

## REVIEW ARTICLE

## Typhoid Fever and Medicinal Plants Review: A Case Study In Nigeria

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## ABSTRACT

**Background:** Lack of waste management and antibiotic overuse make typhoid a major disease in Nigeria. According to many studies, typhoid fever and other salmonella infections are common in Nigeria. Due to multidrug resistance and development of carrier status of *Salmonella typhi* (the causative organism of typhoid fever) herbal medicines is becoming increasingly popular and widely accepted by Nigerians. However, information on plant usage for specific illnesses and diseases is fragmented, and consolidation is needed to understand and share herbal disease management information. **Aim:** This review compiles medicinal plants used in treating typhoid fever in Nigeria. **Method:** Based on inclusion criteria, Google Scholar, PubMed, and Scopus were searched for published publications. **Results:** A total of 166 plant species from 66 families were documented for treating typhoid fever across the six geopolitical zones of Nigeria. Fabaceae is the most employed family, followed closely by Euphorbiaceae and Poaceae. Ten plants (*Mangifera indica* L., *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Psidium guajava* L., *Citrus aurantifolia* Christm, *Ananas comosus* (L.) Merr, *Ocimum gratissimum* L., *Vernonia amygdalina* (Wild) Darke, *Alstonia boonei* De Wild. and *Azadirachta indica* A. Juss) are widely used across the country. All parts of plants are reported to be relevant in treating typhoid fever. Leaves are mostly used alone or in combination with other plant parts. **Conclusion:** A wide variety of plants are used to treat typhoid in Nigeria. It is expected that this documentation of medicinal plants used for the treatment of typhoid fever will further promote bioprospecting and pharmacological research.

**Keywords:** Typhoid fever, medicinal plants, herbs, Nigeria

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## INTRODUCTION

Typhoid fever is an acute, multi-systemic and febrile illness caused by infection of the reticuloendothelial system, intestinal lymphoid tissue and gall bladder by *Salmonella enterica* subspecies *enterica* serovar *typhi* (*S.typhi*) [1,3]. According to the World Health Organization, approximately 9 million people get sick from Typhoid and 110,000 people die from it yearly [3]. In Nigeria, typhoid is among the major prevalent diseases due to various interwoven elements such as scarce amenities for handling waste materials and abuse of antibiotics. Many researchers have reported the prevalence of typhoid fever and other *Salmonella* infections, in different parts of the country [2, 4-6] where several cases of morbidity and mortality have been recorded.

Being a bacteria-occasioned disease, typhoid fever is treated with the use of antibiotics. However, it seems that *S. typhi* always develops resistance to any antibiotic used in the treatment of the disease with time. Plasmid-mediated chloramphenicol-resistant strain of *S. typhi* emerged in the 1970s which made ampicillin and trimethoprim-sulphamethoxazole (TMP-SMZ) became drugs of choice for treatment. However, barely a decade after, multi-drug resistant (MDR) *S. typhi* emerged - resistant to chloramphenicol, ampicillin, TMP-SMZ, streptomycin, sulfonamides, and tetracycline also appeared. In 2018, Akinyemi and coworkers [7] reported that an increase in *S. typhi* resistance to ampicillin, chloramphenicol, cotrimoxazole and tetracycline in Nigeria was up to 100% in 2008 and remained so through 2015. Resistance to fluoroquinolones such as ciprofloxacin, cefotaxime and cefuroxime has also been reported [8].

The use of medicinal plants for maintenance of personal health is increasing even in urban settlements. This is probably due to the increasing failure of many synthetic drugs used for the treatment of many illnesses (including typhoid fever, gonorrhoea, and tuberculosis) as well as the emergence and increasing prevalence of antibiotic-resistant bacteria with high cost of prescription drugs [9,10]. There is no end in sight for the innate

antimicrobial resistance to microbial-originated antimicrobials since it is the natural way by which microorganisms fight for survival among themselves for millions of years even before any antimicrobial agent was developed [11] and thus there is an urgent need for alternative drug line [11,13]. As an alternative to conventional antibiotics, it has been reported that traditional medicines (TM) serve the health need of about 80% of people in the world, especially in Africa [13].

Nigeria is a major country in West Africa located in the tropical rainforest and has a tropical climate temperature ranging between  $m\ 25^{\circ}$  to  $28^{\circ}C$  (Figure 1). A significantly high ratio of the world's reservoir of diverse genetic resources is reportedly found in Nigeria [14]. Nigeria is steeped in the belief and use of traditional medicines in which plants (herbal medicines) play a vital role. Herbal medicines are freely sold in open markets in many parts of Nigeria as in other countries of the world. They are widely accepted by the people as part of the socio-cultural heritage. However, information about plant usage for specific illnesses and diseases is scattered and there is an urgent need for consolidation for better understanding and passage of information on the herbal management of such diseases. A consolidated account will also provide a background for which further investigation could be made for possible drug leads. The objective of the present review is to make a compilation of the recorded local plants/herbs employed in Nigeria for the treatment/management of typhoid fever with a view to making available a compendium to aid future research into anti-typhoid drug development.

## MATERIALS AND METHODS

A search of articles published not later than 2020 on medicinal plants used for the treatment of typhoid fever in Nigeria was conducted in three databases comprising Pubmed, Science Direct and Google Scholar using the keywords: "Ethnobotanical survey", "plants", "herbs", "typhoid" "fever" and "Nigeria". Each state of the country was added in each search to ensure complete coverage. Inclusion and exclusion criteria are as follows:

- i. Only peer-reviewed, original research articles of investigations based on ethnobotanical surveys conducted in Nigeria and published not later than December 2020 were included in the study.
- ii. Studies that assess plants based on local claim(s)

and/or literature review but not with a properly documented ethnobotanical survey were excluded from this review.

iii. Only plants specified for use in treatment/management of typhoid fever were considered in the compilation.

iv. It was ensured that all six geopolitical zones in Nigeria (North-Central, North-East, North-West, South-East, South-South, and South-West) were represented to capture different cultures which have a direct influence on the people's use of plants for healthcare.

v. Information regarding each plant that was not included in the original articles was sought in the literature and included in the compilation.

