

Ethnobotanical and Use Value of Plant Species raised in home garden in some communities in Southern Kaduna, Kaduna State, Nigeria

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ABSTRACT

Use Value of Plant Species raised in home gardens in some communities in Southern Kaduna, Kaduna State, Nigeria was determined. A semi-structured questionnaire was used to engage 90 respondents from three communities for data collection on species grow in home gardens in the areas and their traditional or cultural medicine application. Results show that Stomach pain, malaria fever, and typhoid fever diseases were treated with the highest diversity of plant species, including 67, 59, and 40 species respectively. Moringa oleifera had 46 mentions for ailments like stomach pain, malaria fever, typhoid fever, and diarrhea. Azadirachta indica had 42 mentions for malaria fever, typhoid fever, stomach pain, and skin problems. Other species most mentioned were Carica papaya with 34 mentions for typhoid fever, stomach pain, cancer, and diarrhea, while M. indica had 32 mentions for malaria fever, heart disease, and diarrhea. Also, Persea americana was mentioned 29 times predominantly for heart disease and cholesterol reduction. M. oleifera, M. indica, A. indica, P. americana, C. papaya and E. camaldulensis have the highest use value of 0.700, 0.633, 0.61, 0.489, 0.456 and 0.367

respectively. In was concluded that M. oleifera, M. indica and A. indica were most mentioned for treating common diseases in southern Kaduna. It is therefore recommended that these and other species be conserved in the area for sustainability.

Keywords: Disease, home garden, plant species, Southern Kaduna, Use value

Introduction

Ethnobotany is a multidisciplinary field that studies the relationships between plants and human cultures, encompassing various aspects such as anthropology, botany, medicine, and economics [1]. It involves documenting traditional medicinal knowledge and the application of medicinal plants by indigenous communities. Ethnobotanical surveys have been conducted in diverse regions, including Iran, Turkey, Ethiopia, and India, to record the use of plants for treating various ailments [2,3,4,5]. The documentation of ethnobotanical knowledge is crucial for preserving indigenous wisdom and identifying potential leads for drug development [6]. However, this traditional knowledge is at risk of erosion due to factors such as agricultural expansion and disinterest among younger generations [5].

Use Value (UV) is a quantitative measure used in ethnobotanical studies to evaluate the relative importance of plant species based on their reported uses. It integrates both the frequency of a species' mention and the number of its reported uses, often serving to highlight species of particular significance. Use value in ethnobotany refers to the importance or utility of a plant species to a particular cultural group or community. It is also defined as a measure of the plant's usefulness, versatility, and significance to the people who use it.

Several studies have employed UV to assess the significance of medicinal plants in different communities

Materials and Methods

Description of the study area

The survey was done in in Jema'a is a Local Government Area located in southern Kaduna State, Nigeria, with its headquarters in Kafanchan. Covering an area of 1,384 square kilometers, Jema'a had a population of 278,202 according to the 2006 census. Map of Jema'a is a LGA is shown in Figure 1.

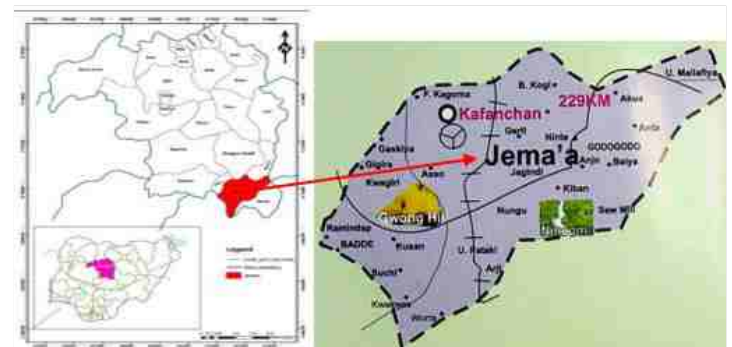


Figure 1: Jema'a Local Government, Kaduna State
Source: Magaji and Hummingbird [7]

Experimental Design

A semi-structured questionnaire was used to engage 90 respondents from three communities for data collection on species grow in home gardens in the areas and their traditional or cultural medicine application.

Determination of Use Value (UV)

Use Value of species is a quantitative method that highlights the relative importance of species within local knowledge systems [8]. It is often employed, where the use value is calculated with the formula below described by Zenderland [9].

$$UV = \sum U_i / n.$$

Here,

U_i = number of uses mentioned by each informant for a particular species, and

n = the total number of informants

Results

Table 1 shows results on diseases treated and the Diversity plant species used in Jema'a Local Government Area (LGA). From the results, 76 different disease categories were being treated, reflecting the extensive reliance on traditional medicine in the region. The survey identified over 150 plant species employed across various disease treatments, with outstanding representation from species like *Moringa oleifera*, *Azadirachta indica* (Neem), and *Carica papaya*. Diseases such as stomach pain, malaria fever, and typhoid fever were treated with the highest diversity of plant species, including 67, 59, and 40 species respectively.

Other notable ailments addressed include hypertension, diabetes, and skin infections. In contrast, conditions like anemia, inflammatory diseases, and eye disorders showed more limited use of plant species. This study highlights the invaluable role of traditional knowledge in local healthcare, advocating for the conservation and integration of these practices into formal medical systems to enhance healthcare delivery and biodiversity preservation.

The most frequently mentioned plant species in Jema'a LGA and their respective citation counts across various diseases are as follows: *Moringa oleifera* (46 mentions) for ailments like stomach pain, malaria fever, typhoid fever, and diarrhea; *Azadirachta indica* (Neem) (42 mentions) for malaria fever, typhoid fever, stomach pain, and skin problems. Other species most mentioned were *Carica papaya* (Pawpaw) (34 mentions) for typhoid fever, stomach pain, cancer, and diarrhea; *Mangifera indica* (Mango) (32 mentions) for malaria fever, heart disease, and diarrhea; and *Persea americana* (Avocado) (29 mentions), predominantly for heart disease and cholesterol reduction. Other notable mentions include *Annona muricata* (Soursop) (20 mentions) for cancer and arthritis. The result further revealed *Khaya senegalensis* (Mahogany) (18 mentions) for diarrhea and blood sugar reduction, *Curcuma longa* (Turmeric) (17 mentions) for hepatitis and liver disorders, and *Ocimum gratissimum* (Scent Leaf) (16 mentions) for diarrhea, malaria, and stomach pain. These figures highlight the extensive use and importance of these species in traditional medicine practices within the region.

