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Ethnobotanical Insight Into Sickle Cell Disease Management: A Comprehensive Study Of Medicinal Plants Utilized In Ondo Local Government Area, Ondo State. Nigeria.

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Abstract:
This research provided an in-depth ethnobotanical analysis of medicinal plants used in managing sickle cell disease in Ondo West Local Government Areas of Ondo State, Nigeria. Through the administration of semi-structured questionnaires, interviews and discussions data were collected from traditional healers, herb sellers, and knowledgeable locals. A total of 30 plant species belonging to 23 different families were identified and documented. The family of Fabaceae is the most represented with three medicinal plant species. Most of the plant species were Herbs (67%), followed by trees (19%) and shrub (14%). The plant parts used were Leaves (57%), Fruits (27%), roots (12%), seed (6%), whole plant (3%) respectively. The whole part of Aristolochia and Newbouldia laevis plants were used. The mode of preparation and administration ranges from decoction (60%), powder (13%), infusion (10%), maceration and juice (6.7%), and by chewing (3.3%) respectively. The study identified and authenticated the properties and bioactive composition of the leaves of the commonly mentioned medicinal plants, Justicia carnea and Carica papaya. The Carica papaya contains more of alkaloids 24.540±24.53 than Justicia carnea with 5.880±5.85. Also, the Flavonoids present in Justicia carnea amounted to 155.246±155.26 while Carica papaya has 36.232±36.25. The findings justified the importance and potential of botanical knowledge as an alternative or supplementary treatments for sickle cell disease. This study not only validates the ethnobotanical practices in the region but also offers a foundation for future pharmacological research.

Keywords: *Ethnobotany, Sickle Cell Disease, Medicinal Plants, alternative medicine, bioactive ingredients.*

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I. Introduction

Sickle cell disease (SCD) is a debilitating genetic disorder marked by abnormally shaped red blood cells, predominately affecting populations in Africa, South America, and Asia. It also present among Mediterranean and Middle Eastern groups (Ohene-Frempong *et al.*, 2023). SCD poses a significant health challenge (Platt *et.al.*, 2020), characterized by painful episodes, chronic anaemia, and organ damage. Annually, around 300,000 babies are born with SCD, 80% of them in Africa, with an estimated 100,000 cases in the United States, mainly among African Americans (Ohene-Frempong *et. al*., 2023). Also, SCD is estimated to contribute to an equivalent of 50% of under-five deaths, with up to 16% in some countries such as Nigeria and half of the affected children live beyond their fifth birthday (Ahmed, 2020). The highest frequency of sickle cell disease is found in tropical regions, particularly Sub-Saharan Africa, India and the Middle-East (Egesa *et. al*., 2022).

In regions like Nigeria, traditional medicine, with the use of medicinal plants, has been a cornerstone in managing SCD's painful crises (Adebayo *et al*., 2023). Scientific studies have begun to validate the anti-sickling properties of various plant extracts traditionally used in various communities (Ananth *et al*., 2021). Despite the success of advanced treatments like bone marrow transplantation and gene therapy, their high costs and logistical challenges make them inaccessible in many developing countries (Ohene-Frempong *et al*., 2023). Consequently, many current pharmaceutical interventions for SCD are either neglected or SCD patients taking incomplete dosage because of the cost and availability of the drugs, especially in the rural areas Ananth *et al*., 2021

Medicinal plants are a diverse group of plants that have been used throughout history to treat a wide range of ailments (Süntar, 2020). They are found to be effective and cheaper than synthetic drugs. Also, they contain a variety of bioactive compounds, including alkaloids, flavonoids, terpenoids, and phenolic acids, which

have been shown to have various therapeutic effects (Abdulrahman *et al.*, 2022; Shrinet *et. al*., 2021; Agbai *et al*., 2023).