## RESULTS

After a thorough screening of the output from the search engines, thirty-nine [39] articles met the inclusion and exclusion criteria and were selected for this review. A total of one hundred and sixty-six [166] plant species belonging to sixty-six [66] families were documented for use in the treatment of typhoid fever in twenty-six [26] states (Abia, Bauchi, Bayelsa, Benue, Borno, Cross River, Delta, Edo, Gombe, Imo, Kaduna, Kano, Katsina, Kebbi, Kogi, Kwara, Lagos, Nasarawa, Niger, Ogun, Osun, Oyo, Rivers, Taraba, Yobe and Zamfara) across the six geopolitical zones of Nigeria (Table 1).

As shown in Figure 2, Fabaceae, followed closely by Caesalpiniaceae, Euphorbiaceae and Poaceae, is the most employed family.

The frequency of plants families notwithstanding, the first ten plants with the broadest use are *Mangifera indica* L., *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Psidium guajava* L., *Citrus aurantifolia* Christm, *Ananas comosus* (L.) Merr, *Ocimum gratissimum* L, *Vernonia amygdalina* (Wild) Darke, *Alstonia boonei* De Wild. and *Azadirachta indica* A. Juss (Table 3).

All parts of plants are reported to be relevant in the traditional management of typhoid fever. However, leaves are the most widely used either alone or in

combination with other parts of a plant (Figure 3).

## DISCUSSION

Fabaceae (legumes) being the third largest family of higher plants, covers about 20,000 plant species [15]. As a result of their nitrogen-fixing property, they are the largest producers of nitrogen-containing phytochemicals like alkaloids and amines, non-protein amino acids (NPAA), cyanogenic glucosides, and peptides [16]. Sikolia and Omondi [2017] reported an abundance of alkaloids and saponins in selected species of the Fabaceae family [17]. This could imply that the nitrogenous phytochemicals could possess a considerable level of anti-salmonella activities responsible for the acclaimed efficiency of this family in the treatment of typhoid fever since antimicrobial potentials have been attributed to alkaloids [18]. The non-nitrogenous phytochemical present in Fabaceae includes phenolics (flavonoids, isoflavones, anthocyanins, catechins, tannins, lignans, coumarins etc.), anthraquinones, and terpenoids (especially triterpenoid, steroidal saponins, tetraterpenes). The family thus appears on the top list of frequently cited plant families in traditional medicinal practices [19]. Fabaceae was also reported to be among the most cited plant families with antimicrobial activities [20]. The Caesalpiniaceae family that is also widely used for management of typhoid fever in Nigeria is actually a sub-family of Fabaceae [63]. All the ten most frequently used plants are also used in traditional treatment of malaria and/or different kinds of stomach disturbances [21-24], both of which share significant numbers of symptoms with typhoid fever [25]. Leaves are widely used in herbal medicines, and this may be due to their availability compared to fruits and seeds, which are seasonal, easy accessibility, and quick regeneration after harvesting. This observation conforms to those of Obode et al., 2020 who reported 63% leaf usage in herbal management of hypertension in Nigeria [26].

From this review, it is evident that Nigeria has a huge, crude resource in the traditional medicinal practice, especially medicinal plants used in the treatment/management of typhoid fever. The review identified 166 plant species used in traditional treatment of typhoid fever in selected articles up till December 2020. The most widely used plants (*Mangifera indica*

L., *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Psidium guajava* L., *Citrus aurantifolia* Christm, *Ananas comosus* (L.) Merr, *Ocimum gratissimum* L., *Vernonia amygdalina* (Wild) Darke, *Alstonia boonei* De Wild. and *Azadirachta indica* A. Juss) can be further researched for active principles that could be useful in the development of new antibiotics and/or adjuvants to tackle both antibiotic resistance as well as the development of the carrier status of the life-threatening disease. An in-depth review of previous studies carried out to establish therapeutic claims, phytochemistry, mechanism of actions and toxic side effects of these crude medicinal substances, especially with regards to typhoid fever and other salmonella infections, would pave the way for further scientific investigations. Out of the thirty-six [36] states in Nigeria, only twenty-six [26] are represented in this compilation. Extensive ethnobotanical/ethnopharmacological surveys need to be done in the remaining ten [10] states to ensure complete coverage of the report. It is expected that this documentation of medicinal plants used for the treatment of typhoid fever will further promote bioprospecting and pharmacological research.

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## TABLES AND FIGURE

**Table 1:** Medicinal Plants used in the treatment of typhoid fever in Nigeria

S/No	Scientific Name	Family	Common Name	Parts used	References
1	<i>Aframomum danielli</i> (Hook.f.) K. Schum	Zingiberaceae	African cardamom	Leaves, Roots	27
2	<i>Abrus precatorius</i> L.	Fabaceae	Crab's eye	Leaves, Stem	28
3	<i>Acacia albida</i> Del.	Mimosaceae	Apple-ring acacia	Leaves	29
4	<i>Acacia sieberiana</i> DC	Leguminosae	African laburnum	Fruit	30
5	<i>Acanthospermum hispidum</i> DC	Asteraceae	Star burr	Whole plant	31
6	<i>Aframomum melegueta</i> K. Schum	Zingiberaceae	Alligator Pepper	Fruits, seed	28
7	<i>Albizia ferruginea</i> (Gull. & Perr.) Benth.	Mimosaceae	West African albizia	Whole plant	31, 32
8	<i>Alchornea cordifolia</i> (Schum. & Thonn.) Muell.Arg.	Euphorbiaceae	Christmas bush	Leaves	32-34
9	<i>Allium cepa</i> L.	Liliaceae	Onions	Bulb	27, 35
10	<i>Allium sativum</i> L.	Liliaceae	Garlic	Bulb	28, 32, 35-37
11	<i>Aloe vera</i> (L.) Burm. f.	Asphodelaceae	Aloe vera	Gel	36, 38
12	<i>Alstonia boonei</i> De Wild. (Syn: <i>Alstonia congensi</i> )	Apocynaceae	Stool wood	Stem bark, Leaves	31,33, 35, 36, 39-41
13	<i>Alternanthera sessilis</i> (L.)DC	Amaranthaceae	Sessile joy weed	Whole plant	33
14	<i>Anacardium occidentale</i> L.	Anacardiaceae	Cashew	Leaves, Stem bark	28, 33 38, 42,
15	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	Pineapple	Unripe fruit	31-32, 35-36, 38, 43-45