Table 1: Diseases and the Diversity of Plant Species in home garden in Jema'a LGA Used for their Treatment

S/No.	Disease treated	S/No. of Species reported for each disease	Plant species used for treatment	Frequency of species reported by respondents
1	Cancer	1.	<i>Acacia nilotica</i>	1
		2.	<i>Annona muricata</i>	6
		3.	<i>Brassica oleracea</i>	1
		4.	<i>Carica papaya</i> (Pawpaw)	1
		5.	<i>Erythrina senegalensis</i>	1
		6.	<i>Khaya senegalensis</i>	1
		7.	<i>Mangifera indica</i> (Mango)	2
		8.	<i>Morinda citrifolia</i>	1
		9.	<i>Moringa oleifera</i>	5
		10.	<i>Musa sapientum</i>	2
		11.	<i>Persea americana</i>	3
		12.	<i>Psidium guajava</i> (Guava)	2
			Prostate cancer	13.
14.	<i>Blighia sapida</i> (Ackee)			1
	Breast cancer	15.	<i>Cactus sp.</i>	1
		16.	<i>Cocos nucifera</i>	1
			Total	30
2	Diarrhea	1)	<i>Acacia nilotica</i>	1
		2)	<i>Adansonia digitate</i> (Baobab tree)	2
		3)	<i>Aloe barbadensis</i>	1
		4)	<i>Moringa oleifera</i>	5
		5)	<i>Anacardium occidentale</i> (Cashew)	1
		6)	<i>Cactus sp.</i>	2
		7)	<i>Calotropis procera</i> (Sodom Apple)	3
		8)	<i>Carica papaya</i>	1

		9)	<i>Citrus limon</i>	1
		10)	<i>Curcuma longa</i> (Turmeric)	2
		11)	<i>Eucalyptus calmadulensis</i>	1
		12)	<i>Khaya senegalensis</i> (Mahogany)	4
		13)	<i>Mangifera indica</i> (Mango)	6
		14)	<i>Morinda citrifolia</i>	1
		15)	<i>Moringa oleifera</i>	3
		16)	<i>Ocimum gratissimum</i> (Scent leave)	2
		17)	<i>Parkia biglobosa</i> (Locust bean)	2
		18)	<i>Persea americana</i> (Avocado)	1
		19)	<i>Psidium guajava</i> (Guava)	2
		20)	<i>Vernonia amygdalina</i> (Bitter leaves)	3
	Mucous diarrhea	21)	<i>Khaya senegalensis</i> (Mahogany)	3
			Total	47
3	Dysentery	1.	<i>Acacia nilotica</i>	1
		2.	<i>Adansonia digitate</i> (Baobab tree)	1
		3.	<i>Aloe barbadensis</i>	1
		4.	<i>Psidium guajava</i> (Guava)	1
		5.	<i>Mangifera indica</i> (Mango)	1
		6.	<i>Newbouldia laevis</i> (Boundary Tree)	1
		7.	<i>Parkia biglobosa</i> (Locust bean)	2
		8.	<i>Persea Americana</i> (Avocado)	1
		9.	<i>Ocimum gratissimum</i> (Scent leave)	3
		10.	<i>Vernonia amygdalina</i> (Bitter leaves)	3
			Total	15
4	Hepatitis	1.	<i>Acacia nilotica</i>	1
		2.	<i>Aloe barbadensis</i>	7
		3.	<i>Carica papaya</i> (Pawpaw)	1
		4.	<i>Curcuma longa</i> (Turmeric)	4
		5.	<i>Jathropha sp.</i>	2
		6.	<i>Mangifera indica</i> (Mango)	1
		7.	<i>Parkia biglobosa</i> (Locust bean)	1
		8.	<i>Terminalia catappa</i> (Indian almond)	1
			Total	18
5	Liver disorder	1)	<i>Acacia nilotica</i>	1
		2)	<i>Azadirachta indica</i> (Neem)	1
		3)	<i>Curcuma longa</i> (Turmeric)	4
		4)	<i>Erythrina senegalensis</i>	1
		5)	<i>Solanum melongena</i> (Garden egg)	1
		6)	<i>Tamarindus indica</i> (Tamarind)	1
			Total	9
6	Malaria fever	1.	<i>Acacia nilotica</i>	1
		2.	<i>Adansonia digitate</i> (Baobab tree)	4
		3.	<i>Anacardium occidentale</i> (Cashew)	2

		4.	<i>Azadirachta indica</i> (Neem)	16
		5.	<i>Carica papaya</i> (Pawpaw)	6
		6.	<i>Citrus aurantiifolia</i> (Lime)	1
		7.	<i>Eucalyptus calmadulensis</i>	4
		8.	<i>Khaya senegalensis</i> (Mahogany)	4
		9.	<i>Mangifera indica</i> (Mango)	1
		10.	<i>Moringa oleifera</i>	5
		11.	<i>Newbouldia laevis</i> (Boundary Tree)	1
		12.	<i>Ocimum gratissimum</i> (Scent leave)	5
		13.	<i>Parkia biglobosa</i> (Locust bean)	3
		14.	<i>Psidium guajava</i> (Guava)	2
		15.	<i>Saccharum officinarum</i> (Sugarcane)	2
		16.	<i>Vernonia amygdalina</i> (Bitter leaves)	2
			Total	59
7	Typhoid fever	1)	<i>Acacia nilotica</i>	1
		2)	<i>Adansonia digitate</i> (Baobab tree)	2
		3)	<i>Aloe barbadensis</i>	1
		4)	<i>Anacardium occidentale</i> (Cashew)	1
		5)	<i>Azadirachta indica</i> (Neem)	10
		6)	<i>Cactus sp.</i>	1
		7)	<i>Carica papaya</i> (Pawpaw)	6
		8)	<i>Citrus sinensis</i> (Sweet orange)	2
		9)	<i>Eucalyptus calmadulensis</i>	1
		10)	<i>Khaya senegalensis</i> (Mahogany)	2
		11)	<i>Mangifera indica</i> (Mango)	1
		12)	<i>Moringa oleifera</i>	4
		13)	<i>Newbouldia laevis</i> (Boundary Tree)	1
		14)	<i>Ocimum gratissimum</i> (Scent leave)	2
		15)	<i>Psidium guajava</i> (Guava)	1
		16)	<i>Tamarindus indica</i> (Tamarind)	1
		17)	<i>Vernonia amygdalina</i> (Bitter leaves)	2
		18)	<i>Zingiber officinale</i> (Ginger)	1
			Total	40
8	Cholesterol reduction	1.	<i>Amaranthus cruentus</i>	2
		2.	<i>Cactus sp.</i>	1
		3.	<i>Cocos nucifera</i> (Coconut)	1
		4.	<i>Zingiber officinale</i> (Ginger)	1
		5.	<i>Psidium guajava</i> (Guava)	2
		6.	<i>Mangifera indica</i> (Mango)	3
		7.	<i>Moringa oleifera</i>	1
		8.	<i>Persea Americana</i> (Avocado)	7
		9.	<i>Vitex negundo</i> (Chaste tree)	1
			Total	19
9	Hypertension	1)	<i>Amaranthus cruentus</i>	1
		2)	<i>Annona muricate</i> (Soursop)	2
		3)	<i>Curcuma longa</i> (Turmeric)	3

