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Phytochemical, antioxidant and antimicrobial profiles of selected Nigerian plants locally used for skin care

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Abstract

Skin disorders are significant public health concerns worldwide, as they can lead to profound long-term changes even after the disease has been treated. This study presents the results of the investigation of the phytochemical composition, antimicrobial, and antioxidant properties of selected Nigerian plants (Peperomia pellucida and Euphorbia hirta) utilized in traditional skin care practices. Tests to determine the classes of phytochemicals in the selected plant extracts were carried out using standard procedures. Antimicrobial assay was conducted using the disc diffusion method to determine the zone of inhibition of the extracts against Staphylococcus aureus and Escherichia coli. Antioxidant activities of the plant extracts were characterized using 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay, and the specific bioactive compounds present in the extracts were screened and identified using gas chromatography-mass spectrometry (GC-MS). Data obtained showed different classes of phytochemicals in the investigated extracts. Alkaloids, flavonoids, tannins, phenolic compounds, and saponins were identified in the ethanol extract of Euphorbia hirta (whole). These classes of phytochemicals, with the exception of flavonoids, were also identified in Peperomia pellucida (whole). Euphorbia hirta (whole) extract showed a relatively stronger antimicrobial activity against Staphylococcus aureus and Escherichia coli at 1000 mg/ml, compared to Peperomia pellucida (whole) extract, which showed little activity against S. aureus and E. coli at 250 mg/ml and 500 mg/mL, respectively. Both Peperomia pelluicda (whole) and Euphorbia hirta (whole) extracts exhibited strong antioxidant activity at the concentration of 3 mg/ml and 1 mg/ml, respectively. The most bioactive compounds that were abundant in Peperomia pellucida (whole) include 9, 12, 15-Octadecatrienoic acid, methyl ester (24.55 %), and 9, 12-Octadecadienoyl chloride (21.15 %), and in Euphorbia hirta (whole) include Glycerin (92.44 %) and Hentriacontane (2.10 %).

Keywords: Antimicrobial, Antioxidants, Flavonoids, Phenolic compounds, Phytochemical, Plants, Skin care

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1. Introduction

Skin diseases are common health problems worldwide and are the leading causes of the global disease burden. They can lead to profound long-term changes even after the disease has been resolved, affecting not only the physical health but also the mental health and quality of life of the patient, placing a high burden on patients' families and national healthcare systems globally (Ewurum et al, 2022). Skin disorders are a significant public health concern in Nigeria, particularly among vulnerable populations such as school children (Noites et al, 2023). Environmental factors and microbial infection are one of the main causes of these disorders, increasing their prevalence (Sanclemente et al, 2017). Microbial infections are among the most common etiological factors, involving a range of pathogens including bacteria, viruses, fungi, and parasites. Notably, "*Staphylococcus aureus*" and "*group A β-hemolytic streptococci*" are frequent bacterial culprits leading to conditions such as impetigo and folliculitis (Ibrahim, 2020). *Escherichia coli* (*E. coli*), traditionally recognized for its role in gastrointestinal infections, has emerged as a significant pathogen in skin diseases, particularly in cases of skin and soft tissue infections (SSTIs) (Hammond et al., 2021). These infectious agents can lead to both primary infections on healthy skin and secondary infections on compromised surfaces (Aly, 2011). Travelers also face unique risks regarding skin infections when exposed to diverse environmental factors. Common travel-related pathogens include bacteria leading to cellulitis or other unspecified infections, dermatophytes responsible for fungal conditions like tinea pedis, and parasitic infestations such as scabies (Hochedez et al., 2008).

The skin is the largest organ in the body, and there are numerous factors that are related to skin health, including nutrition, lifestyle choices, and skin care (Giménez Martínez et al., 2025). Skin care is an essential aspect of personal health and well-being, as it not only affects physical appearance but also influences psychological and social factors (Zhang et al., 2020). Comprehensive skin care routines have been shown to impact skin chemistry and the microbiome, potentially leading to improved skin health (Bouslimani et al., 2019). A recent study highlighted that personal skin care products (such as deodorants, foot powder, face lotion, and moisturizer) effects could last for weeks and produce highly individualized responses, including alteration in steroid and pheromone levels as well as in bacterial and archaeal ecosystem and structure (Bouslimani et al., 2019). While the cosmetic industry often promotes multi-product regimens, there is a growing body of research that scrutinizes the efficacy of these practices (Zhang et al, 2020). Studies reveal that using a relevant daily skin care routine demonstrates visible skin benefits over a short period of time, such as prevention of aging signs and wrinkle reduction (Messaraa et al., 2020).

