern Africa, whereas *E. latideus* primarily inhabits lowland tropical regions and, to a lesser extent, subtropical areas globally, as noted in [4]. *E. racemosa* is found in Kenya, Tanzania, Uganda, Ethiopia, Egypt, South Africa, and also on the Arabian Peninsula and Comoros [5].

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Figure 1 depicts the image of the aerial parts of *E. racemosa* plant. This evergreen, extensively branched species can grow as a small shrub, reaching about 1.8 meters in height, or as a moderate-sized tree, reaching up to 12 meters tall. Besides its ecological significance as a source of wood and edible fruits, *E. racemosa* like other *Euclea* species holds significant medicinal value in African traditional medicine systems. Various plant parts, including the bark, leaves, and roots, have been employed for centuries to treat various ailments and conditions [5], such as constipation management [6]. Given the widespread traditional medicinal uses of this plant, the primary aim of this study was to assess its pharmacognostic, physicochemical, and phytochemical characteristics.

Figure 1: Photograph of *E. racemosa* plant (Pictured by Z. K. Rotich)

MATERIAL AND METHODS

Chemicals and solvents

All chemicals, solvents, and reagents utilized were of analytical grade.

Plant material collection and identification

With the assistance of an experienced herbalist, fresh leaves and roots of *E. racemosa* were collected from Cheptebo in Elgeiyo Marakwet County, Kenya (Figure 2; coordinates: 0˚32'01.1˝N 35˚33'12.6˝E). Subsequently, these plant samples were transported to the East Africa Herbaria situated at the National Museums of Kenya for identification and authentication. Following its examination, the plant was confirmed to be *Euclea racemosa* subspecies *Schimperi* (A. DC.) F. White (Family: Ebenaceae) and was assigned the voucher specimen number: NMK/BOT/CTX/2/ID/14//2023.

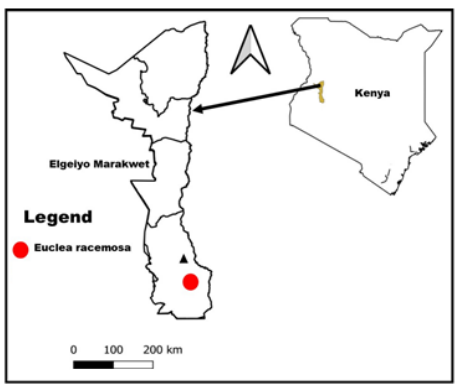

Figure 2: Geographical site map

Plant material processing and aqueous extraction

Following the collection and authentication of plant specimens, the roots were air-dried for two weeks at the Chemistry and Biochemistry laboratories of Moi University, Kenya. Afterward, the dried roots were ground into a fine powder using an electric plant mill and stored in labeled airtight plastic containers in the laboratory.

For phytochemical extraction, the maceration method was employed [7]. Powdered plant samples were soaked in distilled water at a ratio of 1g of sample to 4 ml of water in tightly sealed conical flasks for 72 hours. Subsequently, the extracts were filtered using 0.45 µm filter paper, followed by lyophilization using a freeze dryer [8]. A Harvest Right Medium Home PRO Freeze Dryer, operating at 1350 psi vacuum pressure and maintained at 22.22°C, was utilized to completely dry the extracts [9]. The dried extracts were then stored in a refrigerator at 4 ℃ for future experiments.

Evaluation of Pharmacognostic Profiles of *E. racemosa*

Pharmacognostic properties namely organoleptic properties, macroscopic, qualitative and quantitative microscopy were determined following standard methods.

Determination of Organoleptic Attributes of E. racemosa

The sensory assessments of *E. racemosa* were conducted in accordance with the WHO Quality Control guidelines for herbal medicine evaluation [10]. The various organoleptic attributes assessed encompassed the color, size, odor and taste parameters.

Determination of Macroscopic Attributes of E. racemosa

Macroscopic assessments of *E. racemosa* were conducted in accordance with the WHO Quality Control guidelines for herbal medicine evaluation [11]. The various macroscopic attributes assessed encompassed shape, markings, base, texture, veins, and apex characteristics.