		4)	<i>Khaya senegalensis</i> (Mahogany)	1
		5)	<i>Moringa oleifera</i>	6
		6)	<i>Musa sapientum</i> (Banana)	4
		7)	<i>Zingiber officinale</i> (Ginger)	2
			Total	19
10	Swelling of throat and mouth	1.	<i>Amaranthus cruentus</i>	1
		2.	<i>Eucalyptus calmadulensis</i>	1
			Total	2
11	Intestinal/stomach Ulcer	1)	<i>Amaranthus cruentus</i>	1
		2)	<i>Azadirachta indica</i> (Neem)	4
		3)	<i>Musa sapientum</i> (Banana)	1
		4)	<i>Carica papaya</i> (Pawpaw)	4
		5)	<i>Eucalyptus calmadulensis</i>	2
		6)	<i>Psidium guajava</i> (Guava)	1
		7)	<i>Moringa oleifera</i>	5
		8)	<i>Persea Americana</i> (Avocado)	2
		9)	<i>Musa paradisiaca</i> (Plantain)	1
		10)	<i>Calotropis procera</i> (Sodom Apple)	3
		11)	<i>Vernonia amygdalina</i> (Bitter leaves)	2
			Total	26
12	Heart disease/problem	1.	<i>Anacardium occidentale</i> (Cashew)	3
		2.	<i>Annona muricata</i> (Soursop)	3
		3.	<i>Azadirachta indica</i> (Neem)	1
		4.	<i>Blighia sapida</i> (Ackee)	1
		5.	<i>Cactus sp.</i>	1
		6.	<i>Carica papaya</i> (Pawpaw)	1
		7.	<i>Citrus limon</i> (Lemon)	1
		8.	<i>Citrus paradise</i> (Frape fruit)	1
		9.	<i>Colocasia esculenta</i> (Cocoyam)	1
		10.	<i>Cucurbita moschata</i> (Pumpkin)	1
		11.	<i>Curcuma longa</i> (Turmeric)	1
		12.	<i>Mangifera indica</i> (Mango)	5
		13.	<i>Moringa oleifera</i>	2
		14.	<i>Musa sapientum</i> (Banana)	6
		15.	<i>Persea Americana</i> (Avocado)	17
		16.	<i>Vitex negundo</i> (Chaste tree)	1
			Total	46
13	Anemia	1.	<i>Adansonia digitate</i> (Baobab tree)	1
		2.	<i>Citrus limon</i> (Lemon)	1
			Total	2
14	Bladder/Kidney stones	1)	<i>Citrus limon</i> (Lemon)	3
		2)	<i>Cocos nucifera</i> (Coconut)	2
		3)	<i>Moringa oleifera</i>	1
		4)	<i>Persea Americana</i> (Avocado)	2
		5)	<i>Tamarindus indica</i> (Tamarind)	2
			Total	10
15	Asthma	1.	<i>Adansonia digitate</i> (Baobab tree)	2

		2.	<i>Musa sapientum</i> (Banana)	3
		3.	<i>Brassica oleracea</i> (Cabbage)	1
		4.	<i>Carica papaya</i> (Pawpaw)	1
		5.	<i>Morinda citrifolia</i> (Noni)	1
		6.	<i>Moringa oleifera</i>	4
		7.	<i>Ocimum gratissimum</i> (Scent leave)	1
			Total	13
16	Infectious disease	1)	<i>Adansonia digitate</i> (Baobab tree)	1
		2)	<i>Aloe barbadensis</i>	1
		3)	<i>Annona muricate</i> (Soursop)	2
		4)	<i>Azadirachta indica</i> (Neem)	1
		5)	<i>Ocimum gratissimum</i> (Scent leave)	1
		6)	<i>Parkia biglobosa</i> (Locust bean)	3
		7)	<i>Saccharum officinarum</i> (Sugarcane)	1
			Total	10
17	Pile	1.	<i>Adansonia digitate</i> (Baobab tree)	1
		2.	<i>Aloe barbadensis</i>	1
		3.	<i>Annona muricate</i> (Soursop)	2
		4.	<i>Carica papaya</i> (Pawpaw)	1
		5.	<i>Curcuma longa</i> (Turmeric)	1
		6.	<i>Khaya senegalensis</i> (Mahogany)	2
		7.	<i>Mangifera indica</i> (Mango)	1
		8.	<i>Newbouldia laevis</i> (Boundary Tree)	1
		9.	<i>Parkia biglobosa</i> (Locust bean)	1
		10.	<i>Persea Americana</i> (Avocado)	1
		11.	<i>Tamarindus indica</i> (Tamarind)	2
			Total	14
18	Stomach pain	1.	<i>Adansonia digitate</i> (Baobab tree)	1
		2.	<i>Aloe barbadensis</i>	5
		3.	<i>Anacardium occidentale</i> (Cashew)	3
		4.	<i>Annona muricate</i> (Soursop)	1
		5.	<i>Azadirachta indica</i> (Neem)	7
		6.	<i>Calotropis procera</i> (Sodom Apple)	6
		7.	<i>Canarium schweinfurthii</i> (Elemi)	1
		8.	<i>Carica papaya</i> (Pawpaw)	4
		9.	<i>Cocos nucifera</i> (Coconut)	1
		10.	<i>Curcuma longa</i> (Turmeric)	4
		11.	<i>Khaya senegalensis</i> (Mahogany)	7
		12.	<i>Mangifera indica</i> (Mango)	4
		13.	<i>Moringa oleifera</i>	6
		14.	<i>Ocimum gratissimum</i> (Scent leave)	5
		15.	<i>Psidium guajava</i> (Guava)	2
		16.	<i>Tamarindus indica</i> (Tamarind)	5
		17.	<i>Vernonia amygdalina</i> (Bitter leaves)	4