The study of phytochemical, antioxidant, and antimicrobial profiles of selected Nigerian plants, specifically *Peperomia pellucida* (common name - Pepper elder) and *Euphorbia hirta* (common name - snake weed), is essential in understanding their potential applications in skin care. These plants have been traditionally utilized in various cultures for their therapeutic properties; however, scientific validation of their efficacy remains limited. Investigating the bioactive compounds present in these species can provide insights into their pharmacological potential and support the development of natural skincare products.

Peperomia pellucida (L.) Kunth, also referred to as shiny bush or pepper elder, is an herbaceous plant classified within the family Piperaceae, which encompasses a diverse range of angiosperms. It is found in places such as Indonesia, Nigeria, the Philippines, India, Brazil, and other countries (Ahmad et al., 2023). It is known to treat diseases like rheumatic pain, skin sores and lesions, eczema, abdominal pain, convulsion, kidney problems, diarrhoea, dysentery, headache, and fever (Alves et al., 2019; Silalahi, 2022). It also helps with the reduction of blood cholesterol and has wound healing properties (Alves et al., 2019; Silalahi, 2022). It possesses different pharmacological properties such as antimicrobial, anti- inflammatory, anti-diabetic, analgesic, antioxidant, and anticancer properties (Ahmad et al., 2023; Alves et al., 2019; Silalahi, 2022).

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Euphorbia hirta (E. hirta) L., known as snake weed or asthma weed, belongs to the family *Euphorbiaceae* (Basma et al, 2011; Gupta et al., 2018). It is a small annual herb commonly found in tropical countries. *Euphorbia hirta* is a very popular herb widely used as a decoction or infusion to treat various ailments, including intestinal parasites, diarrhoea, peptic ulcers, heartburn, vomiting, amoebic dysentery, asthma, bronchitis, laryngeal spasms, coughs, colds, kidney stones, menstrual problems, and sterility (Basma et al., 2011; Gupta et al, 2018). Moreover, the plant is also used to treat infections of the skin and mucous membranes, including warts, scabies, tinea, thrush, aphthae, fungal afflictions, measles, Guinea-worm, and as an antiseptic to treat wounds, sores, and conjunctivitis (Basma et al., 2011; Gupta et al., 2018). The diverse phytochemicals found in *E. hirta* have been linked to various health benefits, including anti-inflammatory, antioxidant, antimicrobial, and analgesic effects (Gupta et al., 2018).

Medicinal plants are known to significantly contribute to health improvement; these health benefits are attributed to the phytochemicals in the plants (Alka et al., 2023; Targema & Gberikun, 2023). The extraction and characterization of these compounds from *Peperomia pellucida* and *Euphorbia hirta* may detect the antioxidant properties of these plants, which play a crucial role in protecting the skin from oxidative stress, a major factor in skin aging and disease (Michalak, 2022). Furthermore, assessing the antimicrobial properties of these plants can elucidate their role in preventing skin infections caused by pathogens (Noites et al., 2023). The exploration of these profiles enhances our comprehension of how these indigenous plants can serve as valuable resources in formulating natural remedies for skin health. Ultimately, this research contributes not only to academic discourse but also offers practical implications for enhancing skin health using indigenous resources.

The study aims to explore the phytochemical composition, antioxidant, and antimicrobial properties of selected indigenous plants utilized in traditional skin care practices in Nigeria.

2. Research method

Samples collected include: *Peperomia pellucida* (whole and roots) and *Euphorbia hirta* (whole and flowers), Apparatus: 250 ml beaker, test tube, petri dish, funnel, cotton swab, sterilized cotton bud, 500 ml conical flask, dropper, micropipette, Whatman filter paper, weighing boat, spatula, syringe. The equipment used includes: Blender, UV-Vis Spectrophotometer (Jenway 6850), Autoclave, Water bath, weighing balance, Incubator, Vortex mixer, and laminar air flow hood. additionally, the reagents used include: Ethanol, Wagner's reagent, Fehling's A and B solution, Glacial acetic acid, 5 % Ferric chloride solution, Concentrated Sulphuric acid, 10 % Lead acetate solution, 10 % Sodium hydroxide solution, 1 % Hydrochloric acid, Alcoholic Potassium hydroxide, Distilled water, Acetic anhydride solution, nutrient agar, Dimethyl Sulphate ($DMSO_4$), Methanol, Chloramphenicol, 1 mM 2,2-Diphenyl-1-picrylhydrazyl (DPPH) reagent, (GC-MS) Thermo GC-Trace Ultra Version: 5.0, Thermo MS DSQ II, Helium. The pathogens include (Gram-negative bacteria: *Escherichia coli;* Gram-positive bacteria: *Staphylococcus aureus*)

