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Brief Research Report

Comparative Evaluation of the Nutrients and Phytochemical Composition of Cissus populnea (Ogbodu) Dried Leaves, Roots, and Stem Bark from Nsukka, Enugu State, Nigeria

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Abstract: The purpose of this study was to compare the nutrient contents and phytochemical composition of the leaves, roots, and stem bark of Cissus populnea. The specimens came from Nsukka in Nigeria's Enugu State. Laboratory experimental design was used for this study. Samples of leaves, roots, and stem barks were prepared by drying them for two hours at 50 ^{0}C in a food dehydrator, ground into fine powder and dried again using the air-drying process The analyses were carried out using standard methods. The proximate analyses showed that the samples contain crude protein (1.89 - 2.11%), crude fibre (22.23 - 22.48%), crude fat (1.99 - 2.09%), carbohydrates (43.71 - 64.96%), ash (4.11 - 6.64%) and moisture (4.46- 4.84%). The phytochemical data showed that all plant components contained phenol, alkaloids, tannins, and terpenoids, but not steroids. Both saponin and flavoloid were found in the plant's roots and leaves only. Flavonoid was not detected in the stem. The results of mineral compositions showed that the root, stem, and leaf samples included potassium (340.83 – 439.33 mg/100g) calcium (132.99 – 295.78 mg/100g), iron (1.12 – 4.21 mg/100g), magnesium (27.41-39.67 mg/100g) and manganese (0.14 – 3.99 mg/100g). Because of its nutrient contents and phytochemical proportions, consumers are encouraged to use any parts, though root parts of the plant seem to contain high nutrient.

Keywords: Cissus-Populnea, Mineral, Nutrient, Phytochemical, Proximate

1. Introduction

Cissus Populnea is a member of the Vitacea (ampelidacea) family. This plant is a woody vine that may grow up to three metres tall, semi-climber which grows in some parts of Nigeria and other country (Soladoye et al., 2012). This plant is a rich source of ascorbic acid, triterpenoids, and carotenoids and are used medicinally in many regions of the world. There have long been reports of the plant's therapeutic benefits in some locations. In traditional medicine, the plant has been used to treat a variety of conditions, including oedema, intestinal parasites, sores, boils, sore breasts, indigestion, catharsis, urinary tract infections, sexual dysfunction, and eye issues brought on by black cobra attacks. The extracts have pharmacological activities that include anti-lipogenic, anti-parasitic, antimalarial, anthelmintic, antibacterial, hepatoprotective, larvicidal, anti-diabetic, and antioxidant qualities.

In Nigeria, Uganda, Niger Republic, Cameroon, and Cote d'Ivoire, Cissus populnea thrives in a variety of ecozones (Geidam et al., 2004). Cissus populnea is typically found in the northern, eastern, and southern regions of Nigeria. It is common/local called 'Okoho' in (Idoma and Igala), 'Orogbolo or ajara' in (Yoruba), 'Dafaaraa or latutuwa' in (Hausa) (Aguoru et al., 2014), and Ogbodu or okoho in (Igbo). The whole plant parts (root, stem bark or the leave) is among the thickening agents for soups, along with melon, Irvnigia Gabonensis seed and mucuna. In some regions of Nigeria, Cissus populnea (root, stem bark or leave) is used instead of Irvnigia Gabonensis seed (Ogbono). Health-promoting elements are present in Cissus populnea (root, stem bark or leave) thickening agents. Idoma in some areas of Benue State prepare soup from the stem of Cissus populnea, while others in Nigeria just utilise the root of the plant as a food thickener. These thickening agents contains some essential nutrients crucial in supporting a person’s reproduction, good health, and growth. These can be of two categories: micronutrients and macronutrients.