		18.	<i>Vitex negundo</i> (Chaste tree)	1
			Total	67
19	Yellow fever	1)	<i>Adansonia digitate</i> (Baobab tree)	2
		2)	<i>Azadirachta indica</i> (Neem)	2
		3)	<i>Carica papaya</i> (Pawpaw)	3
		4)	<i>Erythrina senegalensis</i>	1
		5)	<i>Moringa oleifera</i>	2
		6)	<i>Parkia biglobosa</i> (Locust bean)	1
		7)	<i>Psidium guajava</i> (Guava)	1
		8)	<i>Tamarindus indica</i> (Tamarind)	2
			Total	14
20	Arthritis/ Rheumatoid arthritis/ Rheumatism	1.	<i>Aloe barbadensis</i>	1
		2.		
		3.	<i>Annona muricate</i> (Soursop)	4
		4.	<i>Annona muricate</i> (Soursop)	5
		5.	<i>Eucalyptus calmadulensis</i>	2
		6.	<i>Moringa oleifera</i>	4
		7.	<i>Moringa oleifera</i>	1
		8.	<i>Persea americana</i> (Avocado)	4
		9.	<i>Zingiber officinale</i> (Ginger)	2
			Total	22
21	Diabetes	1.	<i>Aloe barbadensis</i>	1
		2.	<i>Anacardium occidentale</i> (Cashew)	1
		3.	<i>Azadirachta indica</i> (Neem)	4
		4.	<i>Cactus sp.</i>	2
		5.	<i>Carica papaya</i> (Pawpaw)	1
		6.	<i>Cocos nucifera</i> (Coconut)	2
		7.	<i>Cucurbita moschata</i> (Pumpkin)	1
		8.	<i>Khaya senegalensis</i> (Mahogany)	1
		9.	<i>Mangifera indica</i> (Mango)	9
		10.	<i>Moringa oleifera</i>	6
		11.	<i>Musa sapientum</i> (Banana)	3
		12.	<i>Parkia biglobosa</i> (Locust bean)	3
		13.	<i>Persea americana</i> (Avocado)	1
		14.	<i>Psidium guajava</i> (Guava)	2
		15.	<i>Solanum melongena</i> (Garden egg)	1
		16.	<i>Vernonia amygdalina</i> (Bitter leaves)	1
			Total	39
22	Heart disease/problem	1)	<i>Anacardium occidentale</i> (Cashew)	3
		2)	<i>Annona muricate</i> (Soursop)	3
		3)	<i>Azadirachta indica</i> (Neem)	1
		4)	<i>Blighia sapida</i> (Ackee)	1
		5)	<i>Cactus sp.</i>	1
		6)	<i>Citrus limon</i> (Lemon)	1
		7)	<i>Citrus paradisi</i> (Grape fruit)	1
		8)	<i>Colocasia esculenta</i> (Cocoyam)	1
		9)	<i>Cucurbita moschata</i> (Pumpkin)	1

		10)	<i>Curcuma longa</i> (Turmeric)	1
		11)	<i>Mangifera indica</i> (Mango)	5
		12)	<i>Moringa oleifera</i>	2
		13)	<i>Musa sapientum</i> (Banana)	6
		14)	<i>Persea americana</i> (Avocado)	17
		15)	<i>Vitex negundo</i> (Chaste tree)	1
			Total	45
23	Inflammatory disease	1.	<i>Anacardium occidentale</i> (Cashew)	1
		2.	<i>Parkia biglobosa</i> (Locust bean)	1
			Total	2
24	Skin problem/infection	1)	<i>Anacardium occidentale</i> (Cashew)	2
		2)	<i>Azadirachta indica</i> (Neem)	2
		3)	<i>Carica papaya</i> (Pawpaw)	2
		4)	<i>Khaya senegalensis</i> (Mahogany)	1
			Total	7
25	Eye disorder	1	<i>Azadirachta indica</i> (Neem)	2
26	Parasitic infection	1.	<i>Azadirachta indica</i> (Neem)	1
		2.	<i>Carica papaya</i> (Pawpaw)	1
			Total	2
27	Parasitic worms	1)	<i>Annona muricata</i> (Soursop)	1
		2)	<i>Azadirachta indica</i> (Neem)	4
		3)	<i>Calotropis procera</i> (Sodom Apple)	2
		4)	<i>Capsicum annuum</i> (Sweet pepper)	1
		5)	<i>Carica papaya</i> (Pawpaw)	1
		6)	<i>Erythrina senegalensis</i>	1
		7)	<i>Tamarindus indica</i> (Tamarind)	1
		8)	<i>Vernonia amygdalina</i> (Bitter leaves)	1
			Total	12
28	Blood pressure reduction	1.	<i>Citrus sinensis</i> (Sweet orange)	1
		2.	<i>Cocos nucifera</i> (Coconut)	1
		3.	<i>Colocasia esculenta</i> (Cocoyam)	1
		4.	<i>Cucurbita moschata</i> (Pumpkin)	1
		5.	<i>Curcuma longa</i> (Turmeric)	2
		6.	<i>Mangifera indica</i> (Mango)	3
		7.	<i>Morinda citrifolia</i> (Noni)	2
		8.	<i>Moringa oleifera</i>	5
		9.	<i>Musa paradisiaca</i> (Plantain)	1
		10.	<i>Musa sapientum</i> (Banana)	2
		11.	<i>Persea americana</i> (Avocado)	3
		12.	<i>Vernonia amygdalina</i> (Bitter leaves)	1
			Total	23
29	Constipation	1)	<i>Calotropis procera</i> (Sodom Apple)	3
		2)	<i>Moringa oleifera</i>	1
		3)	<i>Musa sapientum</i> (Banana)	2
		4)	<i>Tamarindus indica</i> (Tamarind)	3
			Total	9