Two plants, *Peperomia pellucida* (whole plant) and *Euphorbia hirta* (whole plant), were collected within the vicinity of Sheda Science and Technology Complex (SHESTCO) Quarters, Kwali, Abuja. The samples were washed thoroughly under running water to remove contamination and air-dried in the laboratory until fully dried. After drying, it was blended using an electronic blender into a fine powder for easy extraction. The method used for extraction was the cold extraction method, where the powdered sample was soaked in ethanol in a 250 mL beaker and left to stand for 24 hrs. The extracts were filtered after 24 hrs using a funnel, a cotton swab, and a 250 mL beaker. The filtration process was carried out by decanting the extracts onto the cotton swab in the funnel. The filtrate goes into the beaker, and the residue is discarded. The percentage yield of *Peperomia pellucida* whole (PPW) and *Euphorbia hirta* whole (EHW) extract is 6.29 % and 3.27 %,

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respectively. Phytochemical analysis was carried out as described in the literature (Emmanuel et al, 2016; Shaikh & Patil, 2020).

For qualitative phytochemical screening, the presence of alkaloids, reducing sugars, cardiac glycosides, flavonoids, phenolic compounds, tannins, phlobatannin, saponins, triterpenoids, quinones, and resins was determined using the following test:

Wagner's test (Alkaloid): A few milliliters of the extract (filtrate) was poured into a test tube, and 1-2 drops of Wagner's reagent were added along the sides of the test tube. A brown/reddish precipitate was formed to indicate the presence of alkaloids.

Fehling's test (Reducing sugars): In a test tube, 1 ml of the filtrate (extract) was added, and 1 ml each of the Fehling's A & B solution was also added. The mixture was boiled for a couple of minutes. A red precipitate was formed to indicate the presence of reducing sugars.

Keller-Killani test (Cardiac Glycosides): In 1 ml of the extract (filtrate), 1.5 mL of glacial acetic acid, 1 drop of 5% ferric chloride, and concentrated H_2SO_4 (alongside the test tube) were added. A blue coloured solution in the acetic acid layer was formed, which indicated the presence of cardiac glycosides.

Lead acetate test (Flavonoid): In a test tube, 1 mL of the filtrate (extract) was added, and to it, a few drops of 10 % lead acetate solution were added. The presence of flavonoids was indicated by a yellow precipitate.

Ferric chloride test (Phenolic compounds): To a few mL of the extract, a few drops of 5 % ferric chloride solution were added. A dark green/bluish black colour was formed to indicate the presence of phenolic compounds.

10% NaOH test (Tannins): To 0.4 ml of the extract, 4 mL of 10 % NaOH solution was added and shaken well. A white precipitate was formed to indicate the presence of tannins.

HCl test (Phlobatannin): In a test tube, 2 mL of the extract with 2 mL of 1 % HCl solution was boiled in a water bath. A red precipitate was formed, indicating the presence of phlobatannin.

Foam test (Saponin): To a few mL of the extract, 2 mL of distilled water was added and shaken vigorously. Persistent foam will be formed for about 10 mins to indicate the presence of saponin.

Salkowski's test (Triterpenoid): In a test tube, a few mL of the extract and a few drops of concentrated H_2SO_4 were added. The mixture was shaken well and allowed to stand. A golden yellow layer at the bottom was formed, indicating the presence of triterpenoids.

Alcoholic KOH test (Quinones): In 1 ml of the plant extract, a few mL of alcoholic potassium hydroxide was added. A red to blue colour was formed, indicating the presence of quinones.

Acetic anhydride test (Resins): To 1mL of the plant extract, a few mL of acetic anhydride solution, and 1 mL of concentrated H_2SO_4 were added. An orange to yellow colour was formed to indicate the presence of resins.

