

Diversity and Ethnobotany of Traditional Plants used in the Management of Heart Diseases in Nasarawa State

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Abstract

Cardiovascular diseases (CVDs) are a major public health challenge globally, particularly in developing regions where access to modern healthcare is limited. Traditional medicine remains an integral part of healthcare systems, especially in rural communities. This study investigates the diversity and ethnobotanical knowledge of medicinal plants used in the management of heart diseases in Nasarawa, Nigeria. Ethnobotanical surveys were conducted through semi-structured interviews with local herbalists, traditional healers, and knowledgeable community members. A total of 32 plant species belonging to 25 families were documented, with *Moringa oleifera*, *Carica papaya*, and *Allium sativum* identified as the most frequently cited plants for managing hypertension, heart palpitations, and related ailments. Quantitative ethnobotanical indices such as Relative Frequency of Citation (RFC) and Fidelity Level (FL) were used to assess the importance of each species. The study highlighted the rich ethnobotanical knowledge of the Nasarawa community, emphasizing the need for further pharmacological studies to validate the efficacy and safety of these plants. The qualitative phytochemical analysis revealed that all the three most used plants has alkaloids, flavonoids, phenolic compound, tannins and saponins although with exemption of resin which is present in *Allium sativum* but absent in the other two plants. The quantitative phytochemical revealed that *Moringa oleifera* has the highest concentration of alkaloids, flavonoids, saponins and phenol compared to *Allium sativum* and *Carica papaya*. The antioxidant activity of the plants demonstrated a concentration dependent increase in inhibition, the higher the concentration the higher the inhibition. The presence of phytochemicals and their antioxidant activity which are known for their cardio-protective properties confirmed the efficacy of the plants for ethnobotanical use in the management of heart diseases. Therefore, conservation efforts and the integration of traditional medicine into primary healthcare systems are recommended to preserve this valuable knowledge.

Introduction

Cardiovascular disorder (CVD) is the leading cause of mortality globally (Roth et al., 2020). CVD encompasses many problems, including cardiac

muscle diseases and the vascular system that supplies the heart, brain, and other essential organs. Humans have long utilized medicinal and aromatic plants (MAPs) to cure and combat illness. Traces of its usage may be found in all ancient



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civilizations and continents. Thus, despite advances in pharmacology, the medicinal use of plants is still prevalent in certain countries, particularly in impoverished nations (Manusirivithaya et al., 2023).

Plants have been used in traditional medicine for several thousand years. From the time immemorial, human civilizations have been exploring and using various plants and plant products to cure the lethal diseases. Different plants species and their uses as medicine are greatly well-known to indigenous communities in different parts of the world. Local people are specialist for mounting inventive practices and products from their surrounding environment particularly, the plant world (Balkrishna et al., 2024). Many drugs are of plant origin, and several plants are currently undergoing investigation to ascertain their therapeutic efficacies. The knowledge about the use of traditional herbal medicines gradually perishes, although some of the traditional tribal communities and some human beings which believed in the usage of herbal medicines are still practicing the art of herbal healing effectively (Tirgar & Kalpesh, 2017).

Herbal or botanical medicine, or phytotherapy, was defined as “the use of plant materials to prevent and manage ill health or promote wellness”. The use of herbs as medicine is the oldest form of healthcare known to humanity and has been used in all cultures throughout history. Herbal medicine is widely practiced throughout the world from time immemorial. These medicines are safe and environment friendly. The indigenous traditional knowledge of medicinal plants of various ethnic communities, where it has been transmitted orally for centuries is fast disappearing from the face of the earth due to the advent of modern technology and transformation of traditional culture (Azhar et al., 2019). In the last few decades there has been an increasing interest in the study of medicinal plants and their traditional use in different parts of the world. The traditional healers are dwindling in number and there is a grave danger of traditional knowledge disappearing soon since the younger generation is not interested in the knowledge and conservation.

Medicinal plants include all plant types employed in herbal medicine and they are considered the bedrock of traditional medicine. They contain numerous chemical components (predominantly secondary metabolites) responsible for eliciting their protective/curative effects and are continually harnessed for the development of pharmaceutical drugs. Medicinal plants have been in use since the history of man and they are employed daily for managing various ailments like malaria, diabetes, cancer, diarrhoea etc (Kumar et al., 2021).