Micronutrients are nutrients that a person needs in small doses. Micronutrients consist of vitamins and minerals. Although the body only needs small amounts of them, a deficiency can cause ill health. Macro-nutrients are nutrients that a person needs in larger amounts. Macronutrients include water, protein, carbohydrate, and fats. Phytochemical is a chemical compound or substance produced by a plant. Where food and health are concerned, phytochemicals are non-nutritive plant chemicals that have or exert protective or disease-preventing effects. They are not essential nutrients and are not required by the body for sustaining life. However, various phytochemicals have been associated with protection from and/or treatment of chronic diseases such as heart disease, cancer, hypertension, diabetes and other medical conditions. In order to advise users on which part of the plant is best for consumption, the research aims to compare the nutrient and qualitative phytochemical contents of the roots, leaves, and stem bark of Cissus populnea.

1.1. Statement of Problem

In Nigeria's challenging economic climate, a local soup ingredient, Cissus Populnea, is being used as a cost-effective substitute for African or Bush mango (Ogbono) seeds. This study compares the nutritional profiles of both ingredients to determine which one is richer in essential nutrients, promoting informed choices for adequate family nutrition

1.2. Purpose of the Study

This study investigated the potential of Cissus Populnea parts (root, stem bark and leave) as a coping strategy for nutrition security during financial hardship. The objectives were to:

(a) Analyze and compare the nutrient content (proximate values) of Cissus Populnea plant parts
(b) Determine and compare the mineral content of the plant parts
(c) Compare the quantitative phytochemical compounds among the plant parts

1.3. Research Questions

(a) What are the nutrient content (proximate values) of Cissus Populnea plant parts?
(d) What are the mineral content of the plant parts?
(b) What are the quantitative phytochemical compounds among the plant parts?

2. Materials and Methods

2.1. Design for the Study

The study employed an approach of experimental design. This involved preparing powdered and extract samples used for laboratory tests to assess the nutrient, mineral, and phytochemical content of Cissus Populnea parts.

2.1.1. Ethics Statement

The plant materials used in this study were collected from their natural habitat in Igbo-Eze South L.G.A, Nsukka, Enugu State, Nigeria, with the permission of the landowners. The plant species was identified and authenticated by a botanist. The researchers ensured that the collection of plant materials did not harm the ecosystem or deplete the natural resources of the area.

2.2. Area of the Study

The study focuses on the plant species – Cissus populnea (Ogbodu) – and its various parts (leaves, roots, and stem bark) in their natural habitat in Igbo-Eze South L.G.A, Nsukka, Enugu State, Nigeria.

2.3. Population and Sample

The population of interest is Cissus populnea (Ogbodu) plants growing in their natural habitat in Igbo -Eze South L.G. A, Nsukka, Enugu State, Nigeria. This included all parts of the plant (leaves, roots, and stem bark) used in the study. The samples were divided into three groups, each representing a different plant part: Leaves, Roots and Stem Bark)

2.4. Data Collection

2.4.1. Plant sampling equipment: Pruning scissors, cutlass, Hoe, Plant labels

2.4.2. Laboratory equipment: Analytical balance, Laboratory mill, Pipettes, Volumetric flasks, spectrophotometry and atomic absorption spectroscopy (AAS).

2.4.3. Data collection sheets: Sample information sheet (plant part, location, date, etc.), Nutrient analysis sheet (proximate composition, mineral content and phytochemical screening).

2.5. Study Procedure

2.5.1 Plant Collection and Identification: Collection of Cissus populnea plant samples (leaves, roots, and stem bark) from Igbo- Eze South L.G.A, Nsukka, Enugu State, Nigeria. Identification of the plant species and parts was done using botanical keys and expert taxonomists.

2.5.2. Sample Preparation: Dry the plant samples using a food dehydrator at 50°C for 48 hours. Grind the dried samples into powder using a laboratory mill. Store the powdered samples in airtight containers.

2.5.3. Nutrient Analysis: Determine the proximate and mineral content composition (moisture, ash, crude fiber, etc.) using standard analytical techniques (AOAC, 2020).