16	<i>Annona senegalensis</i> Var. <i>deltoids</i> Robyns&Chesq. Pers	Annonaceae	Wildberry	Stem bark, Leaves	33, 43
17	<i>Anogeissusleocarpus</i> Guill. & Perr.	Combretaceae	African birch	Stem, Bark	31, 33, 43
18	<i>Asparagus africanus</i> Lam.	Liliaceae	Bush asparagus	Whole plant	29
19	<i>Aspiliaafricana</i> (Pers) C. D. Adams	Asteraceae	Wild sunflower	Whole plant	28
20	<i>Azadirachta indica</i> A. Juss	Meliaceae	Neem	Leaves, Whole plant	28, 29, 33, 36, 42, 43, 46
21	<i>Balanites aegyptiaca</i> L. Delile	Balanitaceae/Zygophyllates	Desert date/ Egyptian basal	Leaves	32, 33, 47
22	<i>Bambusa vulgaris</i> Schrad. ex J.C. Wendl.	Poaceae	Bamboo	Leaves	38, 39, 43
23	<i>Blighia sapida</i> K. D. Koenig	Sapindaceae	Ackee	Leaves	32, 33 40
24	<i>Boswellia dalzielli</i> Hutch	Burseraceae	Frankin-cense tree	Root	29
25	<i>Brideliaferruginea</i> Benth.	Euphorbiaceae	Bridelia	Bark	48
26	<i>Cadabafarinosa</i> Forssk	Capparidaceae	Herd boy's fruit	NM	29
27	<i>Caesalpinia bonducl.</i>	Apocynaceae	Ricker	Nuts	39
28	<i>Cajanus cajan</i> (L.)Millsp.	Fabaceae	Pigeon bean	Leaves	38
29	<i>Calotropis procera</i> (Ait.)Ait. F	Asclepiadaceae	Sodom apple	Leaves	31, 33
30	<i>Capsicum frutescens</i> L.	Solanaceae	Chile pepper	Fruit, Leaves	35
31	<i>Carica papaya</i> L.	Caricaceae	Pawpaw	Leaves, Unripe fruits	28, 32-33, 35-36, 43- 45, 49-52
32	<i>Cassia fistula</i> L.	Fabaceae	Golden shower	Leaves	41
33	<i>Cassia occidentalis</i> L.	Caesalpiniaceae	Negro coffee, stinking weed	Leaves, Whole plant	29, 32
34	<i>Cassia simea</i> (Lam,) Irwin et	Caesalpinioideae	Bombay	Leaves	48

	Barneby		blackwood		
35	<i>Cassia singueana</i> (Delile) Lock (Syn: Sena singueana (Del.) Lock)	Fabaceae	Winter cassia, Sticky pod	Leaves, Root	29-30
36	<i>Cassia tora</i> L. (Syn: Senna Tora)	Fabaceae	Sickle seea	Leaves	31-32, 53
37	<i>Cassytha filiformis</i> L.	Lauraceae	Parasitic vine	Whole plant	28
38	<i>Ceiba pentandra</i> (L.) Gaerth	Bombacaceae	Silk-cotton	Leaves	44
39	<i>Celastrus indica</i> L	Celastraceae	Bitter sweet	Leaves	35
40	<i>Celtis integrifolia</i> Lam.	Ulmaceae	Hackberry, nettle tree	Leaves	29
41	<i>Chasmanthera dependes</i> Hochst.	Menispermaceae	Climbing plant	Leaves	41
42	<i>Chromolaena odorata</i> (L.) R.M. King & Robinson	Asteraceae	Siam weed	Leaves	28, 33-34, 45, 50
43	<i>Chrysophyllum albidum</i> G. Don.	Sapotaceae	African Star apple	Stem bark,Leaves	28
44	<i>Citrullus colocynthis</i> (L.) Schrad	Cucurbitaceae	Bitter (or wild) gourd	Fruit	33
45	<i>Citrullus lanatus</i> (Thunb.) Matsum& Nakai	Cucurbitaceae	Watermelon	Bark,Fruit	31
46	<i>Citrus aradisi</i> Macfad.	Rutaceae	Grape	Fruit, Leaves	38
47	<i>Citrus aurantifolia</i> Christm	Rutaceae	Lime	Leaves, Fruits	28, 29, 31, 35-36, 38 43, 49-50, 52, 54
48	<i>Citrus limon</i> (L.) Burm. F. Swing	Rutaceae	Lemon	Fruits	35-36
49	<i>Citrus medica</i> L.	Rutaceae	Citron	Fruits, Leaves	31
50	<i>Citrus paradisi</i> Macf	Rutaceae	Grape	Fruits	28, 32-33, 35-36
51	<i>Citrus sinensis</i> (L.) Osbeck	Rutaceae	Orange	Leaves	31, 36, 38, 55

52	<i>Cochlospermumplanchonii</i> Hook.	Cochlospermaceae	False Cotton	Leaves, Root	28
53	<i>Cochlospermumtinctorium</i> A. Rich	Cochlospermaceae	Dyer's Bottle Tree	Root	29
54	<i>Cocos nucifera</i> L.	Palmae	Coconut	Fruits, Bark	28, 32-33, 35-36, 40
55	<i>Codaeium variegatum</i> L.	Euphorbiaceae	Fire croton	NM	50
56	<i>Cola hispida</i> Bren &keay	Sterculiaceae	Kola	Leaves	43
57	<i>Combretum glutinosum</i> Pers. Ex DC	Combretaceae	Bushwillow	Leaves	29
58	<i>Commiphora africana</i> (A. Rich) Endl.	Burseraceae	African myrrh	Leaves	53
59	<i>Commiphora kerstingii</i> Engl.	Burseraceae	Myrrh	Stem bark	33
60	<i>Cordia africana</i> Lam.	Boraginaceae	Close-up of the flowers	Stem bark	29
61	<i>Costus afer</i> Ker- Gaw	Zingiberaceae	Twisted ginger	Leaves	35
62	<i>Curcuma longa</i> L.	Zingiberaceae	Tumeric	Rhizome	41
63	<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	Lemongrass	Leaves, Fruits	27-28, 31- 36, 38, 43, 45, 49, 53
64	<i>Cymbopogon giganteus</i> Chiov.	Poaceae	Kachi grass	Whole plant	31
65	<i>Danielliaoliveri</i> (Rolfe) Hutch. &Dalz.	Fabaceae	African copaiba basalm	Leaves, Bark	28, 31, 32, 33, 36, 56
66	<i>Datarummicrocarpum</i> Gull. & Perr.	Caesalpiniaceae	Sweete detar, tallow tree	Leaves	32
67	<i>Daucus carota</i> L.	Apiaceae	Carrot	Fruit	36, 38
68	<i>Detarium microcarpum</i> Guill ex Perr.	Caesalpiniaceae	Tallow tree	Root	29, 33
69	<i>Dodonaeaviscosa</i> Jacq.	Sapindaceae	Hopshbu	Leaves	46
70	<i>Dolenix regia</i> (Bojer) Raf.	Ceasalpinaceae	Flamboyant	Leaves, Bark	55