In recent decades, plants have become essential sources of both preventative and therapeutic traditional medicinal preparations for humans and animals. Plants are also significant in global business nowadays. In the lack of an excellent medical system, the demand for medicinal plants increases daily in underdeveloped and industrialized countries (Zhang et al., 2018).

Materials and Methods

Study Area

Nasarawa State is located in the North Central region of Nigeria as represented in figure 1 below. The state is bordered to the east by the states of Taraba and Plateau, to the north by Kaduna State, to the south by the states of Benue and Kogi, and to the west by the Federal Capital Territory. It consists of thirteen local government areas (Karu, Keffi, Obi Nasarawa, Eggon, Awe, Doma, Wamba, Keana, Lafia, Akwanga, Toto and Kokona). Nasarawa has a Tropical wet and dry or savanna climate. The city's yearly temperature is 29.39, °C (84.9 °F) and it is -0.07% lower than Nigeria's averages. Nasarawa typically receives about 136.71 millimeters (5.38 inches) of precipitation and has 155.37 rainy days (42.57% of the time) annually (Okorie et al., 2013).

In Nasarawa, the dry season is humid and partially cloudy, and it is hot all year long. The wet season is oppressive and overcast. The average annual temperature ranges from 63 to 95 degrees Fahrenheit, rarely falling below 57 or rising above 101 (Agidi et al., 2018). The hot season, with an average daily high temperature exceeding 93 °F, lasts for 2.5 months. Nasarawa's hottest month of the year is March, with an average high temperature of 95 °F and low temperature of 74 °F.

The 3.7-month cool season, which runs from June 22 to October 13, has an average daily maximum temperature of less than 85 °F. Nasarawa experiences its coldest month of the year in December, with average lows of 64 °F and highs of 89 °F (Agidi et al., 2018).

Sample Size Determination

The sample size of 280 persons was determined using the Thushfield formula, which is commonly used for calculating sample sizes in cross-sectional studies. The formula is given as:

$$n = (Z^2 \times P (1 - P)) / (d^2)$$

Where: n is the desired sample size

Z is the Z-value corresponding to the desired confidence level (e.g., Z = 1.96 for a 95% confidence level). P is the estimated frequency of occurrence (in decimal form)

d is the desired level of precision or margin of error.

In this study, the estimated frequency of occurrence of the plants used is 24.0% based on a previous study conducted by (Abd El-Ghani., 2016). The desired level of precision or margin of error (d) is set at 5%.

Using the Thushfield formula, the sample size was calculated as follows:

$$n = (1.96^2 \times 0.24 (1 - 0.24)) / (0.05^2); n \approx 280$$

Data Collection

Ethnobotanical information was obtained from participants using a semi-structured questionnaire as described by Ariyo *et al.* (2020). The participants were purposively selected, comprising herb sellers, traditional health practitioners, farmers, and individuals with indigenous knowledge. The questionnaire was prepared in English. However, to facilitate efficient communication, informal discussion with herb sellers, traditional health practitioners, farmers/hunters, and the elderly was done in their dialect with the help of interpreters, the local language in these local government areas. A total of 280 participants will be interviewed, and the participants was interviewed individually to maintain confidentiality. Data to be collected includes age, gender, occupation, educational background, residence, local names of the plants

used in managing heart disease and related ailments, plant part used, method of preparation/extraction, and administration method. The study and data to be collected was done following the regulations made by the International Society of Ethnobiology (available at <https://www.ethnobiology.net>, accessed on 30 March 2024).

Collection and Identification of Medicinal Plants

Plant collection was done with the help of herb sellers, traditional health practitioners, farmers/hunters using the plants' local names (in their dialect). The scientific identification of plants was made at Botany Laboratory of the University of Abuja and voucher specimens will be prepared and deposited at the herbarium of University of Abuja Botany Department.

Ethnobotanicals Data Analysis

The information (for e.g., plant name and plant part used to manage heart disease) obtained through the ethnobotanical interviews were analyzed. In order to establish the importance of the documented plants used in management of heart disease, the data were analysed using the following ethnobotanical indices.

Relative Frequency of Citation (RFC)

Based on the methods described by Ariyo *et al.* (2020), the Relative frequency of citation (RFC) for plant species mentioned in the study area was evaluated using the formula;

$$RFC = \frac{FC}{N} \quad (1)$$

Where: FC = frequency of citation/mention; N = Number of participants in the survey.