The *Justicia carnea* and *Carica papaya* among other identified plants were found to be commonly used effectively in the study area to manage SCD crises. *Justicia carnea* belongs to the family "Acanthaceae''. It is a plant known for its powerful medicinal properties. This plant is called *Ewe Eje* or *Ewe Aleri* in the Yoruba Language and *Ogwu Obara* in the Igbo Language. It is a medicinal plant that is used conventionally as blood tonic from time immemorial in Nigeria (Akintimehin *et al.*, 2023).

Carica papaya belongs to Caricaceae family and it is commonly known as 'papaya'. *Carica papaya* is used as anti-inflammatory, antioxidant, diuretic, antibacterial, abortifacient, vermifuge, hypoglycemic, antifungal activity etc. (Shinde, and Bhailume, 2022; Afolabi *et. al*., 2023; Soares *et. al*., 2023;). Scientific evidences suggest their versatile biological function that supports its traditional use in different diseases.

This study focuses on the traditional use of medicinal plants for SCD management in Ondo State, Nigeria. Given the limited treatment options and the challenges associated with existing ones, the study emphasizes the need to bridge traditional and modern medicine through identification and documentation of medicinal plants used for SCD management.

II. Materials And Methods

The study was centered in Ondo West Local Government Areas of Ondo State, Nigeria, and sought to investigate ethnobotanical practices in the management of Sickle Cell Disease. The methods of Hussain *et al.*, (1996) was used to record and reports the folk use of plants by the assistance of 50 local people who are aware with indigence use of plants in the study area. Informants were made to provide useful information on the importance of medicinal plants and their application in the treatment of SCD. Following the Worldwide Society of Ethno biology (ISE) code of ethics, the interview was conducted in sociable environment to allow the informers to response the questions logically. Ethnobotanical data were collected through verbal interview and Semi-Structured Questionnaires, as developed by Galabuzi, *et al.*, (2010); Rashid and Simmonds (2004). Field works consisted of plant collection, photography and data documentation were also done. The Questionnaires is consisting in two portions, in which the first portion is about personal information like age,educational level and gender of the informers, while the other portion was the documentation on the mode of application and methods of preparation used. The interview was conducted in local language/dialet of the area. The herbalists are interviewed at their local places. Botanical and families names were affirmed by the assistance of the curator at the Herbarium unit of Ekiti-State University, Ado-Ekiti, Ekiti-State. Also, plants were equally identified using online site: http://www.theplantlist.org (The Plant List), (The International Plant Name Index) http://www.ipni.org and Kew naming framework www.mpns.kew.org/mpns entryway. The identified species were air dried, labelled and deposited at the Herbarium while some were used to determine the presence of bioactive ingredients of the frequently mentioned plants.

The data obtained was subjected to a descriptive statistical analysis.

Quantitative Investigation

i. **Relative Frequency of Citation (RFC)**

The area information is foreseen quantitatively using Frequency of citation (FC) and Relative Frequency of citation (RFC) Yaseen, *et. al*, (2015) .

The RFC was found out to exhibit the solidarity between the observers on the use of helpful plants around there. It is figured by the going with formula using equation as shown below

$RFC=FC \div N \ (O<RFC<1)$

Where,

FC is the quantity of sources that referred to the species Relative Frequency of Citation (RFC), and N are the aggregate number of sources partakes in the investigation.

The estimation of RFC relies upon the referring to portion of sources for that species.

ii. Informant Consensus Factor (ICF)

The combination used for the calculation of plant species, by using the following formula as reported by Iqbal, *et al.*, 2014;

$ICF= Nur – Nt \div Nur-1 \ (2)$

Where,

Nur: Stands for total number of use reports for each disease category and

Nt: Stands for number of taxa used for the specific category

Phytochemical Analysis

The leaves of the frequently mentioned plants, *Justicia carnea* and *Carica papaya* in the study area were collected and scientifically identified with the assistance of the curator at the University Hebarium unit.

The plants were cut into bits, air dried for two weeks, after which they were pulverized into powder, using Thomas Wiley mechanical blender before being subjected to both qualitative and quantitative phytochemical analysis. The powdered leaves were examined for the presence of alkaloids, flavonoids, glycosides, and phenol.