2.5.4.Phytochemical Analysis: Screen for quantitative phytochemicals (alkaloids, flavonoids, phenolics, etc.) using analytical grade reagents.

2.6. Sources of Materials

All chemicals used were analytical grade and were products of Sigma Aldrich. They were used as purchased without further purification unless otherwise stated. The plant components of Cissus Populnea (leaves, roots, and stem bark) were collected from a farm at Nkalagu Obukpa in Igbo-Eze South Local Government Area, Enugu State, Nigeria. All the Laboratory analysis was done at the Chemistry Advanced Research Centre (CARC) Laboratory, at Sheda Science and Technology Complex, Abuja (SHESTCO).

2.7. Sample Preparation

The three samples (leaves, root and stem) were prepared.

Phase 1 involves preparation of Cissus Populnea leaf powder: The Cissus Populnea plant's leaves were cut off from the stem. To get rid of the grime, they were washed and then dried for two hours at 50 ^{0}C in a food dehydrator. The dry leaves were subsequently ground into fine powder and dried again using the air-drying process.

Phase 2 involves drying and powdering the Cissus Populnea roots. The roots of Cissus Populnea plant were dug up. They were washed and scaped with a knife. The roots were sliced and dried for two hours at 50 ^{0}C in a food dehydrator. After drying, the sample was ground into a fine powder using a mortar. The sample was sieved and stored into a dry container for the chemical analysis

Phase 3 involves drying and powdering the Cissus Populnea stem bark. The plant's stem was cut into small process and scraped. This was dehydrated for two hours at 50 °C in a food dehydrator. The sample was then ground into a fine powder using a mortar and air dried in a room for a duration of two weeks. A 2mm mesh screen was used to sieve the ground samples. This was stored in a dried container for the chemical analysis

2.8. Proximate Analysis of Cissus Populnea plant (leave, roots and stem bark)

The Association of Official Analytical Chemists'(AOAC) standard procedure was used to assess the moisture, total lipid and ash content as recommended by Thiex et al. (2012). A modified Kjeldhal method was used to determine crude protein (Lawrence & Joseph., 2018). Carbohydrates was evaluated indirectly using the Food and Agriculture Organization's 2018 methodology, which involved subtracting the % sum of food nutients: % protein, % crude fiber, % crude lipds, % moisture and % ash from 100%. The Association of Official Analytical Chemists' gravimetric method from 2012 was used to calculate crude fibre (Thiex et al., 2012).

2.9. Mineral Analysis of Cissus Populnea plant (leave, root and stem bark)

The approach of Zoroddu et al. (2019) was utilised to estimate the major elements, which include calcium, sodium, potassium, magnesium, and trace elements, which include iron, zinc, copper, manganese, and cobalt. 2g of each sample was put in a conical flask weighing two grams. Nitric acid (20 ml) was added to the flask. The blend was broken down for at least thirty minutes until a transparent solution was noticed. The mixture was filtered using a 100 ml volumetric flask. To fill the gap, distilled water was added. Additionally, 20 milliliters of nitric acid were digested and added to a 100 ml volumetric flask to create a blank. The mineral screening of the samples solution and the blank were carried out using Atomic Absorption Spectrophotometer (AAS).

2.10. Phytochemical Analysis of Cissus Populnea plant (leave, roots and stem bark)

50g of the samples were soaked differently in bottle with methanol for 2days. Samples were filtered. The filtrates were concentrated to obtain extracts which were used for phytochemical screening. Both samples extract underwent the (Lins et al., 2012) method of qualitative phytochemical analysis protocol for alkaloids, flavonoids, tannin, phenol, terpenoid, saponins, and Steroid**s** components.