Fidelity Level (FL)

In an attempt to determine the preference of a particular plant species for the management of heart disease in the study area, the fidelity level (FL) was calculated as described by Chaachauay & Benkhniue 2021). High FL indicates high usage of a plant for heart disease while low FL denotes a low frequency for this condition.

$$FL = \frac{I_p}{I_u} \times 100 \quad (2)$$

where : l_p = number of participants that claimed a use of certain plant species to manage a heart disease; l_u = represent total mentions of a plant for all conditions

Collection of Plant Samples

From the information gathered using questionnaires, three most frequently used plant species were gotten and transported to the Biological Sciences Department Laboratory of the University of Abuja for analysis. The Plants were identified and authenticated by a known Botanist from the Department of Biological Sciences of University of Abuja. Fresh plant was harvested, washed in running tap, air dried for two (2) weeks under room temperature and blended into powder using laboratory electric blender. The powder form was stored in airtight glass containers protected from sunlight until required for analysis.

Plant Extracts Preparation

The method of Akara et al. (2021) was employed and modified for preparation. 100 g of the plant sample was weighed and dissolved in 1000 ml of each of the different solvents and allowed to soak for 72 hours at room temperature but stirred regularly at every 12 hours. The solvents used were sterile distilled water and ethanol. The resultant suspensions were filtered into a 1000 ml beaker using muslin cloth reinforced with Whatman's No. 1 filter paper. The extracts were brought to dryness using water bath. The excess extracts were stored in the refrigerator at 4°C for further study/use.

Phytochemical Analysis

Qualitative and quantitative phytochemical analysis were carried out on different extracts to ascertain the presence of bioactive components present. The presence of flavonoids, tannins, terpenes, saponins, sterols, phenols and reducing sugar was determined using the methods described by Sofowora (1996).

Antioxidant activity

To carry out the antioxidant activity, 1,1 Diphenyl 1-2 picryl - hydrazine (DPPH) was used to determine the scavenging effect of the ethanol extract of the most used traditional plants as

obtained through the questionnaire. The analysis was carry out according to the method of AOAC with some modification. The free radical scavenging activity was measured in terms of hydrogen donating or radical scavenging ability using the stable radical DPPH. About 0.1mM of the DPPH in ethanol was prepare and 1ml of this solution was added to 3.0ml of extract solution in ethanol at different concentrations (0.5, 0.25, 0.125, 0.0625, 0.03125mg/ml). Thirty minutes later, the absorbance was measure at 517nm. Lower absorbance of the reaction mixture indicated higher free radical scavenging activity. The same experiment was carried out on ascorbic acid which is known antioxidant as the standard. All the test and analysis were in duplicate and the results obtained was average. Radical scavenging activity was express as the inhibition percentage of free radical by the sample and was calculated using formula:

$$\% \text{ inhibition} = ((A_o - A_1) / A_o) \times 100.$$

Where A_o was the absorbance of the control (blank, without extract) and A_1 was the absorbance in the presence of the extract. All these tests were performed in duplicate and the graph plotted with the mean values

Data Analysis

Data obtained in this study was analyzed statistically using Analysis of Variance (ANOVA) from Ms Excel Statistics (Window 10 version) and the test applied was F-test statistic at $P < 0.05$.

Results

The result of diversity and ethnobotanical survey of plants used in the management of heart diseases in Nassarawa State are presented in the tables below. Out of two hundred and eighty (280) questionnaires administered, only two hundred and seventy (280) were filled and returned.

Demographic Profile of Respondents

Among the 280 respondents, 140 (50%) were male, 125 (44.6%) were female while 15 (5.4 %) preferred not to disclose their gender, Table 1.

Table 2 represents the demographic profile of respondents by age, most of the respondents in this survey were within the age of 41-50 years old with

percentage index of 36.8 % while the least response was gotten from ages 0-10 years with 0 % respondents followed by age 11-20 years old with percentage index of 0.7%, Table 2.

Table 3 represents the demographic profile of respondents by occupation, most of the respondents in this survey were herbalist with percentage index of 33.2 % while the least response was gotten from researchers with percentage index of 5.7 %.

Table 4 represents the demographic profile of respondents by academic qualifications, the highest number of respondent by qualification was primary school with percentage index of 38.6 % while the least response was gotten from those with no formal education with 10.7 % respondents.

Knowledge of Ethnobotanicals used for Heart Disease.

The result obtained from survey on respondents knowledge of the use of ethnobotanicals in management of heart disease showed that 190 respondents i.e 67.9 % of the respondents are very familiar with the use of ethnobotanicals in the management of heart diseases, 25 respondents i.e 8.9% are not familiar with its use while 65 respondents have little knowledge of the use of ethnobotanicals, Table 5.