71	<i>Drypetesgossiweileri</i>	Euphorbiaceae	Agawo	Stem bark	39
72	<i>Eleusine indica</i> (L.) Gaertn	Poaceae	Goosegrass	Root	28
73	<i>Enantiachlorantha</i> Oliv.	Amonaceae	African yellow wood	Stem bark, Bark, Whole plant	31-33, 35
74	<i>Eriosema psoraleoides</i> (Lam) G. Don.	Papilionoideae	Canary pea, yellow seed	Leaves	32-33
75	<i>Erythrina senegalensis</i> DC (Syn: <i>Chirocalyx latifolia</i> ; <i>Erythrina latifolia</i> )	Papilionaceae	Coral tree, coral flower	Stem bark	29-30, 33
76	<i>Eucalyptus camaldulensis</i> Dehnh	Myrtaceae	River red gum	Leaves	28, 33
77	<i>Eucalyptus citrisodora</i> D. C.	Myrtaceae	Lemon-scented gum	Leaves	43, 47
78	<i>Euphorbia heterophylla</i> L.	Euphorbiaceae	Spurge weed, wild poinsettia	Whole plant	36
79	<i>Ficus abutilifolia</i> Miq.	Moraceae	Large-leaved rock fig	Fruit	31
80	<i>Ficus capensis</i> Thunb	Moraceae	Cape fig	Stem bark,Leaves	28
81	<i>Ficus exasperata</i> Vahl.	Moraceae	Sandpaper tree	Stem bark, Leaves	28, 36
82	<i>Ficus ingens</i> (Miq.)	Moraceae	Red-leaved fig	Stem bark	30
83	<i>Ficus platyphylla</i> Del.	Moraceae	Flake rubber tree	Leaves, Stem bark	28, 32-33
84	<i>Ficus sur</i> Forssk	Moraceae	Commercial fig	NM	43
85	<i>Ficus thonningii</i> Blume.	Moraceae	Chinese banyan	Leaves	31, 34, 53
86	<i>Floscopa africana</i> (P.Beauv.) C.B.Clarke	Commelinaceae	African floscopa	Leaves	35
87	<i>Garcinia kola</i> Heckel	Guttiferae	Bitter Kola	Fruit, Root bark	28
88	<i>Gardenia aqualla</i> Stapf. & Hutch	Rubiaceae	Cape Jasmine	Root, Leaves	32-33

89	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Liquorice	Leaves	45
90	<i>Gmelina arborea</i> Roxb.	Verbenaceae	Beechwood	NM	43
91	<i>Gossypium arboretum</i> L.	Malvaceae	Cotton tree	NM	39
92	<i>Gossypium herbaceum</i> L. (Syn: <i>Gossypium hirsutum</i> L.)	Malvaceae	Cotton	Leaves, Seed	29, 33, 35, 50, 52
93	<i>Grewia mollis</i> Juss	Tiliaceae	Raisin	Stem bark	32-33
94	<i>Guiera senegalensis</i> J. F. Gmel.	Combretaceae	Moshi medicine	Leaves	31, 57
95	<i>Hygrophilia auriculata</i> (Schumach) Heine	Acanthaceae	Talmak-hana	Leaves	29
96	<i>Hippocratea indica</i> (Hutch. & M. B Moss)	Celastraceae	Mopane paddle-pod, bittersweet	Leaves, Root	41
97	<i>Isobertliniadia</i> Craib & Stapf	Caesalpiniaceae	Hardwood tree	Leaves	31
98	<i>Jatropha curcas</i> L.	Euphorbiaceae	Physic nut	Leaves, Root	28, 47
99	<i>Jatropha gossypifolia</i> L.	Euphorbiaceae	Wild cassava	Leaves	28
100	<i>Khaya gradifolia</i> C. DC	Meliaceae	Khaya	Stem bark	41
101	<i>Khaya senegalensis</i> (Desr.) A. Juss	Mimosaceae	Mahogany	Leaves, Bark	28, 31-34
102	<i>Lagenaria breviflorus</i> (Benth.) Roberty	Cucurbitaceae	Pseudoclocynth	Stem bark	41
103	<i>Lawsonia inermis</i> (L.) Keay	Lythraceae	Henna	Leaves	28, 33, 58, 59
104	<i>Lophira lanceolata</i> Van Tiegh. ex. Keay	Onchanaceae	Red oak	Stem bark, Leaves	28
105	<i>Luffa aegyptiaca</i> Mill.	Convolvulaceae	Sponge gourd	Leaves	28
106	<i>Magnifera indica</i> L	Anacardiaceae	Mango	Stem bark, Leaves	27-28, 31-33, 35-36, 38, 41, 43, 46-47, 50, 56
107	<i>Marrubium vulgare</i> L.	Lamiaceae	Horehound	Leaves, Seed	45