3. Results and Discussion

3.1. Proximate composition of Cissus Populnea (leave, stem bark and root)

Table 1: Proximate composition of Cissus Populnea (%)

Constituents	Leave	Stem bark	Roots
Crude protein	2.11	2.11	1.89
Crude fiber	22.23	31.23	22.48
Total Ash	6.64	6.03	4.11
Moisture	4.75	4.84	4.46
Fat	2.10	1.99	2.11
Carbohydrate	63.18	43.71	64.96

The nutrient makeup of the root, stem, and leaves of Cissus populnea was displayed in Table 1. All of the plant sections that were chosen for the investigation had high levels of carbohydrates (ranging from 43.7087 to 64.9548). It was discovered that the Cissus populnea root had the highest carbohydrate (64.96 **%**), fat (2.1065 **%**) but lowest protein (1.890 **%**) and ash (4.105) contents. Cissus populnea stems, had the highest fibre content (31.23). When compared to other plant parts, the root of Cissus populnea had the highest amount of carbohydrates (64.96**%**), Fat (2.11**%**) and Fiber (22.48 **%)** All of the plant sections under investigation had detectable amounts of carbohydrates. The Cissus populnea root had the highest carbohydrate content (64.96 %) when compared with other samples. This runs counter to the results of (Achikanu & Ani, 2020), who claimed that Cissus populnea stems had a higher amount of carbohydrates (56.04 %), despite the fact that their study did not compare the three components of the plant (only stem bark). Additionally, this outcome (higher carbohydrate content in roots) is consistent with the research done by (Adebowale et al., 2013) who examined the nutritional value of Cissus populnea stem and root and found that the root had a higher concentration of carbohydrates than the stem bark. These plant components can be utilised as foods that provide energy because of their high carbohydrate content.

Carbohydrate values of the different plant parts obtained from this study were less than the Recommended Dietary Allowance (RDA) of 130g but higher than that of the stem bark (56.04 %) reported by (Achikanu & Ani, 2020). (2020). However, Cissus populnea parts (stem bark, roots and leaves) have considerable amount of carbs, which makes them decent source of energy as the body uses carbohydrates as its main energy source to perform biological processes. Since they are a necessary food for a healthy diet, carbohydrates are used by the body to produce and give energy to many cells, including the brain, muscles, and blood (Ejelonu et al., 2011; Emebu & Anyika, 2011) , 2021). Significant amounts of fibre were discovered in the Cissus populnea root, stem bark and leaves. The fibre content of Cissus populnea stem back (31.23 %) was the highest. This high fibre content of the stem bark (31.23 %) of Cissus populnea was found to be in conflict with the results of studies conducted on Cissus populnea stem (2.88%, 9.06% and 3.18%) (Omale et al., 2021); (Akoma et al., 2018) and (Harfouch, 2022) respectively. Although crude fibre helps with the digestion and absorption of fat and glucose, excessive amounts of it can lead to gastrointestinal disorders and reduced nutrient utilization (David et al., 2014). This is because crude fibre is primarily composed of cellulose, which is indigestible by humans, and a small amount of lignin (Otori & Mann, 2014). A reduction in the incidence of colon cancer, diabetes, hypertension, and obesity, as well as digestive problems and cardiovascular diseases, has been linked to increased fibre consumption (United Nations Food and Agriculture Organization (FAO) 2018) Cissus populnea root ought to be chosen over the stem bark and the leaves.

The root of Cissus populnea had a crude lipid content of 2.11%, whilst the stem bark and lave had lipid contents of 1.99% and 2.10%, respectively. The observed low-fat content is beneficial since humans are considered to require a diet that delivers 1-2 percent of their caloric energy as lipids, with excess lipid consumption leading to obesity and cardiovascular problems. Nonetheless, lipid is required in the diet since it is an excellent source of energy, helps move fat-soluble vitamins, supports vital cellular functions, and shields and insulates internal organs(Harvey & Ferrier, 2017). The protein concentrations in the root (2.11 %), stem bark (2.11 %), and leaf (1.89 %), of Cissus populnea was not high. In contrast, Onojah *et al*. (2013) observed that protein was the most abundant nutrient in the stem bark (37.0 %) and root (21.0 %) of Cissus populnea. The 1.89% crude protein content in the stem bark of Cissus populnea was found to be comparable with that found in the study by (Achikanu & Ani, 2020) (crude protein ;1.49 %). In this study, the crude protein content of the root (2.11 %) and stem bark (2.11%) of Cissus populnea is higher than the leaf (1.89 %). The protein values obtained from this study fall short of the recommended daily amount (RDA) of 56g for adults weighing 70kg, 46g for adults weighing 50 kg and 18 to 20g for children per day (Otori & Mann, 2014). The low protein content suggests that Cissus populnea is not a good source of protein.

