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Original article

# Ethnopharmacological survey of medicinal plants used for the management of pediatric ailments in Kano State, Nigeria

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## Abstract

**Background and objectives:** The knowledge of traditional uses of plant species used in the management of pediatric diseases in Kano State is still intact with the traditional healers; thus, the present study was aimed to collect, identify and document plant species used traditionally for the management of pediatric diseases in the study area. **Methods:** The ethnobotanical data was collected through informal interviews with the traditional medicine practitioners, traditional birth attendants, herb sellers and some health workers. **Results:** A total number of sixty eight plant species belonging to thirty five families were reported to be used in the disease management among children in the study area. Most of the plants species belonged to the Fabaceae, Poaceae, Anarcadiaceae, Asteraceae, Combretaceae and Solanaceae families, while *Anogeissus leiocarpus*, *Boswellia dalzielii* and *Citrus sinensis* were the most frequently mentioned plant species. Leaves and stem bark were the most used plant parts in this study. **Conclusions:** Further studies should be conducted to evaluate the pharmacological activities of the plant species that have not yet been investigated and also to identify the phytochemical constituents responsible for their activities.

**Keywords:** ethnopharmacology, Kano State, pediatric diseases, phytochemical constituents

## Introduction

The medical care of infants, children and adolescents in medicine is known as pediatrics. The age limit usually ranges from birth up to 18 years of age, while in some places until completion of secondary education, and until age 21 in the United States [1].

Pediatrics could be differentiated from adult medicine in so many ways which includes physiological body size, congenital defects, developmental issues, *etc*. These differences are of greater concern in pediatrics than in adult medicine [2]. Many children in developing countries suffer from diseases that can cause serious mortalities and about 7 million children under the age of 5 have died in 2011 simply because they did not have access to an affordable health care [3]. Infectious diseases like pneumonia, diarrhea, and malaria have been identified as the main cause of deaths in children younger than 5 years old mostly in developing countries [4].

A recent national demographic survey has revealed that for every 1000 live-births in Kano State, 185 of them would die before attaining the

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age of five. This implies that one in every five children is dying before attaining the age of five. The study also showed that diarrhea and pneumonia accounts for 15 % and 14 % of the forgoing under-five mortality rate, respectively [5].

The extensive use of traditional medicine in African countries is because the people are very poor and thus cannot afford modern medicine [6, 7]. The practice of young mothers being guided in the care of their new born babies after delivery by older women is a common practice among the Hausa people of Kano State. Those older women are armed with traditional knowledge of plants used to treat pediatric ailments so that they can guide the new mothers on what herb to use and how to prepare and administer them [8].

However, to the best of our knowledge, no study has been conducted to document medicinal plants used to treat pediatric ailments in Kano State, Nigeria. Therefore, this study was aimed to investigate, collect, identify and document those plant species before such rich heritages are lost.

## Experimental

*Study area*

The study was conducted in Kano, a state located in the Northwestern part of Nigeria. The State borders Katsina State to the north-west, Jigawa State to the north-east, Bauchi States to the south-east and Kaduna State to the south-west (figure 1).

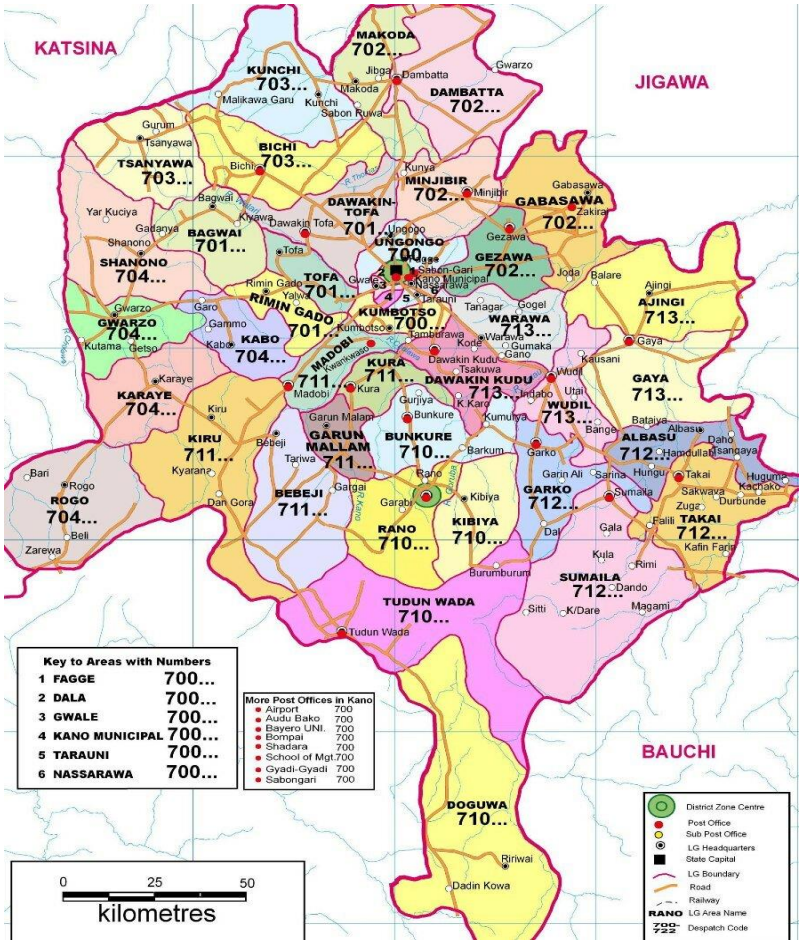


**Figure 1.** Map of Kano State

It is located on 11° 30' N and 8°30' E coordinates, with a mean height of about 472.45m above sea level. According to 2006 census, Kano is the most populous State in Nigeria with a population of 9,383,682 and popularly referred to as the centre of commerce in Nigeria [9].