108	<i>Maytenus senegalensis</i> (Lam.) Exell.	Celastraceae	Spike thorn	Leaves	29
109	<i>Momordica balsamina</i> L.	Convolvulaceae	Balsam pear	Leaves	28
110	<i>Morinda lucida</i> Benth.	Rubiaceae	Brimstone tree	Leaves	28, 32-33, 38 49
111	<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick tree	Leaves	30-32
112	<i>Mucuna pruriens</i> L.	Fabaceae	Velvet bean	Leaves	28
113	<i>Musa paradisiacal</i> L.	Musaceae	Plantain	Fruit	36
114	<i>Nauclea latifolia</i> J. E. Smith.	Rubiaceae	African peach	Stem bark, Root, Leaves	28, 30, 32-33, 41
115	<i>Newbouldialeavisseaman</i> ex bureau	Bignoniaceae	African border tree	Leaves	34, 43
116	<i>Ocimumbasilicum</i> L.	Lamiaceae	Basil	Leaves	32, 38
117	<i>Ocimumgratissimum</i> L	Lamiaceae	Scent leaves	Leaves	33, 35-36, 39, 43, 45, 50-51
118	<i>Olaxsubscorpioidea</i> Oliv.	Olacaceae	Olax, Stinkant forest	Root	31-32
119	<i>Olea hochstetteri</i> Baker	Oleaceae	Olive	Bark	60
120	<i>Physalis angulate</i> L.	Solanaceae	Angular winter cherry	NM	27
121	<i>Parkia biglobosa</i> (Jacq)	Fabaceae	Locust bean	Stem bark, Leaves	28, 31
122	<i>Pennisetum purpureum</i> Schumach.	Poaceae	Elephant grass	Grass	36
123	<i>Pergulariadaemia</i> (Forsk) Chiov.	Asclepiadaceae	Hariknot plant	Leaves	45
124	<i>Persea americana</i> Mill.	Lauraceae	Avocado	Leaves	38
125	<i>Petiveraalliacea</i> L.	Phytoloccaceae	Guinea hen weed	Stem bark, Leaves	41
126	<i>Phyllanthus amarus</i> Schum.&Thonn	Euphorbiaceae	Hurricane weed	Whole plant	27-28, 31
127	<i>Piliostigmathonningii</i> (Schum.)	Fabaceae	Wild bauhinia	Fruit,	28, 31, 33

	Milne –Redh.			Leaves	
128	<i>Pilostigmareticulatum</i> (DC) Hochst	Caesalpiniaceae	Pilostigma	NM	29
129	<i>Plumera rubra</i> L.	Apocynaceae	Temple tree	Leaves	32-33
130	<i>Prosopis africana</i> (Guill. & Perr.) Taub.	Fabaceae	African mesquite, Iron tree	Leaves	53
131	<i>Pseudocedrelakotschy</i> (Schweinf.) Harms.	Meliaceae	Dry-zone cedar, Hard cedar- mahogany	Root	33
132	<i>Psidium guajava</i> L.	Myrtaceae	Guava	Stem bark, Leaves	28, 32-34, 36, 39, 42- 45, 56-57, 60
133	<i>Pyrus cydonia</i> L.	Rosaceae	Quince	Leaves	45
134	<i>Saccharum officinarum</i> L.	Poaceae	Sugar cane	Matured stem	31-32, 36
135	<i>Sarcocephaluslatifolius</i> (JE Sm.) EA Bruce	Rubiaceae	African peach	Stem bark	40
136	<i>Schefflera actinophylla</i> (Endl.) Harms	Araliaceae	Umbrella tree	Leaves	30
137	<i>Securidacalongipedunculata</i> Fresen.	Polygalaceae	Violet tree	Leaves, Stem bark,Roots	32-33
138	<i>Senna spectabilis</i> H. Irwin & Barneby (D.C.)	Leguminosae	Spectacular cassia, golden wonder tree	Leaves	33, 43
139	<i>Senna occidentalis</i> (L.) Link	Fabaceae	Coffee weed	Leaves	32
140	<i>Sida acuta</i> Burm. F.	Malvaceae	Wire weed	Leaves	28, 36
141	<i>Solanum lycopersicon</i> L.	Solanaceae	Tomato	Fruit	36, 38
142	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Guinea Corn	Leaves, Stem	28, 32- 33,41
143	<i>Sphenocentrumjollyanum</i> Pierre	Menispermaceae	Sphenocentrum	Leaves,	41

				Root, Seed	
144	<i>Spondias mombin</i> L	Anacardiaceae	Yellow mombin	Stem bark, Leaves	32-33
145	<i>Stachyrtaphetajamaicensis</i> Vahl.	Verbenaceae	Brazilian tea	Leaves	31
146	<i>Sterculia setigera</i> Del.	Sterculiaceae	Karaya gum tree	Stem bark, Leaves	28
147	<i>Sterospermum kuthianum</i> Cham.	Bignoniaceae	Pink Jacaranda	Stem bark	29
148	<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tamarind, Indian nut	Leaves	29
149	<i>Tectona grandis</i> L.	Verbenaceae	Teak	Leaves	31
150	<i>Telfairea occidentalis</i> Hook.F.	Convolvulaceae	Fluted Pumpkin	Leaves	28
151	<i>Terminalia avicennioides</i> Guill & Perr.	Combretaceae	Indian laurel	Leaves	32-33
152	<i>Terminalia catappa</i> L.	Combretaceae	Indian almond	Leaves	28
153	<i>Terminalia glaucescens</i> Planch. ex Benth.	Combretaceae	Muyati	Leaves	31
154	<i>Thesium viride</i> A. W. Hill	Santalaceae	Viride False- Foxglove	Whole plant	30
155	<i>Thoningiasanguinea</i> Vahl.	Balanophoraceae	Ground pineapple	Flower	31
156	<i>Uvariachamae</i> P. Beaur	Annonaceae	Finger root	Stem bark	34, 40, 43
157	<i>Valeriana officinalis</i> L.	Valerianaceae	Garden heliotrope	Leaves	45
158	<i>Vernonia amygdalina</i> (Wild) Darke	Asteraceae	Bitter leaves	Leaves, Whole plant	28-29, 32- 33, 45, 46, 50
159	<i>Vitellaria paradoxa</i> C. F. Gaertn	Sapotaceae	Shea butter tree	Stem bark, Leaves	28
160	<i>Vitex doniana</i> Sweet	Verbenaceae	Black plum	Leaves, Bark, Root	28, 31-33
161	<i>Waltheria americana</i> L.	Sterculiaceae	Sleepy morning	Roots	29
162	<i>Ximenia Americana</i> L.	Olacaceae	Tallow wood	Stem bark,	32-33