Determination of Microscopic Attributes of E. racemosa

Microscopic examinations were conducted in accordance with the techniques outlined by Musharaf and colleagues [12], with slight adjustments. Thin transverse and longitudinal sections of the leaves, stem, and root specimens were prepared using a sharp blade, followed by treatment with a chloral hydrate solution for clearing and staining with phloroglucinol-hydrochloric acid [1:1] before mounting in glycerin. Observations under the microscope were carried out using a Penta Head Microscope/Multi-view Head Microscope (EUROPE) at × 100 magnifications, and photomicrographs were captured using the Top View digital camera. Qualitative microscopic analysis was conducted on transverse and longitudinal sections of the leaves, stem, and root of *E. divinorum* to determine various characteristics of the plant such as the presence or absence of epidermal cells, stomata type, and distribution. Additionally, quantitative microscopic analysis of the leaves involved determining the stomatal number (stomatal density) and stomatal index, calculated as the average number per square millimeter of leaf epidermis.

Evaluation of Physico-chemical Parameters of *E. racemosa*

Standard methods were used to evaluate for various physico-chemicals parameters of the plant, namely loss on drying, extractive values by hot and cold maceration, and total ash values [13].

Determination of moisture lost on drying

The moisture content of E. racemosa was assessed using the gravimetric method, following standard procedures [14]. Initially, a preheated tarred thin porcelain crucible was weighed, and its weight with the lid was recorded as W1 grams. Next, 100 grams of the dried powdered E. racemosa sample (W_2 grams) was placed into the crucible. The sample was then subjected to drying in an oven at 105°C until two consecutive weights did not differ by more than 0.5 mg. Subsequently, the sample was cooled in a desiccator, and its mass was determined as W_3. The moisture content was calculated using the formula: % moisture = $[(W_2 - W_3) / (W_2 - W_1)] \times 100$; where $(W_2 - W_3)$ represents the weight of moisture and $(W_2 - W_1)$ represents the weight of the sample.

Determination of extractive values

To assess the extractable components of *E. racemosa*, both alcohol-soluble and water-soluble extracts were analyzed using cold and hot maceration techniques, as outlined in established protocols [14].

In the cold maceration method for alcohol-soluble extractive value, 4.0 g of finely ground *E. racemosa* sample was combined with 100 mL of 90% ethanol in a dry 250 mL conical flask. After sealing the flask, it was left to stand for 24 hours with occasional agitation. The resulting solution was filtered, and 25 mL of the filtrate was evaporated to dryness. The percentage of alcohol-soluble extractive value was then calculated using the formula: Alcohol-soluble extractive value (w/w%) = 100 (x), where x represents the weight (g) of the dried matter obtained from the 25 mL extract.

For the hot maceration method, the same procedure was followed, but the mixture underwent gentle refluxing for one hour before filtration. Similarly, in the cold maceration approach for water-soluble extractive values, 4.0 g of the sample was macerated with 100 mL of chloroform water for 24 hours. The resulting filtrate was treated in the same manner as the alcohol-soluble extractives obtained through cold maceration.

For the hot maceration of water-soluble extractives, the sample was refluxed for one hour before filtration, followed by the same process as the cold maceration method. The percentage of water-soluble extractive values was determined using the identical formula employed for alcohol-soluble extractive values.

Total ash content

The total ash content of E. racemosa was determined following standard protocols [14]. Initially, a thin porcelain dish was weighed and then ignited. Next, 2.0 grams of powdered E. racemosa were added to the dish. The dish was then heated using a burner positioned on a pipe-clay triangle and a ritort support. After complete incineration, the contents were allowed to cool in a desiccator. The resulting ash was weighed, and the total ash content was calculated using the formula: Total ash content of the sample = (100(z - x))/y%; where x represents the weight of the empty dish, y is the weight of the drug taken, and z indicates the weight of the dish plus the ash after complete incineration.

Preliminary phytochemical screening of *E. racemosa*

Standard phytochemical methods were employed to screen the aqueous extracts for various compounds, including alkaloids, glycosides (such as anthraquinone, cardiac, coumarin, cyanogenetic, and saponin), steroids, tannins, carbohydrates, proteins, and flavonoids [11, 15].