30	Depression	1.	<i>Musa sapientum</i> (Banana)	3
		2.	<i>Annona muricata</i> (Soursop)	2
			Total	5
31	Blood sugar reduction	1)	<i>Cactus sp.</i>	1
		2)	<i>Carica papaya</i> (Pawpaw)	1
		3)	<i>Cymbopogon citratus</i> (Lemon grass)	1
		4)	<i>Khaya senegalensis</i> (Mahogany)	1
		5)	<i>Mangifera indica</i> (Mango)	1
		6)	<i>Persea americana</i> (Avocado)	1
		7)	<i>Zingiber officinale</i> (Ginger)	1
		Total	7	
32	Viral infection	1	<i>Cactus sp.</i>	1
33	Bronchitis	1.	<i>Carica papaya</i> (Pawpaw)	1
		2.	<i>Eucalyptus calmadulensis</i>	3
			Total	4
34	Headache	1)	<i>Carica papaya</i> (Pawpaw)	2
		2)	<i>Mangifera indica</i> (Mango)	1
		3)	<i>Newbouldia laevis</i> (Boundary Tree)	1
			Total	4
35	Hookworm	1	<i>Carica papaya</i> (Pawpaw)	1
36	Menstrual pains	1.	<i>Carica papaya</i> (Pawpaw)	1
		2.	<i>Psidium guajava</i> (Guava)	2
			Total	3
37	Vomiting	1)	<i>Capsicum annum</i> (Sweet pepper)	1
		2)	<i>Carica papaya</i> (Pawpaw)	2
		3)	<i>Cymbopogon citratus</i> (Lemon grass)	1
		4)	<i>Ocimum gratissimum</i> (Scent leave)	3
			Total	7
40	Cold and catarrh	1.	<i>Citrus limon</i> (Lemon)	7
		2.	<i>Citrus sinensis</i> (Sweet orange)	1
		3.	<i>Cocos nucifera</i> (Coconut)	1
		4.	<i>Cymbopogon citratus</i> (Lemon grass)	4
		5.	<i>Eucalyptus calmadulensis</i>	7
		6.	<i>Morinda citrifolia</i> (Noni)	1
		7.	<i>Ocimum gratissimum</i> (Scent leave)	3
		8.	<i>Saccharum officinarum</i> (Sugarcane)	2
		9.	<i>Zingiber officinale</i> (Ginger)	2
		Total	28	
41	Cough	1)	<i>Canarium schweinfurthii</i> (Elemi)	1
		2)	<i>Citrus limon</i> (Lemon)	7
		3)	<i>Cymbopogon citratus</i> (Lemon grass)	5
		4)	<i>Eucalyptus calmadulensis</i>	1
		5)	<i>Mangifera indica</i> (Mango)	2
		6)	<i>Morinda citrifolia</i> (Noni)	1

		7)	<i>Newbouldia laevis</i> (Boundary Tree)	1
		8)	<i>Ocimum gratissimum</i> (Scent leave)	3
		9)	<i>Psidium guajava</i> (Guava)	2
		10)	<i>Zingiber officinale</i> (Ginger)	1
			Total	24
42	Hernia	1	<i>Citrus sinensis</i> (Sweet orange)	1
43	Jedi-jedi	1	<i>Citrus sinensis</i> (Sweet orange)	1
			Total	2
44	Obesity reduction	1.	<i>Cocos nucifera</i> (Coconut)	1
		2.	<i>Mangifera indica</i> (Mango)	3
		3.	<i>Persea americana</i> (Avocado)	1
			Total	5
45	Pimples healing	1	<i>Cocos nucifera</i> (Coconut)	1
46	Tooth ache/pain	1)	<i>Annona muricate</i> (Soursop)	1
		2)	<i>Calotropis procera</i> (Sodom Apple)	4
		3)	<i>Cocos nucifera</i> (Coconut)	1
		4)	<i>Jathropha sp.</i>	2
		5)	<i>Khaya senegalensis</i> (Mahogany)	1
		6)	<i>Parkia biglobosa</i> (Locust bean)	3
			Total	12
47	Boost immunity	1)	<i>Cucurbita moschata</i> (Pumpkin)	1
		2)	<i>Curcuma longa</i> (Turmeric)	1
			Total	2
48	Pregnancy improvement	1	<i>Cucurbita moschata</i> (Pumpkin)	1
49	Wound healing	1.	<i>Cucurbita moschata</i> (Pumpkin)	1
		2.	<i>Parkia biglobosa</i> (Locust bean)	1
			Total	2
50	Chills	1	<i>Canarium schweinfurthii</i> (Elemi)	1
51	Digestive disorder	1	<i>Canarium schweinfurthii</i> (Elemi)	1
52	Joint pain	1)	<i>Canarium schweinfurthii</i> (Elemi)	1
		2)	<i>Calotropis procera</i> (Sodom Apple)	2
53	Sinusitis	1.	<i>Canarium schweinfurthii</i> (Elemi)	1
		2.	<i>Eucalyptus calmadulensis</i>	1
			Total	2
54	Boil	1	<i>Eucalyptus calmadulensis</i>	1
55	Sexual transmission diseases	1)	<i>Eucalyptus calmadulensis</i>	1

		2)	<i>Parkia biglobosa</i> (Locust bean)	1
		3)	<i>Curcuma longa</i> (Turmeric)	2
		Total		4
56	Sore throat	1.	<i>Eucalyptus calmadulensis</i>	1
		2.	<i>Solanum melongena</i> (Garden egg)	1
			Total	2
57	Migraines	1	<i>Zingiber officinale</i> (Ginger)	1
58	Nausea	1	<i>Zingiber officinale</i> (Ginger)	2
59	Stroke healing	1	<i>Citrus paradisi</i> (Grape fruit)	1
60	Improved weak rection	1	<i>Psidium guajava</i> (Guava)	1
61	Snake bite	1	<i>Jathropha sp.</i>	2
62	Syphilis	1	<i>Khaya senegalensis</i> (Mahogany)	3
63	Convulsion	1)	<i>Cymbopogon citratus</i> (Lemon grass)	1
		2)	<i>Newbouldia laevis</i> (Boundary Tree)	1
			Total	2
64	Apollo	1	<i>Mangifera indica</i> (Mango)	5
65	Body weakness	1.	<i>Mangifera indica</i> (Mango)	1
		2.	<i>Moringa oleifera</i>	2
		3.	<i>Tamarindus indica</i> (Tamarind)	1
			Total	4
66	Stress relief	1	<i>Mangifera indica</i> (Mango)	4
67	Anxiety	1	<i>Morinda citrifolia</i> (Noni)	1
68	Body pain	1	<i>Newbouldia laevis</i> (Boundary Tree)	1
69	Epilepsy	1	<i>Newbouldia laevis</i> (Boundary Tree)	1
70	Fibroid	1	<i>Newbouldia laevis</i> (Boundary Tree)	1
71	Tooth aches	1	<i>Parkia biglobosa</i> (Locust bean)	3
72	Cholera	1	<i>Ocimum gratissimum</i> (Scent leave)	1
73	Gall bladder	1	<i>Tamarindus indica</i> (Tamarind)	1
74	Hemorrhage	1	<i>Curcuma longa</i> (Turmeric)	2
75	Sickle cell disease	1	<i>Citrus aurantiifolia</i> (Lime)	1
76	Virginal infection	1	<i>Citrus aurantiifolia</i> (Lime)	1