Alkaloids:

Determination of alkaloid: The percentage of alkaloid was assessed in plant samples using Essack *et al.* (2017) method. Five grams of plant samples were mixed with acetic acid (200 mL, 10%), and the slurry was left to stand at room temperature for 4 h. The mixture was filtered and concentrated to 50 mL using a rotary evaporator at 60 ºC. A concentrated solution of NH_4OH (1 mL) was added dropwise to the slurry until the precipitate was completely formed. After settling, the precipitated was collected, washed (water and ammonium hydroxide), filtered, dried at room temperature then weighed.

Flavonoids:

The spectrophotometric procedure outlined by Chang *et al.* (2002) was adopted for determining the concentration of flavonoids in each specimens. Five ml of diluted ammonia solution was added to a portion of the aqueous filtrate of each plant extract, followed by addition of concentrated sulphuric acid. Colour changes were observed to draw inference

Cardiac glycosides:

The Keller-Killani test was used. 5 ml of the powdered leaf sample of all the plants studied was treated with 2 ml of glacial acetic acid, containing one drop of Ferric Chloride solution. This was underlay with 1 ml of concentrated sulphuric acid. Colour changes were observed to draw inference.

III. Result And Discussion

The findings of this study shows the demographic characteristics of the respondents. The gender distribution of the respondents revealed 40% (20) male, while 60% (30) were female. The percentage distribution showed that 36% (18) of the respondents were between the ages of 20-40years, 44% (22 respondents) were between the age of 41-60years and while 20% (10 respondents) were above 61years (Table 1). Many of the respondents were Illiterates (Table 1).

A total of 30 plant species belonging to 23 different families were identified and documented. The species are arranged in alphabetical order. Their botanical name, family name, common name, local name and plant parts used were documented. The family Fabaceae is the most represented with three medicinal plant species. Most of the plant species were Herbs (67%), followed by trees (19%) and shrub (14%). The plant parts used were Leaves (60%), Fruits (23%) followed by roots (13%), while seeds 6%. The whole plants parts of *Aristolochia* and *Newbouldia laevis* species (3%) were reportedly used. The methods of preparation and mode of administration reported in this survey indicated that remedies could be prepared as powders, decoction, infusion, boiling, soaking, tincture, and juice. The decoction was obtained by boiling the plant parts in water for a while in order to extract the bioactive substances in the samples, the powder was prepared by the grinding of air-dried plant parts. The paste was prepared by crushing the fresh plants or dried plant parts.Some involved soaking in alcohol for few days before taken (tincture). This ensures deep and total increase in extraction of the extracted samples. The remedies are typically administered orally (Table 2) and Figures 1,2,3 respectively. The frequency of citation of the plants species and their use mention indices were reported in Table 3; fig. 5 below. *Justicia carnea (L), and Caricca papaya* were commonly mentioned than the other plants. The frequency of mention index is a measure of the medicinal relative importance of a plant species to a particular use. It is calculated by dividing the number of times a plant species is mentioned for a particular use by the total number of times it is mentioned for all uses.

Table 4 revels the combinations of plants listed having synergistic effects. This means that the combinations of these plants are better used and they are more effective than any of the individual plants on their own. This information can be used to develop new and more effective herbal remedies for managing SCD crises.

TABLE 1: Socio-Economic Characteristics of the Respondents in the Study Area.

Variables	Demographic categories	Number of respondents	Total (%)
Sex	Male	20	40
	Female	30	60
Age	20-40years	18	36
	41-60years	22	44
	61-120years	10	20
Religion	Muslims	29	58
	Christianity	15	30
	Others	6	12

Education status	Illiterates	28	56
	Literates:		
	I. Primary	8	16
	II. Secondary	6	12
	III. Undergraduate	3	6
	IV. graduate	5	10

TABLE 2: List of Medicinal Plants Used in the Management of Sickle Cell Disease in the Study Area.