Food's mineral content can be determined by looking at its ash content (Olusanya, 2008). According to this study, the Cissus populnea leaf had a greater ash content (6.64) than the stem (3.83) and root (4.105), respectively. The leaf, stem bark, and root were found to have moisture contents of (4.76, and 4.46%), in that order. The food's water activity can be determined by looking at its moisture content (Mermelstein, 2009), (Paliyath et al., 2012). It serves as a gauge of a food material's stability and susceptibility to microbial contamination (Karanth et al., 2023). Even though the moisture content of all the Cissus populnea parts are within the range of values considered as a safe limit for the storage of plant food supplies ((Umar et al., 2007), the moisture content of the stem bark of Cissus populnea was higher than both root and leaf. The observed low moisture content suggests that the samples will not be susceptible to microbial growth but will have a lengthy shelf life. The food's water activity can be determined by looking at its moisture content (Mermelstein, 2009), (Paliyath et al., 2012). It serves as a gauge of a food material's stability and susceptibility to microbial contamination (Karanth et al., 2023).

3.2. Mineral composition of Cissus Populnea (leave, stem bark and root)

Table 2: Mineral content of Cissus populnea (mg/100g)

Minerals	Roots	Stems	Leaves
Sodium	5.96	4.86	2.61
Potassium	341.90	439.33	340.83
Magnesium	27.41	39.67	27.47
Iron	1.12	4.21	1.77
Manganese	ND	0.14	3.99
Zinc	4.16	2.28	2.33
Calcium	132.99	295.78	ND
Nickel	0.052	0.077	0.17

Note: ND mean not detected

The mineral contents screening of the Cissus populnea (root, stem, and leaf) were displayed in Table 2. The root, stem, and leaf included sodium (2.61- 5.96 mg/100g), calcium (0.00 - 295.78 mg/100g), magnesium (27.41 – 39.67 mg/100g), potassium (340.83 - 439.33 mg/100g), iron (1.12 - 4.21 mg/100g), and zinc (2.28 - 4.16 mg/100g), according to the analysis. Among all the nutrients examined in Cissus populnea, potassium was the most abundant mineral when compared to the other minerals identified in the plant's roots, stems, and leaves. Moreover, stems(439.33mg/100g) had a higher potassium concentration than either root (341.90 mg/100g) or leaf (340.83 mg/100g). Of all the samples, nickel contained the least amount. Manganese was not detected in Cissus populnea roots, while calcium was also not detected in Cissus populnea leaves. The roots (132.99 mg/100g) and stems (295.78 mg/100g) of Cissus populnea had the highest calcium content. Calcium and potassium were the minerals present in Cissus populnea in the greatest amounts of all.

When compared with other plant parts, the stem bark of Cissus populnea had the greatest calcium concentration (295.78 mg/100g). The calcium content of the leaves of Cissus populnea was not detected. The calcium content of the root of Cissus populnea was 132.99 mg/100g. These plant roots and stems contain calcium, which suggests that eating them will help to maintain and grow strong bones. The Cissus populnea stem had the highest magnesium concentration (39.67 mg/100g), followed by the leaves (27.47 mg/100g). This contrasts with the Cissus populnea stem described by (Onojah et al., 2013), who also found that the stem had a low magnesium level of 0.010 mg/100g. The richness of the soil in the area where the tree is situated can be the cause of the high magnesium concentration that has been observed. The sections of Cissus populnea had high potassium concentration. Potassium concentrations was, however, high in the stem bark (439.33 mg/100g). One mineral that is necessary for body function is potassium. Numerous potent health benefits are associated with a diet high in potassium. It might lessen blood pressure and water retention, guard against stroke, and lessen the risk of kidney stones and osteoporosis (Weaver, 2013). According to 2019 dietary Reference intake by National Academy of Sciences, Engineering, and Medicine (NASEM), the Dietary Reference Intakes of potassium for humans ranges from 400 to 3,400 mg per day, depending on your age.