Gas Chromatography-Mass Spectrometry (GC-MS) Analysis: The bioactive composition of both plants was determined using a gas chromatography-mass spectrometer (GC-MS) Thermo GC-Trace Ultra Version: 5.0, Thermo MS DSQ II. The equipment has a DB–35–MS Capillary Standard non-polar column with dimensions of 30 mm × 0.25 mm ID × 0.25 µm film. The carrier gas used is Helium with a flow of 1.0 mL/min. The injector was operated at 250 °C, and the oven temperature was programmed as follows: 60 °C for 15 min, then gradually increased to 280 °C at 3 min (Di Donato et al, 2021). Identification of components was achieved based on their retention indices, and interpretation of mass spectra was conducted using the database of the National Institute of Standards and Technology (NSIT). The database consists of more than 62,000 patterns of known compounds. The spectra of the unknown components of *Peperomia pellucida* whole and *Euphorbia hirta* whole fractions obtained were compared with the standard mass spectra of known components stored in the NIST library (NISTII).

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For sterilization, Plates were soaked in sodium hypochlorite for 48 hours and thoroughly rinsed and dried in a sterilized environment. The laminar flow hood and petri dishes were swabbed with 70 % ethanol.

For Media Preparation (500 ml): 11.5 g of nutrient agar was weighed using a weighing balance. 500 mL of distilled water was measured and poured into the agar in a 500 mL conical flask. The flask was covered properly and placed in an autoclave at 121 ^{O}C for 15 mins. In an antiseptic environment, 10 ml of the prepared media was poured into 19 petri dishes and allowed to gel(Targema & Gberikon, 2023).

For Bacterial Subculture: The bacteria cultured were *Escherichia coli* and *Staphylococcus aureus, obtained* from the industrial biotechnology laboratory in the Biotechnology Advanced Research Centre, SHESTCO. Under an aseptic environment, three (3) microorganisms as listed above were subcultured from clinical isolates. The isolates were put in an incubator for 24 hours.

For antimicrobial screening using zone of inhibition, antibacterial screening of the *Kalanchoe pinnata* (Leaves), *Peperomia pellucida* (whole plant), and *Euphorbia hirta* (whole plant) extracts was done on Nutrient agar, using the Disc Diffusion method as described in literature (Doherty et al., 2010). In this method, 10 ml of sterilized Nutrient agar was poured into a sterile petri dish. After solidification, an inoculating loop was used to pick a little amount of the microorganism. A sterilized cotton bud was used to spread the bacteria across the media using the method called carpet streaking. 1 g of the extract was weighed, and then 1mL of $DMSO_4$ was added. It was mixed using a vortex mixer. The Whatman filter paper (6 mm in diameter) was soaked in the mixture at different concentrations and placed over the agar plates using sterile forceps. 200 mg/mL of Chloramphenicol was used as the positive control. The antibacterial plates were kept in the incubator, at 37 ^{O}C for 24 hrs. The diameters of the zone of inhibition were noted down after 24 hrs. For Antioxidant Activity (2, 2-Diphenyl-1-picrylhydrazyl (DPPH) Assay), the principle is based on the measurement of the absorbance at 517 nm of a violet colour, which is reduced to a yellow colour in the presence of antioxidants (Okwute et al, 2016). A stock solution of the extract was prepared, with a concentration of 20 mg/ml (0.4 g/20ml). The following concentrations of the extracts were prepared: 5, 4, 3, 2, 1, 0.5, 0.2, and 0.1 mg/mL in methanol.

For the standard, Ascorbic Acid was used at concentrations 5, 4, 3, 2, 1, 0.5, 0.2, and 0.1 mg/mL. 1ml of the extract was placed in a test tube, and 3 mL of methanol was added, followed by 0.5 mL of 1 mM DPPH reagent. The concentrations were kept in a dark place for 10 minutes. Thereafter, the decrease in absorption was measured using a UV-Vis Spectrophotometer. A blank is prepared containing 4 mL of methanol and 0.5 mL of DPPH. The decrease in absorption was measured and compared to that of the control, which was used to calculate the percentage inhibition. The tests were run in duplicates. Average values were taken, and % Inhibition = $(Ab_b - Ab_s) / Ab_b$.