S/N	Botanical Name & Authority Name	Family Name	Common Name	Local Name	Part Used	Form	Mode of Preparation	Mode of Administration
1.	*Aframomum melegueta* (*K*)	Zingiberceae	Aligator Pepper	Atare	Fruit	Herb	Powder	Oral
2.	*Anacardium occidentale (L)*	Anacardiaceae	Cashew	Kaju/kasu	Stem bark/leaves	shrub	Infusion	Oral
3.	*Ananas comosus* (*M*)	Bromeliaceae	Pineapple	Ekinkun	Fruit	Herb	Juice	Oral
4.	*Aristolochia bracteata* (*M*)	Aristolochiaceae	Pipevine	Akoigun/ Areogun	Whole plant	Herb	Maceration	Oral
5.	*Bryophyllum pinnatum (L)*	Crassulaceae	Miracle Leaf	Abamoda	Leaves	Herb	Powder	Oral
6.	*Cajanus cajan (L)*	Fabaceae	Pigeon pea	Otili	Seed	Herb	Decoction	Oral
7.	*Carica papaya (L)*	Caricaceae	Pawpaw	Ibepe	Leaves	Shrub	Decoction	Oral
8.	*Citrus aurantifolia (S)*	Combretaceae	Lime	Osan wewe	Fruit/leaves	Shrub	Juice	Oral
9	*Cucurbita maxima (D)*	Cucurbitaceae	Pumpkin	Ewe esin	Leaves	herbs	Infusion	Oral
10	*Corchorus olitorius (L)*	Malvaceae	Jute	Eweedu	Leaves	Herb	Decoction	Oral
11	*Citrus sinensis (L)*	Rutaceae	Orange	Osan mumu	Fruit/leaves	Tree	Decoction	Oral
12	*Combretum racemosum (PBeauv.)*	Combretaceae	Bush willow	Arunbiesuru	Root/leaves	herbs	Decoction	Oral
13	*Dysphania ambrosioides (L)*	Amaranthaceae	Worm grass	Arunpale	Root/leaves	Herb	Decoction	Oral
14	*Elaeis guineensis (J)*	Arecaceae	Oil palm tree	Igi ope	Stem bark	Tree	Powder	Oral
15	*Garcinia kola (H)*	Clusiaceae	Bitter kola	Orogbo	Fruit	Tree	Decoction	Oral
16	*Justicia carnea (L)*	Acanthaceae	Water willow	Ewe eje	Leaves	Shrub	Decoction	Oral
17	*Khaya grandifolia (C)*	Meliaceae	African mahogany	Oganwo	Stem bark/leaves	Tree	Maceration	Oral
18	*Mangifera indica (L)*	Anacardiaceae	Mango	Mangoro	Bark/leaves	Tree	Decoction	Oral
19	*Newbouldia laevis* (P)	Bignoniaceae	Boundry tree	Ewe Akoko	leaves	Tree	Decoction	Oral
20	*Olax subscorpioidea* (O)	Olacaceae	Indigo	Ifon	Root	Tree	Decoction	Oral
21	*Piper guineense (S)*	Piperaceae	Black pepper	Iyere	Seed	Herb	Powder	Oral
22	*Pterocarpus osun (R)*	Fabaceae	Wing fruit	Osun	Stem Bark/leaves	Tree	Decoction	Oral
23	*Rauvolfia vomitoria (A)*	Apocynaceae	Swizzle stick	Igi asofeyeje	Root/leaves	Tree	Infusion	Oral
24	*Sorghum bicolor (L)*	Poaceae	Guinea corn	Poporo	Leaves	herb	Decoction	Oral
25	*Terminalia superba (E)*	Combretaceae	White afara	Afara	Stem bark	Tree	Decoction	Oral
26	*Tetrapleura tetraptera (S)*	Fabaceae	Canopy	Aidan	Fruit	Tree	Decoction	Oral
27	*Vernonia amygdalina (D)*	Compositae	Bitter leaf	Ewuro	Leaves	Shrub	Decoction	Oral