3.3. The qualitative phytochemical screening of Cissus Populnea (leave, stem bark and root)

Table 3: The qualitative phytochemical screening of Cissus Populnea

Compounds	Roots	Stem bark	Leaves
Phenol	+	+	+
Alkaloid	++	++	++
Saponin	+	ND	+
Flavonoids	+	ND	+
Tannin	+	+	ND
Terpenoid	++	++	++
Steroids	ND	ND	ND

Note: ND means not detected

The qualitative phytochemical screening of the root, stem, bark, and leaves of Cissus populnea was displayed in Table 3. Flavonoids, phenol, alkaloids, saponins, tannins, and terpenoids were detected in the root of Cissus populnea. Stem bark analysis revealed that phenol, tannin, terpenoid and alkaloid were present. Additionally, phytochemical screening of the leaf revealed the presence of phenol, terpenoid, alkaloid, flavonoid, and saponin. Steroids was not detected in all section of the plant. The presence of alkaloids, flavonoids, saponin, tannins, terpernoids and phenols in some parts of the plant was in accordance with qualitative phytochemical screening of cissus populnea stem bark done by (Achikanu & Ani, 2020). The absence of steroids in all cissus populnea parts was in agreement with report of (Onojah et al., 2015). The presence of these phytochemicals was an indication that the root, stem bark and leaves of Cissus populnea could be a good source of bioactive compounds useful for medicinal purposes. Reports from various studies show that alkaloids possess antimalarial, anticancer, antiasthma (Kittakoop et al., 2014), antiarrhythmic, vasodilatory (Karanth et al., 2023), analgesic, hypoglycemic and antibacterial activities (Shi et al., 2014). Flavonoids are antioxidants and possess antiinflammatory, anti-allergic (Sharma et al., 2023), anti-microbial, anti-diarrheal and anti-cancer properties. Saponins possess anti-cancer property (Sun et al., 2009). Tannins aid in speeding up blood clotting processes, reduction of blood pressure, modulation of immune-response and in reduction of plasma lipid (Williams et al., 2019). Terpenoids are useful in the management and treatment of malaria, ulcer and cancer; also possess antimicrobial and diuretic activity (Ghasemzadeh & Ghasemzadeh, 2011).Phenols also possess antioxidant activities and anti-carcinogenic properties (Ghasemzadeh *et.al*., 2011).

4. Conclusion

The study's findings demonstrated that Cissus populnea stem, leaves, and roots are good providers of important minerals, including calcium, magnesium, potassium, iron, and manganese, as well as other nutrients. The plant root had high carbohydrate content. The study also revealed that cissus root, stem bark and leave extract contain a variety of phytochemical compounds that can effectively shield the body from oxidative stress brought on by free radicals. As a result, they may be utilised as a natural food source or as a source of powerful therapeutic chemicals. Both the root and the stem of Cissus populnea are good sources of calcium and potassium. For this reason, we recommend that all the parts contain good nutrient and appreciable amount of qualitative phytochemical properties.

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Author Contributions

Conceptualization: NA and CE
Formal analysis: NA and CE
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Investigation: NA and CE
Methodology: NA and CE
Data analysis: NA and CE
Writing – original draft, review & editing: NA and CE

Availability of Data Statement

The article contains the original contributions to the study; for further information, contact the author.

Conflict of Interest

The authors declare that there is no conflict of interest.

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