				Leaves	
163	<i>Xylopiya aethiopica</i> L.	Annonaceae	Bitterwood	Fruits	31, 61
164	<i>Zea mays</i> L.	Poaceae	Maize	Stem	28
165	<i>Zingiber officinale</i> Roscoe.	Zingiberaceae	Ginger	Rhizome	28, 31-33 36, 51, 56
166	<i>Ziziphus abyssinica</i> Hochst	Rhamnaceae	Large jujube	Root, Stem bark	32-33

Syn = synonyms; NM = not mentioned

Table 2:

S/No	Scientific Name	Frequency	NC	NE	NW	SE	SS	SW
1	<i>Magnifera indica</i> L.	15	3	1	3		4	4
2	<i>Carica papaya</i> L.	12	3		2	1	3	2
3	<i>Cymbopogon citratus</i> (DC.) Stapf	12	4		1	1	4	2
4	<i>Psidium guajava</i> L.	12	4	3	1	1	2	1
5	<i>Citrus aurantifolia</i> Christm	11	4	1		1	2	3
6	<i>Ananas comosus</i> (L.) Merr.	8	1		1	1	3	2
7	<i>Ocimum gratissimum</i> L.	8	2				3	3
8	<i>Vernonia amygdalina</i> (Wild) Darke	8	2	1	2		2	1
9	<i>Alstonia boonei</i> De Wild. (Syn: <i>Alstonia congensi</i> )	7	1				1	5
10	<i>Azadirachta indica</i> A. Juss	7	3	2	1		1	
11	<i>Zingiber officinale</i> Roscoe.	7	3		1		1	2
12	<i>Cocos nucifera</i> L.	6	2		1		1	2
13	<i>Lawsonia inermis</i> (L) Keay	6	3	1	1			1
14	<i>Morinda lucida</i> Benth.	6	2		1	1	1	1
15	<i>Allium sativum</i> L.	5	2		1		1	1
16	<i>Chromolaena odorata</i> (L.) R.M. King & Robinson	5	3				2	
17	<i>Citrus paradisi</i> Macf	5	2		1		1	1
18	<i>Gossypium herbaceum</i> L. (Synonym: <i>Gossypium hirsutum</i> L.)	5		2			1	2
19	<i>Khaya senegalensis</i> (Desr.) A. Juss	5	3		1			1
20	<i>Nauclea latifolia</i> J. E. Smith.	5	2		2			1
21	<i>Anacardium occidentale</i> L.	4	2	1			1	
22	<i>Bambusa vulgaris</i> Schrad. ex J.C. Wendl.	4	1				1	2
23	<i>Citrus sinensis</i> (L.) Osbeck	4	1				2	1

24	<i>Danielliaoliveri</i> (Rolfe) Hutch. & Dalz.	4	2		1			1
25	<i>Enantiachlorantha</i> Oliv.	4	1		1			2
26	<i>Erythrina senegalensis</i> DC or <i>Chirocalyx latifolia</i> ; <i>Erythrina latifolia</i>	4	2	1	1			
27	<i>Sorghum bicolor</i> (L.) Moench	4	2		1			1
28	<i>Vitex doniana</i> Sweet	4	2		1			1
29	<i>Alchornea cordifolia</i> (Schum. & Thonn.) Muell. Arg.	3	2		1			
30	<i>Anogeissus leocarpus</i> Guill. & Perr.	3	2					1
31	<i>Balanites aegyptiaca</i> L. Delile	3	1		2			
32	<i>Blighia sapida</i> K. D. Koenig	3	1		1			1
33	<i>Cassia singueana</i> (Delile) Lock (Syn: <i>Sena singueana</i> (Del.) Lock)	3	1	1	1			
34	<i>Cassia tora</i> L. ( <i>Senna tora</i> )	3			2			1
35	<i>Ficus platyphylla</i> Del.	3	2		1			
36	<i>Ficus thonningii</i> Blume.	3	1		1			1
37	<i>Moringa oleifera</i> Lam.	3			2			1
38	<i>Phyllanthus amarus</i> Schum. & Thonn	3	1				1	1
39	<i>Piliostigma thonningii</i> (Schum.) Milne –Redh.	3	2					1
40	<i>Saccharum officinarum</i> L.	3			1		1	1
41	<i>Uvariachamae</i> P. Beaur	3	2					1
42	<i>Aframomum melegueta</i> K. Schum	2	1					1
43	<i>Albizia ferruginea</i> (Gull. & Perr.) Benth.	2			1			1
44	<i>Allium cepa</i> L.	2					1	1
45	<i>Aloe vera</i> (L.) Burm. F.	2					2	

46	<i>Annona senegalensis</i> Var. <i>deltoids</i> Robyns&Chesq. Pers.	2	2					
47	<i>Cajanus cajan</i> (L.) Millsp.	2					1	1
48	<i>Calotropis procera</i> (Ait.) Ait. F.	2	1					1
49	<i>Cassia occidentalis</i> L.	2		1	1			
50	<i>Citrus limon</i> (L.) Burm. F. Swing	2					1	1
51	<i>Daucus carota</i> L.	2					2	
52	<i>Detarium microcarpum</i> Guill ex Perr.	2	1	1				
53	<i>Eriosema psoraleoides</i> (Lam) G. Don.	2	1		1			
54	<i>Eucalyptus camaldulensis</i> Dehnh	2	2					
55	<i>Eucalyptus citrisodora</i> D. C.	2	1		1			
56	<i>Ficus capensis</i> Thunb	2	1					1
57	<i>Ficus exasperata</i> Vahl.	2	1				1	
58	<i>Gardenia aqualla</i> Stapf. & Hutch	2	1		1			
59	<i>Grewia mollis</i> Juss	2	1		1			
60	<i>Guiera senegalensis</i> J. F. Gmel.	2		1				1
61	<i>Jatropha curcas</i> L.	2	1		1			
62	<i>Newbouldia leaviss</i> Eaman ex bureau	2	2					
63	<i>Ocimum basilicum</i> L.	2			1		1	
64	<i>Olax subscorpioidea</i> Oliv.	2			1			1
65	<i>Parkia biglobosa</i> (Jacq)	2	1					1
66	<i>Plumera rubra</i> L.	2	1		1			
67	<i>Securidacal longipedunculata</i> Fresen.	2	1		1			
68	<i>Senna spectabilis</i> H. Irwin & Barneby (D.C.)	2	2					
69	<i>Sida acuta</i> Burm. F.	2	1				1	