Table 2 reveals the relationship between plant species, the number of ailments they reportedly treat, and their Use Value (UV) in Jema'a LGA, highlighting the extensive utilization of traditional medicinal plants. A total of 44 species were documented, with *Moringa oleifera* emerging as the most versatile, treating 63 ailments and having the highest UV (0.700). *Mangifera indica* was also highly significant, treating 57 ailments (UV: 0.633), followed by *Azadirachta indica* (*Neem*) with 55 ailments (UV: 0.611) and *Persea americana* (*Avocado*) addressing 44 ailments (UV: 0.489). Other notable species include *Carica papaya* (*Pawpaw*) (41 ailments, UV: 0.456) and *Eucalyptus camaldulensis* (33 ailments, UV: 0.367). These plants were primarily used for treating common diseases such as malaria, typhoid, stomach pain, and diarrhea. The findings emphasize the cultural and therapeutic significance of these species, advocating for their conservation and further exploration in modern pharmacological studies.

Table 2: Plant Species, Number of Ailments Treated, and their Use Value (UV)

S/No.	Tree species	Name of Disease treated	No. diseases treated by a single species	Frequency of mention by respondents	Use Value (UV)
1	<i>Acacia nilotica</i>	1) Cancer		1	0.078
		2) Diarrhea		1	
		3) Dysentery		1	
		4) Hepatitis B.	7	1	
		5) Liver disorder		1	
		6) Malaria fever		1	
		7) Typhoid fever		1	
		Total		7	
2	<i>Amaranthus cruentus</i>	1. Cholesterol reduction		2	0.089
		2. Diarrhea		2	
		3. Hypertension		1	
		4. Swelling of throat and mouth	5	2	
		5. Intestinal/stomach Ulcer		1	
		Total		8	
3	<i>Blighia sapida</i> (Ackee)	1) Heart disease/problem		1	0.022
		2) Prostate cancer	2	1	
		Total		2	
4.	<i>Adansonia digitate</i> (Baobab tree)	1) Anemia		1	0.189
		2) Asthma		2	
		3) Diarrhea		2	
		4) Dysentery		1	
		5) Infectious disease	10	1	
		6) Malaria fever		4	
		7) Pile		1	
		8) Stomach pain,		1	
		9) Typhoid fever		2	
		10) Yellow fever		2	
		Total		17	
5	<i>Aloe barbadensis</i>	1) Arthritis		1	0.233
		2) Diabetes		1	
		3) Diarrhea		1	
		4) Dysentery	11	1	
		5) Hepatitis B		7	
		6) Infectious disease		1	
		7) Pile		1	
		8) Rheumatism		1	
		9) Rheumatoid		1	
		10) Stomach pain		5	
		11) Typhoid fever		1	
		Total		21	
6	<i>Anacardium occidentale</i> (Cashew)	1) Diabetes		1	0.156
		2) Diarrhea		1	
		3) Heart disease/problem		3	
		4) Inflammatory disease		1	
		5) Malaria fever	8	2	
		6) Skin problem/infection		2	
		7) Stomach pain		3	
		8) Typhoid fever		1	
		Total		14	
		1) Diabetes		4	
		2) Eye disorder		2	
		3) Heart disease/problem		1	
		4) Infectious disease		1	

7	<i>Azadirachta indica</i> (Neem)	5) Intestinal/stomach Ulcer	13	4	0.611
		6) Liver disorder		1	
		7) Malaria fever		16	
		8) Parasitic infection		1	
		9) Parasitic worms		4	
		10) Skin problem/infection		2	
		11) Stomach pain		7	
		12) Typhoid fever		10	
		13) Yellow fever		2	
		Total		55	
8	<i>Musa sapientum</i> (Banana)	1) Asthma		3	0.289
		2) Blood pressure reduction		2	
		3) Cancer		2	
		4) Constipation		2	
		5) Depression	9	3	
		6) Diabetes		3	
		7) Heart disease/problem		6	
		8) Hypertension		4	
		9) Intestinal/stomach Ulcer		1	
		Total		26	
9	<i>Brassica oleracea</i> (Cabbage)	1) Asthma	2	1	0.022
		2) Cancer		1	
		Total		2	
10	<i>Cactus sp.</i>	1) Blood sugar reduction,		1	0.111
		2) Cholesterol reduction		1	
		3) Diabetes		2	
		4) Diarrhea	8	2	
		5) Heart disease/problem		1	
		6) Prostate cancer		1	
		7) Typhoid fever		1	
		8) Viral infection		1	
		Total		10	
11	<i>Carica papaya</i> (Pawpaw)	1) Asthma		1	0.456
		2) Blood sugar reduction		1	
		3) Bronchitis		1	
		4) Cancer		1	
		5) Diabetes		1	
		6) Diarrhea		1	
		7) Headache		2	
		8) Heart disease/problem		1	
		9) Hepatitis B.		1	
		10) Hookworm	21	1	
		11) Intestinal/stomach Ulcer		3	
		12) Malaria fever		6	
		13) Menstrual pains		1	
		14) Parasitic infection		1	
		15) Parasitic worms		1	
		16) Pile		1	
		17) Skin problem/infection		2	
		18) Stomach pain		4	
		19) Typhoid fever		6	
		20) Vomiting		2	
		21) Yellow fever		3	
		Total		41	

12	<i>Citrus limon</i> (Lemon)	1) Anemia		1	0.211
		2) Bladder/Kidney stones		3	
		3) Cold and catarrh		7	
		4) Cough	6	6	
		5) Diarrhea		1	
		6) Heart disease/problem		1	
		Total		19	
13	<i>Citrus sinensis</i> (Sweet orange)	1) Blood pressure reduction		1	0.089
		2) Cold and catarrh		1	
		3) Hernia	5	2	
		4) Jedi-jedi		2	
		5) Typhoid fever		2	
		Total		8	
14	<i>Cocos nucifera</i> (Coconut)	1) Bladder/Kidney stones		2	0.133
		2) Blood pressure reduction		1	
		3) Breast cancer		1	
		4) Cholesterol reduction		1	
		5) Cold and catarrh	10	1	
		6) Diabetes		2	
		7) Obesity reduction		1	
		8) Pimples healing		1	
		9) Stomach pain		1	
		10) Tooth ache/pain		1	
		Total		12	
15	<i>Colocasia esculenta</i> (Cocoyam)	1) Blood pressure reduction		1	0.022
		2) Heart disease/problem	2	1	
		Total		2	
16	<i>Cucurbita moschata</i> (Pumpkin)	1) Blood pressure reduction		1	0.067
		2) Boost immunity		1	
		3) Diabetes	6	1	
		4) Heart disease/problem		1	
		5) Pregnancy improvement		1	
		6) Wound healing		1	
		Total		6	
17	<i>Canarium schweinfurthii</i> (Elemi)	1) Chills		1	0.067
		2) Cough		1	
		3) Digestive disorder	6	1	
		4) Joint pain		1	
		5) Sinusitis		1	
		6) Stomach pain		1	
		Total		6	
18	<i>Erythrina senegalensis</i>	1) Cancer		1	0.044
		2) Liver disorder	4	1	
		3) Parasitic worms		1	
		4) Yellow fever		1	
		Total		4	
		1) Arthritis		2	
		2) Boil		1	
		3) Bronchitis		3	
		4) Cold and catarrh		7	
		5) Cough		7	
		6) Diarrhea		1	
		7) Intestinal/stomach Ulcer	13	2	