Table 6 represents respondent's response on the use of ethnobotanicals in management of heart diseases. Among the 280 respondents, 177 (63.2 %) of them has used plant for management of heart disease while 75 (26.8 %) has no idea if the use of ethnobotanicals.

Plants Used for Heart Disease Management

From the survey carried out, different plant species has been listed by different respondents as plants used in management of heart disease in Nasarawa State. Out of 32 plant species identified for the management of heart diseases, *Moringa oleifera* accounted for 14.6 % of most used followed by *Carica papaya* 13.1 % and *Allium sativum* 11.8 %, Table 8.

Results of Plants Relative Frequency (RFC) and Fidelity Level (FL)

The Ethnobotanicals Information in Table 9 provides data on various plant species used in traditional medicine and cultural practices.

RFC indicates how frequently a particular plant is mentioned or cited by participants during ethnobotanicals surveys or interviews. Higher relative frequency (RFC) values mean the plant is more commonly recognized or used by the community. Fidelity level (FL) represents the percentage of informants claiming the use of a specific plant for a particular ailment compared to those mentioning its general use. *Moringa oleifera* (with RFC = 0.50, FL = 135) is the most frequently cited and widely used plant. *Carica papaya* and *Allium sativum* also show high ethnobotanical importance. Plants like *Nerium oleander* and *Piper longum* have the lowest RFC and FL values, indicating they are less commonly used.

Phytochemical Components of the Three Most Used Ethnobotanicals

Table 10 presents the results of the qualitative phytochemical screening of the three most used ethnobotanicals plants in the management of heart diseases, focusing on the presence of flavonoids, steroids, alkaloids, saponins, and tannins etc. all the three most used plants contains alkaloids, tannins, phenolic compound and saponins.

Similarly, the quantitative analysis of the phytochemicals showed that *Carica papaya* has the highest amount of tannins, 1.09 mg/g followed by *Moringa oleifera* 0.41 mg/g. Likewise, *Moringa oleifera* has the highest amount of alkaloids, 0.6 mg/g followed by *Carica papaya* 0.01 mg/g. For flavonoid, saponin and phenol, *moringa oleifera* was observed to contain higher amount compared to the other two most used plants, Table 11.

Antioxidant Activity of Three Most Used Plants in Management of Heart Disease

The results of the antioxidant activities of *Moringa oleifera*, *Carica papaya* and *Allium sativum* are represented in figures 4.4, 4.5 and 4.6 respectively. The antioxidant data demonstrates a concentration-dependent decrease in % inhibition, a pattern consistent across all plant extracts.

Table 1: Demography by Gender

Gender	No of Respondents	Percentage of Respondents (%)
Male	140	50.0
Female	125	44.6
Prefer Not to say	015	5.4
Total	280	100.0

Table 2: Demography by Age

Age	No. of Respondents	Percentage of Respondents (%)
0-10	00	0.0
11-20	02	0.7
21-30	49	17.5
31-40	67	23.9
41-50	103	36.8
51-60	42	15.0
60-above	17	6.1
Total	280	100

Table 3: Percentage Demographic of Respondents by Occupation

Occupation	No. of Respondents	Percentage of Respondents (%)
Researchers	16	5.7
Health Practitioners	68	24.3
Farmers	61	21.8
Herbalists	93	33.2
Others	42	15.0
Total	280	100

Table 4: Percentage Demographic of Respondents by Academic Qualifications

Educational Qualifications	No. of Respondents	Percentage of Respondents (%)
Primary	108	38.6
Secondary	84	30.0
Tertiary	58	20.7
No formal Education	30	10.7
Total	280	100

Table 5: Familiarity with the Use of Ethnobotanicals for Heart Disease Management

Parameter	No. of Respondents	Percentage of Respondents (%)
Very Familiar	190	67.9
Not Familiar	25	08.9
Somehow Familiar	65	23.2
Total	280	100

Table 6 Used Ethnobotanicals for Heart Disease Management Before

Parameter	No. of Respondents	Percentage of Respondents (%)
Yes	177	63.2
No	75	26.8
Indecisive	28	10.0
Total	280	100