70	<i>Solanum lycopersicon</i> L.	2					2	
71	<i>Spondias mombin</i> L	2	1		1			
72	<i>Terminalia avicennioides</i> Guill & Perr.	2	1		1			
73	<i>Ximenia Americana</i> L.	2	1		1			
74	<i>Xylopia aethiopica</i> L.	2				1		1
75	<i>Ziziphus abyssinica</i> Hochst	2	1		1			
76	<i>Aframomum danielli</i> (Hook.f.) K. Schum	1					1	
77	<i>Abrus precatorius</i> L.	1	1					
78	<i>Acacia albida</i> Del.	1		1				
79	<i>Acacia sieberiana</i> DC	1			1			
80	<i>Acanthospermum hispidum</i> DC	1						1
81	<i>Alternanthera sessilis</i> (L.) DC	1	1					
82	<i>Asparagus africanus</i> Lam.	1		1				
83	<i>Aspilaafricana</i> (Pers) C. D. Adams	1	1					
84	<i>Boswellia dalzielli</i> Hutch	1		1				
85	<i>Bridelia ferruginea</i> Benth.	1		1				
86	<i>Cadaba farinosa</i> Forssk	1		1				
87	<i>Caesalpinia bonduc</i> L.	1						1
88	<i>Capsicum frutescens</i> L.	1						1
89	<i>Cassia fistula</i> L.	1						1
90	<i>Cassia simea</i> (Lam.) Irwin et Barneby	1		1				
91	<i>Cassytha filiformis</i> (L.) Lauraceae	1	1					
92	<i>Ceiba pentandra</i> (L.) Gaerth	1				1		
93	<i>Celastrus indica</i> L.	1						1
94	<i>Celtis integrifolia</i> Lam.	1		1				
95	<i>Chasmanthera dependes</i> Hochst.	1						1

96	<i>Chrysophyllum albidum</i> G. Don.	1	1					
97	<i>Citrullus colocynthis</i> (L.) Schrad	1	1					
98	<i>Citrullus lanatus</i> (Thunb.) Matsum& Nakai	1						1
99	<i>Citrus aradisi</i> Macfad.	1					1	
100	<i>Citrus medica</i> L.	1						1
101	<i>Cochlospermumplanchonii</i> Hook.	1	1					
102	<i>Cochlospermumtinctorium</i> A. Rich	1		1				
103	<i>Codaeium variegatum</i> L.	1					1	
104	<i>Cola hispida</i> Bren &keay	1	1					
105	<i>Combretum glutinosum</i> Pers. Ex DC	1		1				
106	<i>Commiphora africana</i> (A. Rich) Endl.	1			1			
107	<i>Commiphora kerstingii</i> Engl.	1	1					
108	<i>Cordia africana</i> Lam.	1		1				
109	<i>Costus afer</i> Ker Gaw	1						1
110	<i>Curcuma longa</i> L.	1						1
111	<i>Cymbopogon giganteus</i> Chiov.	1						1
112	<i>Datarummicrocarpum</i> Gull. & Perr.	1			1			
113	<i>Dodonaea viscosa</i> Jacq.	1			1			
114	<i>Dolenix regia</i> (Bojer) Raf.	1	1					
115	<i>Drypetesgossiweileri</i>	1						1
116	<i>Eleucine indica</i> (L) Gaertn	1	1					
117	<i>Euphorbia heterophylla</i> L.	1					1	
118	<i>Ficus abutilifolia</i> Miq.	1						1
119	<i>Ficus ingens</i> (Miq.)	1			1			
120	<i>Ficus sur</i> Forssk	1	1					
121	<i>Floscopa africana</i> (P.Beauv.)	1						1

	C.B.Clarke							
122	<i>Garcinia kola</i> Heckel	1	1					
123	<i>Glycyrrhiza glabra</i> L.	1					1	
124	<i>Gmelina arborea</i> Roxb	1	1					
125	<i>Gossypium arboretum</i> L.	1						1
126	<i>Hygrophilia auriculata</i> (Schumach) Heine	1		1				
127	<i>Hippocratea indica</i> (Hutch. & M. B Moss)	1						1
128	<i>Isoberialiadoka</i> Craif & Stapf	1						1
129	<i>Jatropha gossypifolia</i> L.	1	1					
130	<i>Khaya gradifolia</i> C. DC	1						1
131	<i>Lagenaria breviflorus</i> (Benth.) Roberty	1						1
132	<i>Lophira lanceolata</i> Van Tiegh. ex. Keay	1	1					
133	<i>Luffa aegyptiaca</i> Mill.	1	1					
134	<i>Marrubium vulgare</i> L.	1					1	
135	<i>Maytenus senegalensis</i> (Lam.) Exell.	1		1				
136	<i>Momordica balsamina</i> L.	1	1					
137	<i>Mucuna pruriens</i> L.	1	1					
138	<i>Musa paradisiacal</i> L.	1					1	
139	<i>Olea hochstetteri</i> Baker	1		1				
140	<i>Physalis angulate</i> L.	1					1	
141	<i>Pennisetum purpureum</i> Schumach.	1					1	
142	<i>Pergulariadaemia</i> (Forsk) Chiov.	1					1	
143	<i>Persea americana</i> Mill.	1					1	
144	<i>Petiveraalliacea</i> L.	1						1