19	<i>Eucalyptus calmadulensis</i>	8) Malaria fever		4	0.367
		9) Sexual transmission diseases		1	
		10) Sinusitis		1	
		11) Sore throat		2	
		12) Swelling of throat and mouth		1	
		13) Typhoid fever		1	
		Total		33	
20	<i>Solanum melongena</i> (Garden egg)	1) Diabetes		1	0.033
		2) Liver disorder	3	1	
		3) Pregnancy improvement		1	
		Total		3	
21	<i>Zingiber officinale</i> (Ginger)	1) Arthritis		2	0.144
		2) Blood sugar reduction		1	
		3) Cholesterol reduction		1	
		4) Cold and catarrh		2	
		5) Cough	9	1	
		6) Hypertension		2	
		7) Migraines		1	
		8) Nausea		2	
		9) Typhoid fever		1	
Total		13			
22	<i>Citrus paradisi</i> (Grape fruit)	1) Heart disease/problem		1	0.022
		2) Stroke healing	2	1	
		Total		2	
23	<i>Psidium guajava</i> (Guava)	1) Cancer		2	0.233
		2) Cholesterol reduction		2	
		3) Cough		2	
		4) Diabetes		2	
		5) Diarrhea		2	
		6) Dysentery	13	1	
		7) Improved weak rection		1	
		8) Intestinal/stomach Ulcer		1	
		9) Malaria fever		2	
		10) Menstrual pains		2	
		11) Stomach pain		2	
		12) Typhoid fever		1	
		13) Yellow fever		1	
Total		21			
24	<i>Terminalia catappa</i> (Indian almond)	1) Hepatitis B.	1	1	0.011
25	<i>Jathropa sp.</i>	1) Hepatitis B.		2	0.067
		2) Snake bite	3	2	
		3) Tooth ache/pain		2	
		Total		6	
26	<i>Khaya senegalensis</i> (Mahogany)	1) Blood sugar reduction		1	0.344
		2) Cancer		1	
		3) Diabetes		1	
		4) Diarrhea		4	
		5) Hypertension		1	
		6) Malaria fever		4	
		7) Mucous diarrhea	13	3	
		8) Pile		2	
		9) Skin problem/infection		1	
		10) Stomach pain		7	

		11) Syphilis		3	
		12) Tooth ache/pain		1	
		13) Typhoid fever		2	
		Total		31	
27	<i>Cymbopogon citratus</i> (Lemon grass)	1) Blood sugar reduction		1	0.133
		2) Cold and catarrh		4	
		3) Convulsion	5	1	
		4) Cough		5	
		5) Vomiting		1	
		Total		12	
28	<i>Mangifera indica</i> (Mango)	1) Apollo		5	0.633
		2) Blood pressure reduction		3	
		3) Blood sugar reduction		1	
		4) Body weakness		1	
		5) Cancer		2	
		6) Cholesterol reduction		3	
		7) Cough		5	
		8) Diabetes		9	
		9) Diarrhea		6	
		10) Dysentery	19	1	
		11) Headache		1	
		12) Heart disease/problem		5	
		13) Hepatitis B.		1	
		14) Malaria fever		1	
		15) Obesity reduction		3	
		16) Pile		1	
		17) Stomach pain		4	
		18) Stress relief		4	
		19) Typhoid fever		1	
		Total		57	
29	<i>Morinda citrifolia</i> (Noni)	1) Anxiety		1	0.078
		2) Asthma		1	
		3) Blood pressure reduction		2	
		4) Cancer	6	1	
		5) Cold and catarrh		1	
		6) Cough		1	
		Total		7	
30	<i>Moringa oleifera</i>	1) Arthritis		4	0.700
		2) Asthma		4	
		3) Bladder/Kidney stones		1	
		4) Blood pressure reduction		5	
		5) Body weakness		2	
		6) Cancer	18	5	
		7) Cholesterol reduction		1	
		8) Constipation		1	
		9) Diabetes		6	
		10) Diarrhea		3	
		11) Heart disease/problem		2	
		12) Hypertension		6	
		13) Intestinal/stomach Ulcer		5	
		14) Malaria fever		5	
		15) Rheumatism		1	
		16) Stomach pain		6	
		17) Typhoid fever		4	
		18) Yellow fever		2	
		Total		63	

31	<i>Newbouldia laevis</i> (Boundary Tree)	1) Body pain		1	0.122
		2) Convulsion		1	
		3) Cough		1	
		4) Dysentery	10	1	
		5) Epilepsy		2	
		6) Fibroid		1	
		7) Headache		1	
		8) Malaria fever		1	
		9) Pile		1	
		10) Typhoid fever		1	
		Total		11	
32	<i>Parkia biglobosa</i> (Locust bean)	1) Diabetes		3	0.278
		2) Diarrhea		2	
		3) Dysentery		2	
		4) Hepatitis B.		1	
		5) Infectious disease		3	
		6) Inflammatory disease		1	
		7) Malaria fever		3	
		8) Pile	13	1	
		9) Sexual transmission diseases		1	
		10) Tooth ache/pain		3	
		11) Tooth aches		3	
		12) Wound healing		1	
		13) Yellow fever		1	
		Total		25	
33	<i>Persea americana</i> (Avocado)	1) Arthritis		4	0.489
		2) Bladder/Kidney stones		2	
		3) Blood pressure reduction		3	
		4) Blood sugar reduction		1	
		5) Cancer		3	
		6) Cholesterol reduction		7	
		7) Diabetes	13	1	
		8) Diarrhea		1	
		9) Dysentery		1	
		10) Heart disease/problem		17	
		11) Intestinal/stomach Ulcer		2	
		12) Obesity reduction		1	
		13) Pile		1	
		Total		44	
34	<i>Musa paradisiaca</i> (Plantain)	1) Blood pressure reduction	2	1	0.022
		2) Intestinal/stomach Ulcer		1	
		Total		2	
35	<i>Ocimum gratissimum</i> (Scent leave)	1) Asthma		1	0.322
		2) Cholera		1	
		3) Cold and catarrh		3	
		4) Cough		3	
		5) Diarrhea	11	2	
		6) Dysentery		3	
		7) Infectious disease		1	
		8) Malaria fever		5	
		9) Stomach pain		5	
		10) Typhoid fever		2	
		11) Vomiting		3	
		Total		29	