Where: Ab_b= Absorbance of blank

Ab_s= Absorbance of sample

3. Findings and discussion

The results of the qualitative phytochemical screening of ethanol extracts of flowers, roots, and whole plants of *Peperomia pellucida* and *Euphorbia hirta are* illustrated in Table 4.1. The presence of secondary metabolites such as alkaloids, tannins, saponins, cardiac glycosides, resins, phenols, flavonoids, triterpenoids, reducing sugars, and phlobatannin was detected in the extracts. Alkaloids, tannins, and saponins were present in all extracts. Flavonoids, triterpenoids, and reducing sugars were absent in the ethanolic extract of *Peperomia pellucida* root (PPR), *Peperomia pellucida* whole (PPW), and *Euphorbia hirta* flower (EHF). Phlobatannins and Cardiac glycosides were present in only the *Peperomia pellucida* whole (PPW) extract. Quinones were absent in all extracts, while resins were present in the ethanolic extract of *Euphorbia hirta* flower (EHF) and *Euphorbia hirta* whole (EHW).

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Table 4.2 shows the result of the zone of inhibition of the extracts. The extracts were tested against microorganisms, *Staphylococcus aureus* and *Escherichia coli.* EHW showed inhibitor *a*ctivity at all test concentrations in a dose-dependent manner. However, the extracts of PPW showed no signs of inhibitory activity at 1000 mg/mL, but little activity of 11 mm was observed at 250 mg/mL against *Staphylococcus aureus* and 9 mm at 500 mg/mL against *Escherichia coli.*

Figure 4.1 shows the result of the antioxidant activity of the ethanol extracts of *Peperomia pellucida* (whole) and *Euphorbia hirta* (whole), in comparison to that of the standard, Ascorbic acid. The antioxidant activity of the ethanol extracts of *Peperomia pellucida* (whole) and *Euphorbia hirta* (whole) showed an increase in scavenging activity against DPPH at the concentrations of 3 mg/mL and 1 mg/mL. The result obtained from the GC-MS analysis of the whole plant of *Peperomia pellucida* and *Euphorbia hirta,* as illustrated in Table 4.3, led to the identification of specific bioactive compounds. The most abundant compound in PPW extract is - 9, 12, 15- Octadecatrienoic acid, methyl ester (24.55 %) with a retention time of 23.291 minutes, while in EHW is glycerin (92.44%) with a retention time of 11.219 minutes.

The therapeutic values of medicinal plants have been studied towards the treatment of diseases in developing countries (Emmanuel et al., 2016). The use of these plants is being boosted by the notion commonly linked to certain side effects associated with the use of synthetic drugs (Emmanuel et al., 2016). Bioactive compounds detected within plants are used to reveal the endless possibilities for their antagonistic nature against microbial agents and oxidative stress, thereby placing them as the best possible option for drug candidates (Emmanuel et al., 2016). Furthermore, this serves to corroborate the claim according to folklore, stating that indigenous plants are being used for traditional African medicine (Mann et al., 2008). Skin care formulations normally possess bioactive compounds such as flavonoids, polyphenols, carotenoids, vitamin C, vitamin A, minerals, and provitamin A (Michalak, 2022). As shown in Table 4.1, flavonoids and phenolic compounds are present in both ethanol extracts of *Peperomia pellucida* (whole) and *Euphorbia hirta* whole (EHW). Although the presence of flavonoids was not detected in the ethanol extract of PPW. There are previous reports supporting this current result regarding the absence of flavonoids in the ethanol leaf extract of *P. pellucida* (Ibrahim & Yahaya, 2020). This is in consonant to the report given by Oloyede (2011), who reported the presence of flavonoids in the methanol leaf extract of *Peperomia pellucida*. This difference in result might be due to the solvent used for extraction. In EHW, both flavonoids and phenolic compounds were present, highlighting its potential to be used in skin care products. Studies highlight that ethanol, hexane, and chloroform extracts of *E. hirta* leaves reveal the presence of flavonoids (Ahmad et al., 2017). Also, the presence of flavonoids was detected in the isopropanol and aqueous extracts of the leaves, fruits, root, and stem of *E. hirta* (Shaikh et al., 2023).

These compounds possess antioxidant, antimicrobial, and anti-inflammatory properties, which contribute to the efficacy of certain skin care formulations (Giménez Martínez et al., 2025). Flavonoids, which are a diverse group of polyphenols, possess pharmacological properties such as antioxidants, anti-viral, antimicrobial, anti-inflammatory, and anti-allergic properties (Hasat et al., 2024). Phenolic compounds are secondary metabolites that reduce oxidative stress and lipid peroxidation in humans, possessing pharmacological potentials such as antioxidants, anti-carcinogenic, anti-inflammatory, anti-viral, anti-tumor, and anti-allergic properties (Sarengaowa et al., 2022). The presence of these two phytochemicals (flavonoids and Phenolic compounds) indicates the plant's potential in treating skin disorders and usage in skin care formulations. These compounds also possess both antimicrobial and antioxidant properties.