Table 7: Plants and Parts Used for Heart Disease Management

Family Name	Common Name	Scientific Name	Part Used	Mode of Use
Moringaceae	Moringa	<i>Moringa oleifera</i> Lam	Leaf	Decoction
Rosaceae	Alpine Strawberry	<i>Fragaria vosca</i> L.	Rhizomes Fruit	
Asteraceae	Garden Lettuce	<i>Lactuca sativa</i> L.	Leaf	Decoction
Cariaceae	Pawpaw	<i>Carica papaya</i> L.	Leaf	Decoction
Myristicaceae	Nutmeg	<i>Myristica fragrans</i> Hoult.	Fruit	Decoction
Fabaceae	Sickle wood	<i>Falcario vulgaris</i> Bernh.	Leaf, Flower	Decoction
Lamiaceae	Spearmint	<i>Mentha spicata</i> L.	Leaf	Decoction
Lamiaceae	Peppermint	<i>Mentha x piperita</i> L.	Leaf	Decoction
Lamiaceae	Lemon Balm	<i>Melissa officinalis</i> L.	Aurial parts and Leaf	Decoction
Fabaceae	Sweet Clover	<i>Molilotos clover</i> L.	Leaf	Decoction
Fabaceae	Alfalfa Leaves	<i>Moticaga sativa</i> L.	Leaf	Decoction
Malvaceae	Common Mallow	<i>Malva noglocta</i> L.	Leaf and Stem	Decoction
Rosaceae	Table Apple	<i>Malus domestica</i> Borkh	Pods and fruits	Eaten Raw
Anacardiaceae	Aam	<i>Mangifera indica</i> L.	Fruit	Eaten Raw
Lamiaceae	Motherwort	<i>Leonurus cardiaca</i> L.	Whole plant	Decoction
Cupressaceae	Common Junipor	<i>Juniporus communis</i> L.	Fruit	Decoction
Asteraceae	Elocampano	<i>Inula helenium</i> L.	Whole plant	Decoction
Apiaceae	Bathar	<i>Semolina asiatica</i> L.	Bark and Root	Decoction
Asteraceae	Gondolia	<i>Gondolia townfortii</i> DC	Leaf	Decoction
Fabaceae	Alfalfa	<i>Modicago sativa</i> L.	Whole Plant	Decoction
Amaryllidaceae	Garlic	<i>Allium sativum</i> L.	Garlic Bulbs	Eaten Raw or Decoction
Oleaceae	Olive	<i>Olea europaea</i> L.	Seeds	Eaten Raw
Lamiaceae	Basil	<i>Ocimum bacilicum</i> L.	Whole plant	Decoction
Nerieae	Nerium	<i>Nerium oleadar</i> L.	Leaf and flower	Decoction
Ranunculaceae	Black caraway	<i>Nigella sativa</i> L.	Fruit and seed	Juicing
Piperaceae	Long pepper	<i>Piper longum</i> L.	Root and fruit	Cataplasma
Apiaceae	Gotu kola	<i>Tontolla asiatica</i> L.	Leaf	Decoction
Zingiberaceae	Tumeric	<i>Curcuma longa</i> L.	Root tuber	Decoction
Clusiaceae	Amsul	<i>Garcina indica</i> Choisy	Leaf	Decoction or Eaten Raw
Asteraceae	Gundelia	<i>Gundelia townfortii</i> DC	Leaf	Decoction
Clusiaceae	Citrin	<i>Garcinia cambogia</i> Desr.	Leaf and fruit	Decoction or eaten Raw
Clusiaceae	Mangosteens	<i>Garcina poduncilata</i> Roxb	Fruit	Eaten Raw