145	<i>Pilostigmareticulatum</i> (DC) Hochst	1		1				
146	<i>Prosopis africana</i> (Guill. & Perr.) Taub.	1			1			
147	<i>Pseudocedrelakotschy</i> (Schweinf.) Harms.	1	1					
148	<i>Pyrus cydonia</i> L	1					1	
149	<i>Sarcocephaluslatifolius</i> (JE Sm.) EA Bruce	1						1
150	<i>Schefflera actinophylla</i> (Endl.) Harms	1			1			
151	<i>Senna occidentalis</i> (L.) Link	1			1			
152	<i>Sphenocentrumjollyanum</i> Pierre	1						1
153	<i>Stachystarphetajamaicensis</i> Vahl.	1						1
154	<i>Sterculia setigera</i> Del.	1	1					
155	<i>Sterospermumkuthianum</i> Cham.	1		1				
156	<i>Tamarindus indica</i> L.	1		1				
157	<i>Tectona grandis</i> L.	1						1
158	<i>Telfairea occidentalis</i> Hook.F.	1	1					
159	<i>Terminalia catappa</i> L.	1	1					
160	<i>Terminalia glaucescens</i> Planch. ex Benth.	1						1
161	<i>Thesiumviride</i> A. W. Hill	1			1			
162	<i>Thoningiasanguinea</i> Vahl.	1						1
163	<i>Valeriana ifficinalis</i> (L)	1					1	
164	<i>Vitellaria paradoxa</i> C. F. Gaertn	1	1					
165	<i>Waltheria americana</i> L.	1		1				
166	<i>Zea mays</i> L.	1	1					
	<b>Total</b>	<b>385</b>	<b>128</b>	<b>34</b>	<b>61</b>	<b>8</b>	<b>64</b>	<b>89</b>

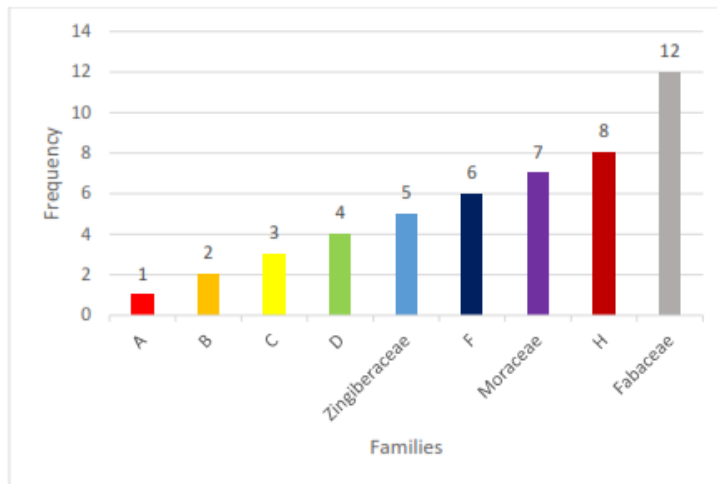
NC-North central Nigeria; NE-Northeastern Nigeria; NW-North western Nigeria; SE-South eastern Nigeria; SS-south southern Nigeria; SW-South western Nigeria





Figure 1: Map of Nigeria showing the States.

(Source: <https://www.nationsonline.org/oneworld/map/nigeria-administrative-map.htm> Assessed 20/03/2021)



<b>A</b>	Acanthaceae	Bromeliaceae	Palmae	<b>B</b>
	Amaranthaceae	Capparidaceae	Papilionaceae	
	Amonaceae	Caricaceae	Papilionoideae	
	Apiaceae	Commelinaceae	Phytoloccaceae	
	Araliaceae	Guttiferae	Polygalaceae	
	Asphodelaceae	Lythraceae	Rhamnaceae	
	Balanitaceae/Zygophyllates	Moringaceae	Rosaceae	
	Balanophoraceae	Musaceae	Santalaceae	
	Bombacaceae	Oleaceae	Tiliaceae	
	Boraginaceae	Onchanaceae	Ulmaceae	
			Valerianaceae	
<b>C</b>	Anacardiaceae	Celastraceae	Lamiaceae	Mimosaceae
	Annonaceae	Convolvulaceae	Malvaceae	Myrtaceae
	Burseraceae	Cucurbitaceae	Meliaceae	Solanaceae
				Sterculiaceae
<b>D</b>	Apocynaceae			
	Asteraceae			
	Rubiaceae			
	Verbenaceae			
<b>F</b>	Combretaceae			
	Rutaceae			
<b>H</b>	Caesalpinaceae			
	Euphorbiaceae			
	Poaceae			

Figure 2: Families of medicinal plants used to treat typhoid fever across Nigeria

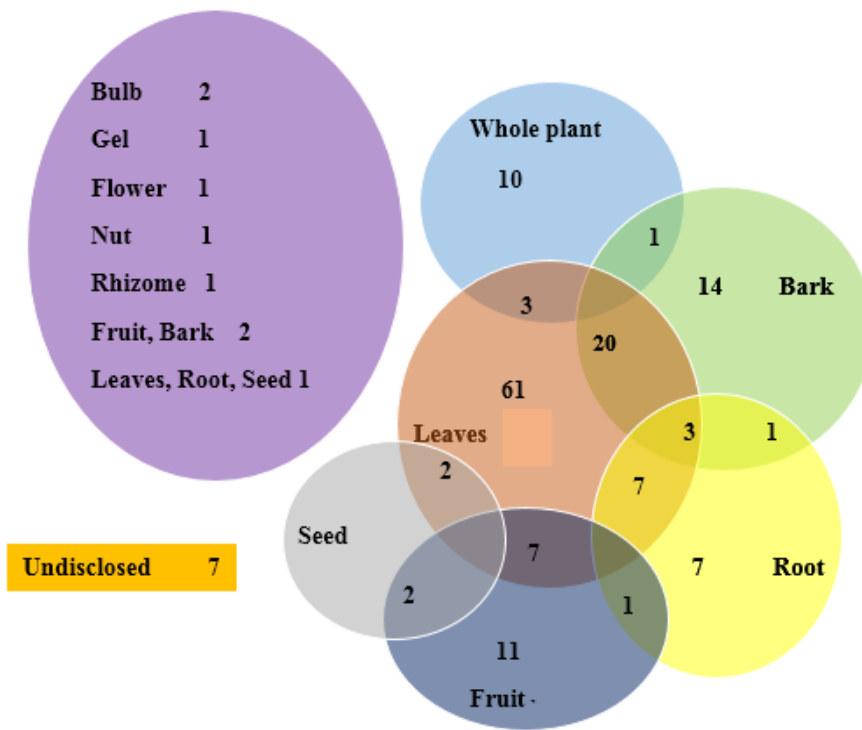


Figure 3: Venn diagram of plant parts used in traditional treatment of typhoid fever in Nigeria