Screening for alkaloids – the Dragendorff's test

To determine the presence of alkaloids in the aqueous root extract of *E. racemosa*, the powder acquired from aqueous extraction was mixed with HCl and filtered. Afterward, a few drops of Dragendorff's reagent were added to 2 to 3 mL of the filtrate. The emergence of an orange-brown precipitate indicated a positive outcome.

Screening for anthraquinone glycosides – the Bornträger's test

After mixing the plant extract with chloroform and filtering it, the resulting filtrate was agitated with a 10% ammonia solution. Detection of anthraquinones was indicated by the emergence of a pink, red, violet, or purple hue in the ammoniacal layer.

Screening for cardiac glycosides - the Keller-Killiani tests

In this procedure, 2ml of the plant extract was mixed with glacial acetic acid containing a small quantity of ferric chloride solution. Subsequently, a drop of 5% concentrated sulfuric acid was added. The emergence of a brown ring at the boundary between the two layers, which gradually changed to a violet or bluish-green hue, signaled the presence of cardiac glycosides.

Screening for coumarin glycosides

The desiccated plant extract powder was introduced into a test tube and moistened. A filter paper soaked in diluted sodium hydroxide was positioned on top of the test tube, which was subsequently immersed in a water bath. After a period of time, the filter paper underwent exposure to ultraviolet light, displaying a yellowish-green fluorescence, indicative of the presence of coumarins.

Screening for saponin glycosides – the honey comp test

1 gram of the sample was measured and placed into a conical flask. Then, 10 mL of distilled water was added, and the mixture was boiled for 5 minutes. Subsequently, the resulting mixture was filtered, and 2.5 mL of the filtrate was withdrawn. This portion was then mixed with 10 mL of distilled water and vigorously shaken for approximately 30 seconds. The confirmation of saponins was indicated by the formation of frothy honeycomb structures.

Screening for flavonoids – the Shinoda test

Dry powder from the extract was combined with 5 mL of 95% ethanol/t-butyl alcohol, along with a few drops of concentrated HCl and 0.5 grams of magnesium turnings. The emergence of colors

spanning from orange to pink, red, and purple indicated the presence of flavonoids.

Screening for proteins – the Biuret's test

A volume of 3 mL from the test solution was introduced into 4% sodium hydroxide along with a few drops of 1% copper (II) sulfate solution. The appearance of a violet or pink color is indicative of a positive result.

Screening for sugars – the Barfoed's Test

The plant extract was combined with Barfoed's reagent, consisting of copper acetate dissolved in acetic acid, and heated in a boiling water bath for 1-2 minutes, then allowed to cool. The presence of monosaccharides was confirmed by the appearance of a brick-red precipitate within 3 to 4 minutes.

Screening for steroids

A volume of 2 mL of the extract was combined with 2 mL of chloroform and 2 mL of concentrated sulfuric acid. Upon thorough shaking, the emergence of a red color in the chloroform layer and a greenish-yellow fluorescence in the acid layer indicates a positive result for steroids.

Screening for tannins - ferric chloride test

A mass of 1 gram of the extract was mixed with 10 mL of distilled water, filtered, and then 1 mL of a 5% ferric chloride solution was added to the filtrate. The presence of tannins was revealed by the formation of a blue-black, green, or blue-green precipitate.

RESULTS

Pharmacognostic Characteristics of *E. racemosa*

Organoleptic Properties

The sensory characteristics of *E. racemosa* leaves are outlined in Table 1. The leaves appeared light green, and measured between 92.5 - 95.5 mm in length and 23.4 - 26.9 mm in width. They emitted a faint odor and exhibited both bitter and mucilaginous properties.

Macroscopic Properties

Figure 3 shows the morphological structure of *E. racemosa* leaf. The results for macroscopic examination were tabulated in Table 2. Opposite phyllotaxy was noted, accompanied by some alternate leaf types characterized as simple. The leaf apex exhibited obtuse angles, while the leaf base appeared cuneate. The leaf margin was observed to be entire, and the surface texture was smooth. Venation displayed a reticulate pattern, with the midrib prominently visible on the lower surface.