Disease-causing pathogens such as *Staphylococcus aureus,* which is commonly associated with skin disorders including atopic dermatitis, impetigo, folliculitis, and so on, have gained a lot of attention owing to their prevalence among the community population (Aly, 2011). Another significant disease-causing pathogen

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is *Escherichia coli*, which is known to cause superficial infections such as wound infections (Frichmann et al, 2019). Antimicrobial activity is a characteristic of the anti-bacterial compounds observed in the plants, thereby supporting the data obtained from the phytochemical analysis. The results obtained show that the ethanol extract of EHW possesses a strong activity against *Staphylococcus aureus* and *Escherichia coli* at a concentration of 1000 mg/ml. In comparison to a study conducted by Ahmad et al (2017), it was reported that the ethanol leaves and flower extract of *E.hirta* show a significant activity of 13 mm and 11 mm against *S. aureus*. In further studies, the aqueous leaf, isopropanol leaf, and fruit extracts of *E. hirta* exhibit a moderate antibacterial activity of 18 mm, 13.2 mm, and 10 mm, respectively, against *S. aureus* (Shaikh et al, 2023). In addition, the aqueous and isopropanol leaf, fruits, root, and stem of *E. hirta* show a significant activity against *E. coli*, showing the zone of inhibition of (15.3 mm and 16 mm), (11.3 mm and 16 mm), (11.3 mm and 17.3 mm), and (12.3 mm and 25.3 mm) respectively (Shaikh et al, 2023). In comparison to this study's result, a slight difference has been observed, which can probably be due to the solvent of extraction used, the part of the plant used, or the concentration of the extract.

The antimicrobial activity of ethanol extracts of PPW is low compared to that of EHW. It shows little antimicrobial activity against *E.coli* at 500 mg/ml and against *S.aureus* at 250 mg/ml. Similarly, another study reported by Miazatul and Nor (2020) highlights that the ethanol extract of *P. pellucida* leaves is effective against *S. aureus* and *E. coli* at the concentration of 100 mg/ml, with a zone of inhibition of 10.67 mm and 15.67 mm, respectively. Compared to the study conducted by Oloyede et al (2011), who observed that the methanol extract of the leaves was low in activity compared to n-hexane, ethyl acetate, and butanol extracts against *E. coli* and *S. aureus* at the concentration of 50-200 mg/ml. This difference might be a result of either the solvent of extraction, the parts of the plants worked on, or the concentration of the extract used. Both extracts were effective against *Staphylococcus aureus* and *Escherichia coli*.

Antioxidants such as flavonoids, carotenoids, vitamin C, and vitamin E are compounds that neutralize free radicals, thereby preventing oxidative stress, which is linked to various diseases such as skin disorders, cardiovascular diseases, and many others (Kotha et al., 2022). These compounds possess properties such as anti-inflammatory properties, which are key in the treatment or prevention of skin allergies, irritation, or inflammation (Kotha et al, 2022). Analysis of the antioxidant potentials of these extracts suggests that the presence of certain phytochemicals, particularly flavonoids and phenolic compounds in concert with other constituents, triggers the free radical scavenging activity (FRSA). In this study, the FRSA against DPPH was conducted. As illustrated in Figure 1, the ethanol extract of PPW and EHW shows maximum antioxidant activity at the concentrations of 3 mg/mL and 1 mg/mL, respectively. According to a study conducted by Basma et al (2011), it was reported that the methanol extract of E. hirta leaves exhibited a maximum DPPH scavenging activity of 72.96% at 1 mg/mL, followed by the flowers, roots, and stems, whose scavenging activities were 52.45%, 48.49% and 44.42%, respectively, at the same concentration. This agrees with the result that at 1 mg/mL, EHW exhibits maximum DPPH scavenging activity. Moreover, a study conducted by Oloyede et al (2011) reported that the fractions (methanol, ethyl acetate, butanol, and n-hexane) exhibited maximum scavenging activity against DPPH at a concentration of 1-0.0625 mg/ml. Although the butanol extract possessed the highest activity of 98%. This difference in result might be due to the part of the plant used, the solvent used for extraction, or the concentration of the extract. These results suggest that PPW and EHW have strong antioxidant activity at low concentrations and can be used in the treatment of skin disorders resulting from oxidative stress.