Table 8: Plants considered most effective

Scientific Name	Total No. of Respondent	Percentage of Respondents (%)
<i>Moringa oleifera</i> Lam.	135	14.6
<i>Fragaria vesca</i> L.	40	4.3
<i>Lactuca sativa</i> L.	31	3.3
<i>Carica papaya</i> L.	121	13.1
<i>Myristica fragrans</i> Houtt.	4	0.4
<i>Falcario vulgaris</i> Bernh.	24	2.6
<i>Montha spicata</i> L.	19	2.1
<i>Mentha x piperita</i> L.	7	0.8
<i>Melissa officinalis</i> L.	4	0.4
<i>Molilotos clover</i> L.	46	5.0
<i>Moticaga sativa</i> L.	10	1.1
<i>Malva noglocta</i> L.	43	4.6
<i>Malus domestica</i> Borkh.	9	1.0
<i>Mangifera indica</i> L.	9	1.0
<i>Leonurus cardiaca</i> L.	25	2.7
<i>Juniporus communis</i> L.	53	5.7
<i>Inula helenium</i> L.	35	3.8
<i>Semolina asiatica</i> L.	14	1.5
<i>Gondolia tournotortii</i> DC.	32	3.5
<i>Modicago sativa</i> L.	40	4.3
<i>Allium sativum</i> L.	109	11.8
<i>Olea europaea</i> L.	9	1.0
<i>Occimum bacilicum</i> L.	8	0.9
<i>Nerium oleadar</i> L.	2	0.2
<i>Nigella sativa</i> L.	13	1.4
<i>Piper longum</i> L.	2	0.2
<i>Tontolla asiatica</i> L.	9	1.0
<i>Curcuma longa</i> L.	22	2.4
<i>Garcina indica</i> Choisy.	6	0.6
<i>Gundelia townfortii</i> DC.	11	1.2
<i>Garcinia cambogia</i> Desr.	13	1.4
<i>Garcina poduncilata</i> Roxb	19	2.1

Table 9: Results on Plants Relative Frequency (RFC) and Fidelity Level (FL)

Scientific Name	RFC	FL
<i>Moringa oleifera</i> Lam.	0.50	135
<i>Fragaria vesca</i> L.	0.14	40
<i>Lactuca sativa</i> L.	0.11	31
<i>Carica papaya</i> L.	0.43	121
<i>Myristica fragrans</i> Houtt.	0.01	4
<i>Falcario vulgaris</i> Bernh.	0.09	24
<i>Montha spicata</i> L.	0.07	19
<i>Mentha x piperita</i> L.	0.03	7
<i>Melissa officinalis</i> L.	0.01	4

<i>Molilotos clover</i> L.	0.16	46
<i>Moticaga sativa</i> L.	0.04	10
<i>Malva noglocta</i> L.	0.15	43
<i>Malus domestica</i> Borkh.	0.03	9
<i>Mangifera indica</i> L.	0.03	9
<i>Leonurus cardiaca</i> L.	0.09	25
<i>Juniporus communis</i> L.	0.19	53
<i>Inula helenium</i> L.	0.13	35
<i>Semolina asiatica</i> L.	0.05	14
<i>Gondolia tournortortii</i> DC.	0.11	32
<i>Modicago sativa</i> L.	0.14	40
<i>Allium sativum</i> L.	0.39	109
<i>Olea europaea</i> L.	0.03	9
<i>Ocimum bacilicum</i> L.	0.03	8
<i>Nerium oleadar</i> L.	0.01	2
<i>Nigella sativa</i> L.	0.05	13
<i>Piper longum</i> L.	0.01	2
<i>Tontolla asiatica</i> L.	0.03	9
<i>Curcuma longa</i> L.	0.08	22
<i>Garcina indica</i> Choisy.	0.02	6
<i>Gundelia townfortii</i> DC.	0.04	11
<i>Garcinia cambogia</i> Desr.	0.05	13
<i>Garcina poduncilata</i> Roxb.	0.07	19

Key: RFC: Relative Frequency of Citation; FL: Fidelity Level

Table 10 Results of Qualitative Phytochemical Analysis

Phytochemicals	<i>Allium sativum</i>	<i>Carica papaya</i>	<i>Moringa oleifera</i>
Alkaloid	+	+	+
Flavonoids	+	+	+
Reducing Sugar	-	-	-
Phenolic compound	+	+	+
Tannins	+	+	+
Saponins	+	+	+
Philobatanin	-	+	-
Cholesterols	+	-	+
Terpenoids	-	-	-
Triterpenoids	+	+	-
Coumarins	-	-	-
Resins	+	-	-

Key: +: Present; -: Absent

Table 11: Results for Quantitative Phytochemical Analysis

Phytochemical	<i>Carica papaya</i>	<i>Allium sativum</i>	<i>Moringa oleifera</i>
Tannin @395(mg/g)	1.0924±0.010	0.1521±0.100	0.4093±0.210
Alkaloids @565(mg/g)	0.0194±0.100	0.0044±0.110	0.0641±0.015
Flavoniod@490(mg/g)	0.0571±0.020	0.2742±0.010	0.9965±0.110
Saponins @490(mg/g)	0.3815±0.001	0.1624±0.200	0.5760±0.310
Phenols @505(mg/g)	0.1882±0.001	1.5500±0.011	2.2609±0.013

Values are expressed as mean ± standard deviation from the replicate values.