Figure 3: Morphological structure of *E. racemosa* leaf (Z. K. Rotich)

Microscopic evaluations

Figure 4 displays the photomicrograph obtained from the microscopic analysis of the lower leaf epidermis, which aided in deriving the leaf constants detailed in Table 3 (quantitative microscopy). Additionally, qualitative microscopic examinations of the Transverse Sections (T.S.) across the midrib of the leaf lamina, the stem, and the root resulted in the photomicrographs presented in Figures 5, 6, and 7, respectively. Figure 8 illustrates the photomicrographs depicting the Longitudinal Section (L.S.) of the *E. racemosa* root.

The microscopic investigation of the lower leaf epidermis of *E. racemosa* revealed stomatal density of 4.0, epidermal cells of 27±1.41 and stomatal index of 14.87±0.66 all expressed as number of specific cells per square millimeter. Furthermore, examination of the T.S. of the leaf lamina across the midrib unveiled cortical parenchymal cells containing calcium oxalate crystals, lignified xylem, and non-lignified phloem (Figure 5). Both the T.S. and L.S. microscopy of the stem (Figures 6 and 8) exhibited single-layered cells comprising the epidermis, secondary phloem, secondary xylem, and pith. Similar structures observed in the stem were also evident in the T.S. microscopy of the roots (Figure 7).

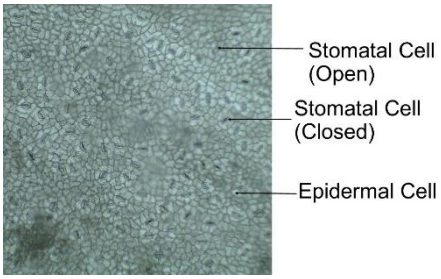

Figure 4: Photomicrograph of leaf of *E. racemosa* showing abaxial (lower) surface (Z. K. Rotich)

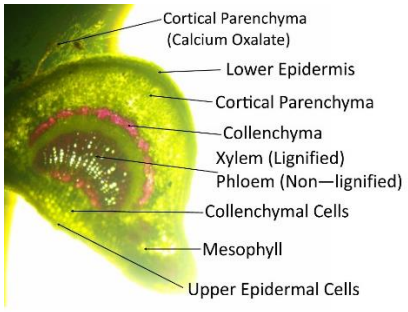

Figure 5: Photomicrograph showing the T. S. of *E. racemosa* leaf lamina across the midrib 100x (Z. K. Rotich)

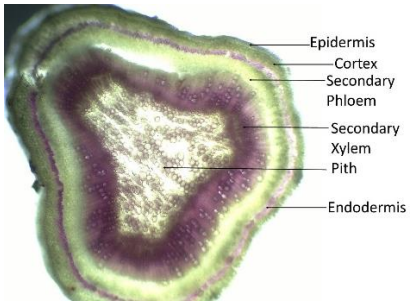

Figure 6: Photomicrograph showing the T. S. of *E. racemosa* stem 100x (Z. K. Rotich)

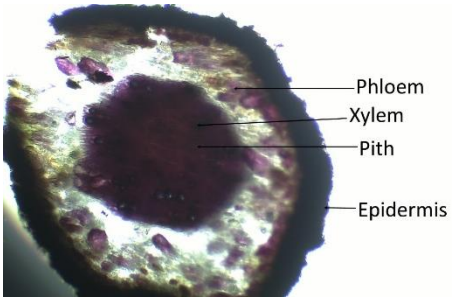

Figure 7: Photomicrograph showing the T. S. of *E. racemosa* root 100x (Z. K. Rotich)

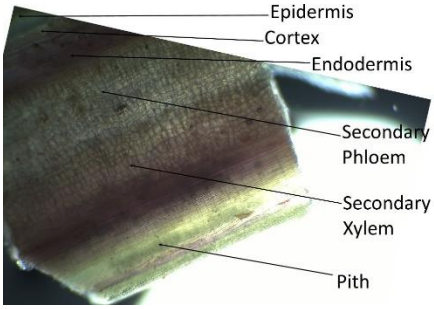

Figure 8: Photomicrograph showing the L. S. of *E. racemosa* root 100x (Z. K. Rotich)

Physico-chemical Parameters of *E. racemosa*

Moisture content

The results for moisture content (loss on drying, LOD) are depicted in Table 4. The moisture content was found to be 42.5±0.17%.