The result obtained from the Gas Chromatography-Mass Spectrometry (GC-MS) analysis of the ethanol extract of PPW and EHW identifies a number of bioactive compounds. Among the identified components in PPW, 9, 12, 15-Octadecatrienoic acid, methyl ester attained the largest peak (24.55 %), with the retention time

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of 23.291, followed by 9, 12-Octadecadienoyl chloride, which had the area percentage of 21.15 %. A study conducted by Narayanamoorthi et al. (2015) highlighted the most abundant compound in the ethanol extract of *Peperomia pellucida* whole plant as Apiol, which had an area percentage of 22.64 %. This difference in result might be due to the time and period the plant was collected. The most abundant compound in EHW is glycerin with a peak area percentage of 92.44 %, followed by hentracontane. In a study by Igwe et al (2016), it was reported that the major compounds in the methanol extract of *Euphorbia hirta* were Niacin or Nicotinic acid, which had an area percentage of 31. 70 %. This difference in both results can probably be due to the solvent extraction used, the part of the plant used, or the time and period the sample was collected. These compounds can possess pharmacological properties such as antioxidant and antimicrobial effects.

Table

Table 1: Results of Qualitative Phytochemical analysis of plants

Phytochemicals	Ethanol P.P.W	Ethanol E.H.F.	Ethanol P.P.R.	Ethanol E.H.W.
Alkaloids	+	+	+	+
Cardiac Glycosides	+	-	-	-
Reducing Sugars	-	-	-	+
Flavonoids	-	-	-	+
Phenolic	+	-	-	+
Tannins	+	+	+	+
Phlobatannins	+	-	-	-
Saponins	+	+	+	+
Triterpenoids	-	-	-	+
Quinones	-	-	-	-
Resins	-	+	-	+

Key: + = present; - = absent; P.P.W. - Peperomia pellucida (whole); E.H.F. - Euphorbia hirta (flower); P. P.R. - Peperomia pellucida (root); E.H.W - Euphorbia hirta (whole)

Table 2: The Zone of Inhibition of Ethanol extract of *Euphorbia hirta* whole (EHW) and *Peperomia pellucida* whole (PPW)

Plants	Concentration	Microorganisms	
		Escherichia coli	*Staphylococcus aureus*
EHW	1000 mg/mL	20 mm	26 mm
	500 mg/mL	15 mm	13 mm
	250 mg/mL	11 mm	6 mm
PPW	1000 mg/mL	-	-
	500 mg/mL	9 mm	-
	250 mg/mL	-	11 mm
+ve control Chloramphenicol	200 mg/mL	22 mm	25 mm

Key: +ve - positive; PPW - Peperomia pellucida whole; EHW - Euphorbia hirta whole

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Table 3: Most Abundant Components in Ethanol extract of *Peperomia pellucida* whole (PPW)

Compound	Retention time (RT)	Area %
9, 12, 15-Octadecatrienoic acid, ME	23.291	24.55
9, 12-Octadecadienoyl chloride	23.177	21.15
Phytol	20.063	7.22
Methyl stearate	23.405	5.43
9, 12-Octadecadienoic (Z,Z)	23.955	5.36
1-(3, 3-Dimethyl-but-1-ynyl)-2,2,33-tetramethy	19.093	4.09
Lupeol	19.336	4.03
Tetratetracontane	18.570	3.71
Hexadecanoic acid, ME	21.113	3.57