36	<i>Calotropis procera</i> (Sodom Apple)	1) Constipation		3	0.256
		2) Diarrhea		3	
		3) Intestinal/stomach Ulcer		3	
		4) Joint pains	7	2	
		5) Parasitic worms		2	
		6) Stomach pain		6	
		7) Tooth ache/pain		4	
		Total		23	
37	<i>Annona muricata</i> (Soursop)	1) Arthritis		4	0.322
		2) Cancer		6	
		3) Depression		2	
		4) Heart disease/problem		3	
		5) Hypertension		2	
		6) Infectious disease	11	2	
		7) Parasitic worms		1	
		8) Pile		2	
		9) Rheumatism		5	
		10) Stomach pain		1	
		11) Tooth ache/pain		1	
		Total		29	
38	<i>Saccharum officinarum</i> (Sugarcane)	1) Cold and catarrh		2	0.056
		2) Infectious disease	3	1	
		3) Malaria fever		2	
		Total		5	
39	<i>Capsicum annum</i> (Sweet pepper)	1) Parasitic worms		1	0.022
		2) Vomiting	2	1	
		Total		2	
40	<i>Tamarindus indica</i> (Tamarind)	1) Bladder/Kidney stones		2	0.211
		2) Body weakness		1	
		3) Constipation		3	
		4) Gall bladder		1	
		5) Liver disorder	10	1	
		6) Parasitic worms		1	
		7) Pile		2	
		8) Stomach pain		5	
		9) Typhoid fever		1	
		10) Yellow fever		2	
		Total		19	
41	<i>Curcuma longa</i> (Turmeric)	1) Blood pressure reduction		2	0.278
		2) Boost immunity		1	
		3) Diarrhea		2	
		4) Heart disease/problem	11	1	
		5) Hemorrhage		2	
		6) Hepatitis B.		4	
		7) Hypertension		3	
		8) Liver disorder		4	
		9) Pile		1	
		10) Sexual transmission diseases		1	
		11) Stomach pain		4	
		Total		25	
		1) Blood pressure reduction		1	0.222
		2) Cancer		1	
		3) Diabetes		1	
		4) Diarrhea		3	
		5) Dysentery		3	

42	<i>Vernonia amygdalina</i> (Bitter leaves)	6) Intestinal/stomach Ulcer	10	2	0.222
		7) Malaria fever		2	
		8) Parasitic worms		1	
		9) Stomach pain		4	
		10) Typhoid fever		2	
		Total		20	
43	<i>Vitex negundo</i> (Chaste tree)	1) Cholesterol reduction		1	0.033
		2) Heart disease/problem	3	1	
		3) Stomach pain		1	
		Total		3	
44	<i>Citrus aurantiifolia</i> (Lime)	1) Malaria fever		1	0.033
		2) Sickle cell disease	3	1	
		3) Virginal infection		1	
		Total		3	

Discussion

The most frequently mentioned plant species in Jema'a LGA were *M. oleifera* (46 mentions) for ailments like stomach pain, malaria fever, typhoid fever, and diarrhea; and *A. indica* (42 mentions) for malaria fever and typhoid. This confirms why *M. oleifera* is widely cultivated and utilized in Northern Nigeria, particularly for its nutritional and medicinal as reported by Idris, and Raubilu [10,11]. Aisha [12] reported that *A. indica* medicinal properties are well-recognized in Nigeria, with its leaves being popularly used for treating malaria fever. A survey conducted in Lagos State, Nigeria by Ishola [13] identified *A. indica* as one of the most frequently used plants (25.5%) for local antimalarial herbal recipes. Similarly, Odugbemi [14] study in Okeigbo, Ondo State reported *A. indica* among the top plants used for malaria therapy.

In this study, *M. oleifera*, *M. indica*, *A. indica*, *P. americana*, *C. papaya* and *E. camaldulensis* have the highest UVs of 0.700, 0.633, 0.61, 0.489, 0.456 and 0.367 respectively. In a study conducted in Turgutlu, Turkey, Rosa canina (0.75), *Ficus carica* subsp. carica (0.74), *Tilia platyphyllos* (0.71), and *Vitex agnus-castus* (0.70) were identified as the most important plants based on UV calculations [3]. These UV values falls within the range obtained in this study. Similarly, in Rawalpindi, Pakistan, UV ranged from 0.125 for *Asparagus racemosus* to 0.34 for *Syzygium aromaticum* [15] which are also within the range recorded in this research. Interestingly, some studies reported significantly higher UV values. For instance, in Sri Lanka, *Aerva javanica* had the highest UV of 1.67 for antidiabetic remedies [16]. In contrast, a study in Pakistan found UV values ranging from 0.23 to 0.02, with *Mentha arvensis* (0.23) having the highest value [17] which are below the ones obtained in this study. Interestingly, UV calculations have revealed some contradictions in plant usage across different regions of Nigeria. While *Rosa canina* had the highest UV in southwest Nigeria, it was not reported as a significant medicinal plant in other surveyed areas. This suggests regional variations in ethnobotanical knowledge and practices within the country [3,18,19] as also recorded in this study.

Conclusion

The study revealed that *M. oleifera*, *M. indica*, *A. indica*, *P. americana*, *C. papaya* and *E. camaldulensis* species have the highest use value. *M. oleifera* and *A. indica* were most mentioned for treating common diseases in southern Kaduna. It is therefore recommended that these and other species be conserved in the area for sustainability.

Authors' contributions

Designed, coordinated the study and the work, A.S.I.N; analyzed and wrote the article, D.O.E; carried out the study P.I.T.

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Availability of data and materials

All data will be made available on request according to the journal policy.

Conflicts of interest

The authors confirm that there is no conflict of interest to declare

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