Extractive values

Table 5 summarizes the findings for extractive values obtained through both hot and cold maceration methods. The water-soluble extractive value was determined to be 12.9±0.3% for cold maceration and 20.8±0.37% for hot maceration. Conversely, the alcohol-soluble extractive value was measured at 0.4±0.08% for cold maceration and 15.5±0.78% for hot maceration.

Total ash content

Table 6 displays the findings regarding the determination of the total ash value. The total ash value was obtained to be 5.52±0.34%.

Preliminary Qualitative Assessment of Phytochemical of *E. racemosa*

The outcomes of the qualitative assessment of phytochemicals of *E. racemosa* are presented in Table 7. Abundant presence of anthraquinone glycosides, coumarin glycosides, saponin glycosides, flavonoids, proteins, and tannins was observed. Sugars were moderately present. However, alkaloids, cardiac glycosides, and steroids were not detected.

Table 1: Organoleptic Properties of *E. racemosa* Leaf

Organoleptic property	**Leaf characteristics**
Color	Light green
Lamina size	Length: 92.5 - 95.5 mm; Width: 23.4 - 26.9 mm
Odour	Non-distinct
Taste	Bitter and mucilaginous

Table 2: Macroscopic Properties of *E. racemosa* Leaf

Macroscopic property	**Leaf characteristics**
Phyllotaxy	Opposite with some alternate
Leaf type	Simple leaf
Leaf apex	Obtuse
Leaf base	Cuneate
Margin	Entire
Surface texture	Smooth
Venation	Reticulate
Midrib	Provident on the lower surface

Table 3: Quantitative leaf microscopy of *E. racemosa*

No of stomata (S)/ sq. mm	**No of epidermal cells (E+S)/ sq. mm**	**Stomatal Index = 100S/(E+S)**
4	25	16.0
4	28	14.3
4	28	14.3
Average = 4.0	Average = 27±1.41	Average =14.87±0.66

Table 4: Loss on drying (moisture content) of *E. racemosa* root

Weight of sample (S) $(W_2 - W_1)$ **g**	**Weight of moisture** $(W_2 - W_3)$ **g**	**% moisture =** $(W_2 - W_3)/(W_2 - W_1)x100$
S_1= 100	42.4	42.4
S_2= 100	42.3	42.3
S_3= 100	42.7	42.7
Average = 100	Average = 42.5±0.17	Average =42.5±0.17

Table 5: Extractive values of *E. racemosa* root

Experiment	**Replicates**	**Water-soluble extractive value (%)**	**Alcohol-soluble extractive value (%)**
Cold maceration	1	12.9	0.4
	2	13.3	0.3
	3	12.5	0.5
	Average	12.9±0.3	0.4±0.08
Hot maceration	1	20.4	15.5
	2	21.3	16.2
	3	20.8	14.9
	Average	20.8±0.37	15.5±0.78

Table 6: Total ash content of *E. racemosa* root

Initial mass of sample (g)	**Final mass (ash)**	**Total ash content (%)**
2.0	0.113	5.65
2.0	0.117	5.85
2.0	0.101	5.05
Average	0.11± 0.01	5.52± 0.34

Table 7 Preliminary Phytochemical Screening of *E. racemosa*

Phytochemical class	**Specific test**	**Result**
Alkaloids	Dragendoffr's test	-
Anthraquinone glycosides	Borntrager's test	+++
Cardiac glycosides	Baljet's test	-
Coumarine glycosides	Feric chloride test	+++
Saponin glycosides	Foam test	+++
Flavonoids	Alkaline test (general test)	+++
Proteins	Biurets test	+++

Sugars	Barfoeds test (monosaccharides)	++
Steroids	Salkwolski test	-
Tannins	Ferric chloride test	+++

DISCUSSION

The sensory attributes of plants, such as odor, taste, and appearance, are shaped by their chemical composition, including compounds like alkaloids and flavonoids. In the case of *E. racemosa*, its leaves exhibited a non-distinct odor, which could be attributed to the absence of alkaloids, while they were found to be bitter and mucilaginous.

Macroscopic examination of *E. racemosa* revealed several features. The arrangement of leaves, known as phyllotaxy, was observed to be opposite with some alternate, resembling a whorl or verticillate pattern. Additionally, the leaves were simple, dorsiventral, and displayed a light green color. These macroscopic characteristics, outlined in Table 1, align with descriptions found in literature for Diospyros and Euclea species [1].