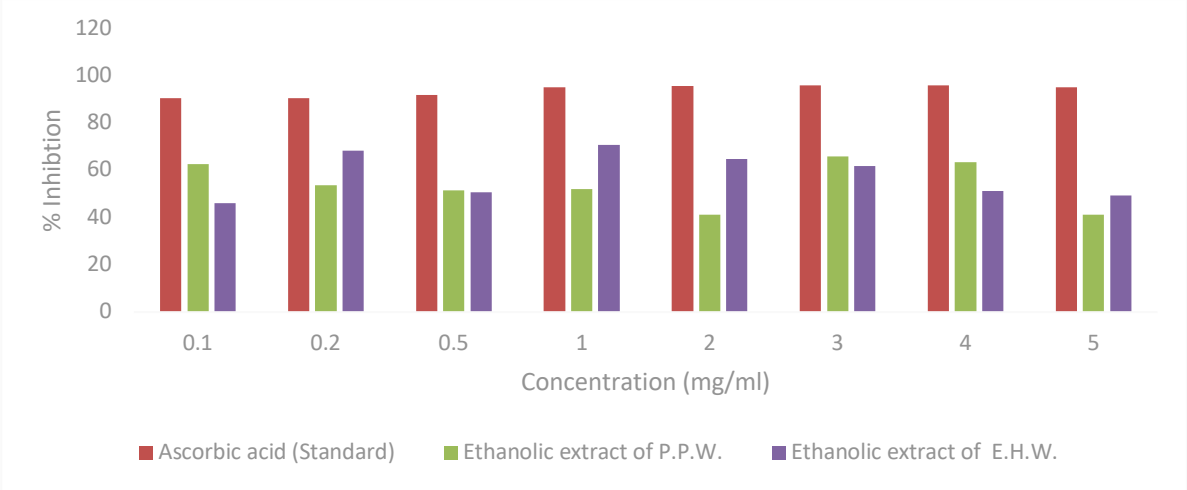
Key: ME - Methyl ester

Table 4: Most Abundant Compounds in Ethanol Extract of *Euphorbia hirta* whole (EHW)

Compound	Retention time (RT)	Area %
Glycerin	11.219	92.44
Hentriacontane	19.630	2.10
2-methyloctacosane	19.758	1.58
2-Pentadecanone	20.314	1.05

Figure

Figure 1: Graphical representation of the antioxidant analysis of plant extracts and standard (Ascorbic acid)



Keys: P.P.W. - Peperomia pellucida (whole); E.H.W. - Euphorbia hirta (whole)

4. Contribution of the study

Accordingly, the whole plant and flower of *Euphorbia hirta* and the whole plant and root of *Peperomia pellucida* were tested, and the results recorded major bioactive compounds, like flavonoids, phenolics, saponins, and triterpenoids, giving us a clearer picture of Nigeria's plant chemistry. The presence of flavonoids and phenolics together usually means the extract has good antioxidant potential, while saponins and triterpenoids often point to antimicrobial and membrane-active effects. These compounds can exhibit wound healing properties, contribute to improved skin hydration and elasticity and help in fighting skin infection such as atopic dermatitis, contact dermatitis, boils etc. Using GC–MS, the of detection 9,12,15-octadecatrienoate, methyl ester

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(24.55%), an omega-3 fatty acid derivative in *Peperomia pellucida* (whole) extract, suggests that these plants possess antioxidant and anti-photoaging properties, which aligns with the study's quantitative antioxidant assays. However, the identification of 9,12-octadecadienoyl chloride (21.15%) in the same extract, which is a known skin corrosive, serves as a critical warning that not all detected compounds are safe, and raw extracts require purification or safety testing before topical use.

Glycerin (92.44%), which is present in the whole plant of *Euphorbia hirta* (whole) extract, possesses hydration and skin-aging properties, antimicrobial properties, and improves wound healing and skin conditions such as psoriasis, eczema, and dry skin. Hentriacontane (2.10%), which is also present in the whole plant extract of *Euphorbia hirta,* possesses anti-inflammatory and antibacterial activity. Standard antioxidant tests (DPPH) were used to measure how well each extract neutralizes free radicals, which shows how useful they might be for fighting skin aging, oxidative stress, and supporting wound repair. On top of that, the extracts were tested against common skin pathogens like *Staphylococcus aureus* and *Escherichia coli*, measuring the clear zones to see which ones worked best. The most promising candidate, *Euphorbia hirta,* exhibited the presence of phenolics and flavonoids, high antioxidant properties, and showed large inhibition zones against skin pathogens. Follow-up work should include MIC/MBC determination, cytotoxicity assays, compound isolation, and stability testing in prototype formulations.

5. Conclusion

These plants are identified as a fountain of significant pharmacological products. The data in this study offer scientific support to the folklore beliefs stating that the studied plants are used in the treatment of skin disorders. The plants in question, *E. hirta* and *P. pellucida*, possess antimicrobial activity, especially that of the ethanol extract of *Euphorbia hirta* whole (EHW) at the concentration of 1000 mg/ml. The phytochemical composition of these plants suggests that they both have the potential to be used in skin care formulations, with the presence of flavonoids and phenolic compounds in the extracts. Other compounds present, such as alkaloids, tannins, cardiac glycosides, saponins, and reducing sugars, show that the plants possess many significant pharmacological properties, most especially anti-microbial and antioxidant properties, which are key characteristics that are looked for to determine the potential of plants for skin care formulations.

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