28	*Waltheria indica (L)*	Malvaceae	Sleepy morning	Ewe epo	Leaves	Shrub	Decoction	Oral
29	*Xylopia aethiopica (A)*	Annonaceae	Ethiopia pepper	Arunje/Aruje	Fruit/leaves	Tree	Decoction	Oral
30	*Zanthoxylum zanthoxyloides (L)*	Rutaceae	Sichuan pepper	Orin ata	Stem/leaves	Tree	Chewing	Oral

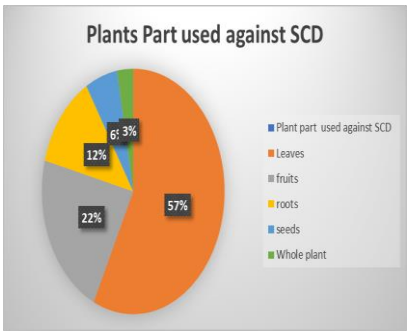

FIG 1: Plants Part used against SCD

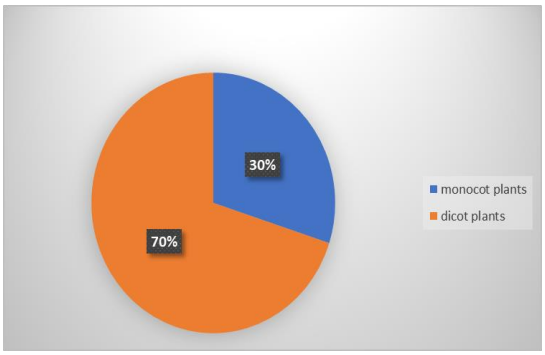

FIG: 2 Plant diversity in the study area

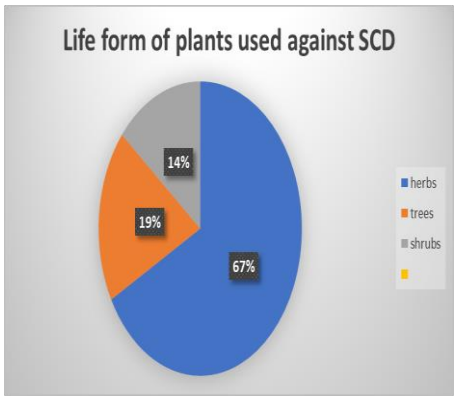

FIG: 3 Life form of Plants used against SCD

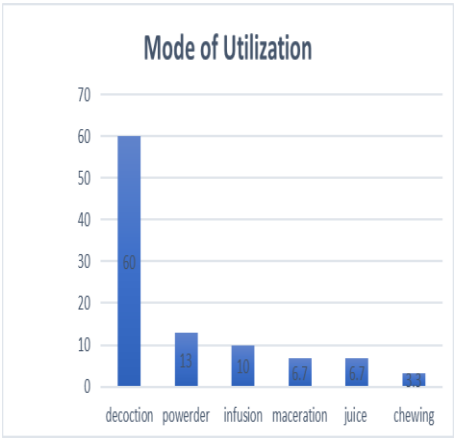

FIG: 4 Mode of Utilization

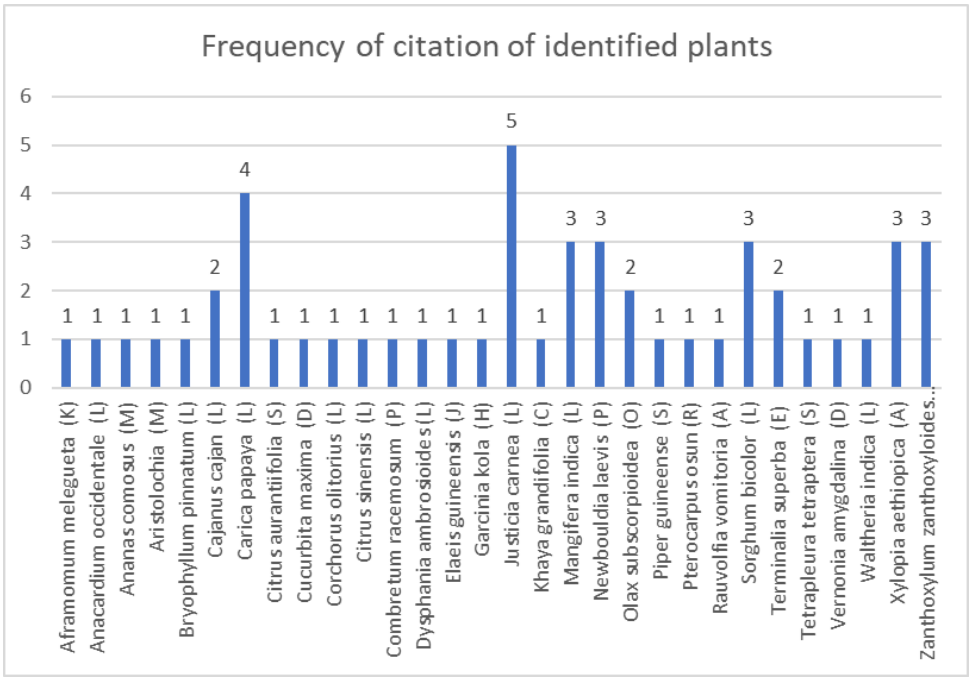

Fig: 5 Frequency of Citation of Identified Plant

TABLE 3: Frequency of the citation of Plant Species identified.

S/N	Botanical Name	Frequency of citation	Relative frequency of citation	Relative frequency of citation (%)
1.	*Aframomum melegueta* (K)	1	0.02	2
2.	*Anacardium occidentale (L)*	1	0.02	2
3.	*Ananas comosus* (M)	1	0.02	2
4.	*Aristolochia* (M)	1	0.02	2
5.	*Bryophyllum pinnatum (L)*	1	0.02	2