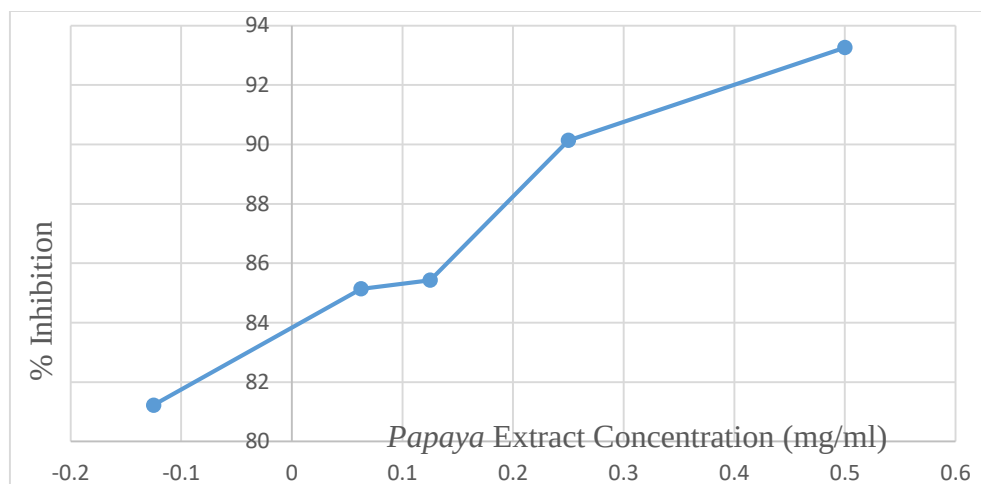


Figure 1: A Graphical Representation of the Antioxidant Concentration of *Carica papaya*

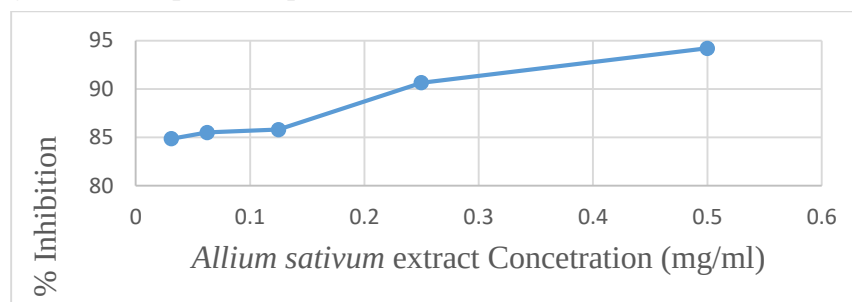


Figure 2: A Graphical Representation of the Antioxidant Concentration of *Allium sativum*

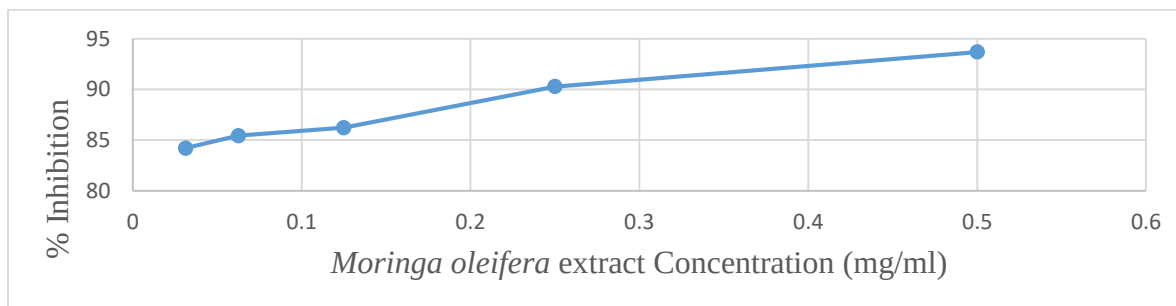


Figure 3: A Graphical Representation of the Antioxidant Concentration of *Moringa oleifera*

Discussion

The use of medicinal plants in the management of heart diseases has been well documented in various ethnobotanical studies. Traditional medicine remains an integral part of healthcare in many developing regions, including Nigeria, where indigenous knowledge plays a crucial role in disease management (WHO, 2019). The present study focused on identifying the most commonly utilized plant species for heart disease management in Nasarawa State, documenting their diversity based on family and genera, exploring

ethnobotanical knowledge associated with these plants, and conducting phytochemical investigations on the three most active species.