Microscopic examination of the lower epidermis leaf revealed that the anticlinal walls exhibit various patterns such as straight, curved, or undulating. Additionally, each stoma typically consists of four to six guard cells, mirroring the characteristics of the surrounding epidermal cells. This configuration, known as the anomocytic state or ranunculaceous type, aligns with findings documented in literature for *Diospyros* and *Euclea* species [1].

Based on quantitative leaf microscopy findings, E. racemosa exhibited an average stomatal density of 4.0 and the epidermal cell density was found to be 27±1.41. This translated to a stomatal index of 14.87±0.66 all expressed as number of specific cells per square millimeter. Notably, there are no recorded literature values for leaf constants specific to *E. racemosa*. However, this stomatal index is by far lower than that reported in literature [16] for a related genus *Diospyros linnaeus* ranged from 256.42 to 306.70 per sq mm.

With respect to, the leave size of *E. racemosa,* it was observed that the lamina length ranged from 92.5 to 95.5 mm and the width ranged from 23.4 to 26.9 mm. This indicates that *E. racemosa* leaves are comparatively larger than those of *E. divinorum*, which have been reported to typically measure between 35 to 90 mm in length and 10 to 25 mm in width [17].

The moisture content of *E. racemosa* root was measured at 42.5±0.17%. This value was found to be 22 times higher than for the root of a related genus *Diospyros villosa*, reported in literature to be 1.93 ± 0.04% [18].

Total ash value is a crucial parameter for evaluating the purity and quality of herbal drugs or plant extracts. It reflects the plant's mineral content, impacting therapeutic properties, stability, and safety. While variations due to geography and seasonality are expected, total ash values generally fall within a specific range. Deviations may signal adulteration, contamination, or improper processing of herbal products. Although the *E. racemosa* root's total ash value was discovered to be 5.52±0.34% in this research, there was no available documentation of these ash values in literature. However, the *E. racemosa* fruit has been observed to have a maximum ash concentration of 12.8% ± 0.37 [19]. The total ash content of *E. divinorum* is higher than that of *D. villosa* (Ebeneceae), which has been determined to be 1.93 ± 0.04%.

The results for qualitative phytochemical screening of the aqueous root extract of *E. racemosa* revealed the presence of glycosides (anthraquinone, coumarines, and saponins), polyphenols (flavonoids), tannins and proteins. The root aqueous extract of *E. racemosa* yielded negative results for cardiac glycosides, steroids and alkaloid screening tests conducted. The present study's results corroborated those of Ayele and colleagues, who found that terpenes, saponins, flavonoids, and phenols were present in the root aqueous extract of *E. racemosa* L. but alkaloids and steroids were absent [6]. The results also revealed a number of the phytochemicals are commonly found in various species under the genus Euclea. Analysis of aqueous root extract of *E. divinorum* has shown the presence of polyphenols (flavonoids), saponins, glycosides, tannins, and terpenoids [20]. Similarly, the result of phytochemical screening of methanolic extracts of *E. schimperi* leaves showed the presence of polyphenols (flavonoids), saponins, tannins and terpenoids [20].

In contrast to the observed absence of steroids and alkaloids in the aqueous root extract of *E. racemosa,* the methanolic extracts of *E. schimperi* leaves showed the presence of steroids, while the n-hexane, DCM, and ethanol extracts of leaves, stem, root bark and roots of *E. divinorum* gave a positive test for alkaloids [2]. Additionally, methanol leaf and stem extracts of *E. undulata* and *E. crispa* showed the presence of alkaloids [21].

The presence of anthraquinone glycosides in *E racemosa* aqueous root extract supports the use of *E. racemosa* as a laxative in folkloric medicine [2]. The available ethnobotanical information of *E. racemosa* documents its use in the management of skin conditions of mycotic origin, which can be attributed to the presence of quinones [22, 23].

CONCLUSION

The current research has generated the most relevant diagnostic characters to identify leaves of *E. racemosa* and have potential applications in quality control procedures pertaining to this medicinal plant.

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Conflict of interest

There is no conflict of interest.

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None declared.

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