6.	*Cajanus cajan (L)*	2	0.04	4
7.	*Carica papaya* (L)	4	0.08	8
8.	*Citrus aurantiifolia* (S)	1	0.02	2
9.	*Cucurbita maxima* (D)	1	0.02	2
10.	*Corchorus olitorius (L)*	1	0.02	2
11.	*Citrus sinensis (L)*	1	0.02	2
12.	*Combretum racemosum (P)*	1	0.02	2
13.	*Dysphania ambrosioides (L)*	1	0.02	2
14.	*Elaeis guineensis (J)*	1	0.02	2
15.	*Garcinia kola (H)*	1	0.02	2
16.	*Justicia carnea (L)*	5	0.1	10
17.	*Khaya grandifolia (C)*	1	0.02	2
18.	*Mangifera indica (L)*	3	0.06	6
19.	*Newbouldia laevis (P)*	3	0.06	6
20.	*Olax subscorpioidea (O)*	2	0.04	4
21.	*Piper guineense (S)*	1	0.02	2
22.	*Pterocarpus osun (R)*	1	0.02	2
23.	*Rauvolfia vomitoria (A)*	1	0.02	2
24.	*Sorghum bicolor (L)*	3	0.06	6
25.	*Terminalia superba (E)*	2	0.04	4
26.	*Tetrapleura tetraptera (S)*	1	0.02	2
27.	*Vernonia amygdalina (D)*	1	0.02	2
28.	*Waltheria indica (L)*	1	0.02	2
29.	*Xylopia aethiopica (A)*	3	0.06	6
30.	*Zanthoxylum zanthoxyloides (L)*	3	0.06	6

TABLE 4: Synergistic Effects of the identified Plants to treat SCD symptoms in the Study Area.