The study identified a range of plant species frequently utilized by traditional healers and herbalists in Nasarawa State for the management of heart-related ailments. The findings align with existing ethnobotanical research, such as the study conducted by Gbolade (2012), which reported that traditional healers often rely on indigenous knowledge to select plant species with cardio-protective properties. Similarly, Ogbole et al. (2015)

highlighted that local communities in Nigeria employ medicinal plants for cardiovascular health due to their affordability and accessibility.

Several studies have reported on the medicinal plants used for cardiovascular ailments, with significant overlaps in species utilized across different regions. In this study, various plant species, including *Carica papaya*, *Allium sativum* and *Moringa oleifera*, were frequently cited for their cardioprotective properties. Similar findings have been reported in other African regions, where these plants are traditionally employed for their antihypertensive and lipid-lowering effects (Ekor, 2014). The predominance of species such as *Moringa oleifera*, *Allium sativum*, and *Carica papaya* in this study echoes previous research by Tahraoui et al. (2021), which recognized these species for their anti-hypertensive and cholesterol-lowering effects. The frequent use of these plants in Nasarawa State suggests their widespread acceptance and efficacy in traditional heart disease management.

The study also revealed a rich diversity of plant species belonging to families such as Asteraceae, Lamiaceae, and Apocynaceae, which are well-known for their bioactive compounds with cardiovascular benefits. Previous research has also highlighted the prominence of these families in ethnomedicine, particularly in managing hypertension and atherosclerosis (Odukoya et al., 2022). The high representation of these families in Nasarawa State aligns with findings from other ethnobotanical studies in Nigeria and West Africa, indicating the universality of plant use in traditional cardiovascular managements.

The ethnobotanical knowledge surrounding these medicinal plants is deeply rooted in indigenous practices, often passed down through generations. The preparation methods identified in this study such as decoctions, infusions, and macerations are consistent with reports from other African ethnobotanical surveys (Kuate, 2017). For example, *Allium sativum* is widely recognized for its cardiovascular benefits and is commonly administered in raw or infused forms for heart disease prevention (Rahman & Lowe, 2006). Furthermore, *Moringa oleifera* tea is commonly used

to lower blood pressure, a practice also reported in Ghana and Cameroon (Fasinu et al., 2016).

Phytochemical analyses of the three most active plants, *Carica papaya*, *Allium sativum*, and *Moringa oleifera* revealed the presence of flavonoids, alkaloids, tannins, phenolic compound and saponins, which have been associated with cardioprotective effects. These findings align with previous phytochemical studies that demonstrate the bioactive potential of these compounds in managing cardiovascular conditions (Odukoya et al., 2022). Flavonoids, in particular, have been reported to exhibit antioxidant and vasodilatory properties, contributing to improved heart function (Yang et al., 2018). The presence of these bioactive compounds in the studied plants provides a scientific basis for their traditional use in managing heart diseases. In a similar study by Rahman and Lowe (2006), *Allium sativum* and other ethnobotanical plants contains bioactive chemicals which are capable of relieving cardiovascular disorder, this report conformed to this present study.

The antioxidant data demonstrate a concentration-dependent decrease in % inhibition, a pattern consistent across all plant extracts. This suggests that at lower concentrations, the antioxidant activity diminishes, which may reduce therapeutic effectiveness and increase vulnerability to oxidative stress. This report agrees with the report of Chaves et al. (2020) who studied the quantification of the antioxidant activity of plant extracts and found out that the antioxidant of most examined plants is concentration dependent. Conversely, higher concentrations, while more effective, could increase the risk of toxicity due to elevated bioactive compound levels.

Conclusion

The results obtained in this study revealed the ethnobotanical importance of some plant species in the management of heart diseases. The plants revealed an excellent phytochemical bioactive compound capable of managing heart diseases.

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Conflict of Interest

There was no conflict of Interest.

Author Contribution

The authors confirm contribution to the paper as follows: study design: Nasir Yusuf, Rebecca W. Ndana and John R. Solomon, data collection: Nasir Yusuf, Rebecca W. Ndana and John R. Solomon; analysis and interpretation of results: Nasir Yusuf, Rebecca W. Ndana and John R. Solomon; draft manuscript preparation: Nasir Yusuf, Rebecca W. Ndana and John R. Solomon. All authors reviewed the results and approved the final version of the manuscript

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