S/N	Name of Plants	Part Used	Disease symptom treated	Method of Preparation	Mode of Administration
1.	*Vernonia amygdalina, Garcina kola, Newbouldia laevis and Zanthoxylum zanthoxyloides*	Leaf, stem bark, root and stem	Severe fatigue or tiredness; swelling of hands and feet, associated with pains	The plant materials are boiled in water(15-20minutes)	Half glass cup (150ml) of the remedy is taken twice daily after food
2.	*Citrus medica and Citrus sineensis*	Fruit	Vision problems	The fruit juice is mixed with a tablespoon of honey	The mixture is taken once daily
3.	*Bryophyllum pinnatum, Xylopia aethiopica, Piper guineense and Aframomum melegueta*	Leaf, fruit and seed	Swelling of hands and feet, associated with pains; Delayed growth noted in children and adults	The plant materials are extracted in red wine	1cup of the mixture is taken once daily
4.	*Mangifera indica, Carica papaya, Zingiber officinale and Allium sativum*	Fruit, leaf, rhizome and bulb	Frequent episodes of pain, also known as crises in different parts of the body; Severe fatigue or tiredness	The plants are washed and boiled for 15-20minutes	250ml of the remedy is taken once daily
5.	*Sorghum bicolor and Theobroma cocao*	Leaf and bark	Anaemia (low red blood cell); swelling of hands and feet, associated with pains	The plant materials are boiled for 15-20minutes	1glass cup of the remedy is taken twice daily

6.	*Tetrapleura tetraptera and Allium ascalonicum*	Fruit and leaf	Frequent infections; Severe fatigue or tiredness	The plant materials are cut into small pieces and boiled	Honey is added to the extract and 1cup of the remedy is taken twice daily (morning and night)

Qualitative Phytochemical Analysis of *Carica papaya* and *Justicia carnea*

The phytochemical composition of *Carica papaya* and *Justicia carnea* was disclosed in table 5. It was revealed that Alkaloids, Glycosides, Phenol were present in *Carica papaya* and *Justicia carnea*. However, Flavonoids was found in a moderate amounts in *Carica papaya* and strongly present in *Justicia carnea*.

Table 5. Qualitative Phytochemical of *Carica papaya* and *Justicia carnea*

Parameters	*Carica papaya*	*Justicia carnea*
Alkaloids	++	+
Phenols	+	+
Flavonoids	++	+++
Glycosides	++	+

NOTES: +: Present, ++: Moderately present, +++: Strongly present

The table 6 below revealed that the plants contain bioactive ingredients in appreciable quantities. The alkaloids content of the plant species falls between 5.880±5.85 in *Justicia carnea* to 24.540±24.53 in *Carica papaya*, the glycosides content of the plant species ranged between 0.910±0.92 in *Justicia carnea* and 5.120±5.18 in *Carica papaya*. Phenol contents of plant species varied from 3.368±3.35 in *Carica papaya* to 3.551±3.54 in *Justicia carnea*. While the flavonoids content of plant species was 36.232±36.25 in *Carica papaya* while it was 155.246±155.26 in *Justicia carnea*.

Table 6: Quantitative Phytochemical of *Carica papaya* and *Justicia carnea*

Parameters	Alkaloids	Phenols	Flavonoids	Glycosides
Carica papaya	24.540±24.53	3.368±3.35	36.232±36.25	5.120±5.18
Justicia carnea	5.880±5.85	3.551±3.54	155.246±155.26	0.910±0.92

IV. Discussion

The study is a valuable contribution to the field of Ethnobotany. The study investigated the medicinal plants that are utilized for the management of Sickle Cell in Ondo State, Nigeria.

Sickle Cell Disease is a genetic disorder that affects the haemoglobin in red blood cells (Tisdale *et al*., 2020). Haemoglobin is responsible for carrying oxygen throughout the body. In people with Sickle Cell Disease, the haemoglobin is abnormal and can form crescent-shaped cells. These crescent-shaped cells can block blood vessels, causing pain and other health problems (Yeruva *et al.*, 2021).

There is no cure for sickle cell disease, but there are treatments with the use of herbal mixtures that can help to manage the symptoms and prevent complications (Ballas, 2018). In the study, medicinal plants like *Justicia carnea, Carica papaya Vernonia amygdalina, Garcina kola, Newbouldia laevis, Zanthoxylum zanthoxyloides, Citrus medica* were identified and are used to manage sickle cell disease in Ondo State. Leaves are more frequently use as compared with other parts of the identified plants. The use of leaves in herbal medicine was found commonly in several ethnomedicinal studies Ahmad (2011); Jasvinder *et al*.,(2012); Kayani *et. al*., (2014), Jasvinder *et al*. Prabhu *et. al*., (2021), Ihinmikaiye *et. al*., 2022; Olanipekun *et. al;* 2022; Olanipekun 2023. However, the regular use of leaves does not mean that the other plant parts having fewer or no active elements. Also, leaves are vigorous in photosynthesis and production of metabolites (Ghorbani, 2005), collection is quite easier as compared to roots, tubers and according to conservation point of view. It is noteworthy that the whole plant body could contains active elements.The presence of bioactive ingredients could responsible for the efficacies when used to make herbal remedies. This can be clarified by the way the most informants acquired traditional knowledge, this has being used by try and error over a period of times. This is different from scientific learning. However, the use of stem bark, roots, and the whole plants were not scientific. It could be rarely used or discouraged. The practice could lead to the death of the whole plants. Olanipekun *et. al*; 2022; Olanipekun 2023; Rehman *et.al.*,(2015).

Life form, parts used, preparations

The study area falls in temperate climatic region and has a rich floral diversity, represented by a large number of plant species. The medicinal plant diversity shows and the frequent use of herbs among the indigenous communities could be due to the rich wealth of herbaceous plants in the environments (Ayyanar and Ignacimuthu, 2005; Uniyal *et al*., 2006). The practice is natural, less toxic, and does not develop resistance against the disease caused organisms. Leaves (60%) were mostly and often used for the preparation of herbal

medicine exclusively or mixed with other plant parts (Mahishi *et al*., 2005; Ignacimuthu *et. al*., 2006, 2008; Srithi *et al*., 2009; Cakilcioglu and Turkoglu, 2010; Giday et al., 2010; Gonzalez *et. al*., 2010). The preparation of herbal remedies by various methods ensure deep and total increase in extraction of the plant samples. The remedies are typically administered orally for the treatment of Sickle Cell Disease. It is a common practice among the ethnic communities in Akure, Ondo-State. This is in agreement with some other studies conducted elsewhere (Ssegawa and Kasenene, 2007; Andrade-Cetto, 2009; Lee *et al*., 2008; Samy *et al*., 2008; Poonam and Singh, 2009).

Oral administration is better and effective because the body absorbs it as quick as possible, thus generate relief and effectiveness to the various symptoms Beri *et. al.*, (2021).

Frequency of Citation (FC) of Mostly Reported Medicinal Plants and Their Uses

In the present study, the most cited plant is ***Carica papaya*** **and** ***Justicia carnea.*** The high frequency of citations of medical plants mean these plants are well known and are more frequently used by the local informers, thus shows the reliability and effectiveness of the plants. In this study, highest number of citations is of ***Carica papaya*** **and** ***Justicia carnea.*** They are which is used to treat Helmelenthesis, Diabetes, Dysentery, Liver inflammation, Kidney stone Carbohydrates.

It was also found during interview of the respondents and the local traditional healers that most of the peoples use wild plants species for the management of various diseases ranging from fever, stomach pain, kidney stone and other different illnesses. Many of the plants are very common in the study area, and they are used both as medicine and as vegetable for primary health care as well for food. The study found that the people of Ondo State have a deep knowledge of medicinal plants and their use in the management of Sickle Cell Disease. This knowledge is an important part of the cultural heritage in the study area and should be preserved.

The study also found that some of the medicinal plants used to manage sickle cell disease have been shown to have biological activity. For example, *Justicia carnea* and *Carica papaya* have both been shown to have anti-inflammatory and antioxidant properties (Shrinet *et. al*., 2021; Abdulrahman *et al*., 2022; Agbai *et al*., 2023;). These properties may be beneficial for people with sickle cell disease, as inflammation and oxidative stress are thought to play a role in the disease.

In conclusion, this study provides insights into the use of herbal mixture or the use of medicinal plants to manage sickle cell disease in Ondo State. The identified plants could be used as the basis for the development of novel drugs and the local knowledge can be used to develop new and more effective treatments for the management of sickle cell disease.

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