*Ethnopharmacological survey*

The main data sources consisted of a series of informal interviews administered on the Traditional Medicine Practitioners (TMPs), Traditional Birth Attendants (TBAs), herb sellers and some health workers. The interviews were done in Hausa language, while the information obtained was sorted, and the data collected included the local names of plants, parts of the plants used, medical conditions they treated, methods of preparation and modes of administration. The plants were identified and authenticated at the Ethnobotany Unit of Bioresources Development Centre Kano, National Biotechnology Development Agency (NABDA), Nigeria. All species and families were validated taxonomically in the plant list (www.plantlist.org) and "Hausa names for plants and trees" written by Roger Blench.

*Statistical analysis*

Descriptive statistics such as percentages and pie chart were used in the analysis of the data.

**Results and Discussion**

A total number of 38 respondents were interviewed consisting majorly the traditional medicine practitioners, traditional birth attendants, health workers and herb sellers (table 1). Most of the respondents were within the age range of 41-50 years (34 %), female (63 %), primary school leavers (50 %) and traditional medicine practitioners (50 %).

A total number of sixty eight plant species belonging to thirty six families have been collected, identified and documented as being used for the management of different pediatric diseases in Kano State. The families Fabaceae, Poaceae, Anarcadiaceae, Asteraceae, Combretaceae and Solanaceae showed the highest incidence of encounter. *Anogeissus leiocarpus* was the most frequently mentioned plant species, followed by *Boswellia dalzielii* and *Citrus sinensis*. Leaves and stem bark were the most frequently used plant parts (figure 2).

**Table 1.** Demographic characteristics of the respondents

| Variable | Specification | Percentage (%) |
|---|---|---|
| Age | 20-30 | 8 |
| | 31-40 | 24 |
| | 41-50 | 34 |
| | 51-60 | 24 |
| | >60 | 10 |
| Sex | Male | 37 |
| | Female | 63 |
| Marital Status | Married | 97 |
| | Divorced | 3 |
| Educational status | No certificate | 19 |
| | Primary | 50 |
| | Secondary | 26 |
| | Tertiary | 5 |
| Practice | Traditional practitioners | 50 |
| | Herb sellers | 20 |
| | Traditional birth attendants | 26 |
| | Health workers | 4 |

Common pediatric ailments which were said to be treated with herbal remedies by the respondents included malaria, fever, pneumonia, stomach ache, diarrhea, measles, nose bleeding, jaundice, pile, heat rashes, kwashiorkor, headaches, teething, hemophilia, coughs, eye problems, umbilical cord complications, sickle cell anemia, convulsion, ring worms, meningitis, bilharzia and lateness walking.

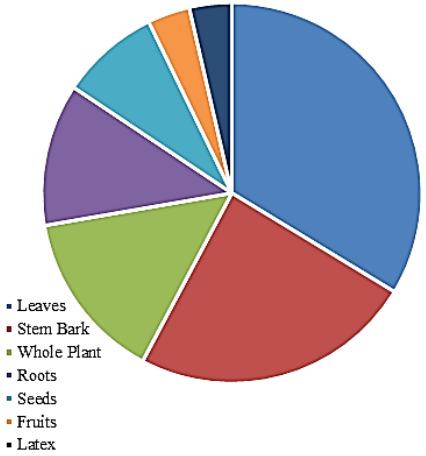


**Figure 2.** Percentage occurrence of plant parts used for the management of pediatric ailments

**Table 2.** Plants used for the management of pediatric ailments in Kano State

| No. | Family | Plant name | Local name | Common name | Disease (s) | Part (s) used | Voucher number |
|---|---|---|---|---|---|---|---|
| 1 | Acanthaceae | *Dyschoriste perrottettii* (O. Ktze) | Fidda Hakukuwa | Tall yellow | Eye infection | Seeds | BDCKN/EB/1738 |
| 2 | Anarcadiaceae | *Anarcadium occidantale* (L.) | Kashu | Cashew | Malaria, heat rashes and fever | Leaves and stem bark | BDCKN/EB/1772 |
| | | *Mangifera indica* (L.) | Mangwaro | Mango | Fever, malaria and jaundice | Leaves | BDCKN/EB/1763 |
| | | *Sclerocarya birrea* (A. Rich.) Hochst | Danya | Marula | Diarrhea | Stem bark | BDCKN/EB/1743 |
| 3 | Annonaceae | *Annona senegalensis* (Pers.) | Gwandar Daji | African custard apple | Kwashiorkor malaria and sickle cell anemia | Leaves, stem bark and root | BDCKN/EB/1727 |
| 4 | Amaryllidaceae | *Allium sativum* (L.) | Tafarnuwa | Garlic | Cough | Bulb | BDCKN/EB/1777 |
| 5 | Apocynaceae | *Calotropis procera* (Aiton) | Tumfafiya | Sodom apple | Pile and umbilical cord complications | Latex and roots | BDCKN/EB/1758 |
| 6 | Araceae | *Pistia stratiotes* (L.) | Kainuwa | Water lettuce | Convulsion | Whole plant | BDCKN/EB/1780 |
| 7 | Asclepiadaceae | *Leptadenia histata* (Pers.) Decne | Yadiya | Hagal hadjar | Ear infection and sickle cell anemia | Leaves | BDCKN/EB/1755 |
| 8 | Asteraceae | *Artemisia absinthium* (L.) | Tazargade | Wormwood | Diarrhea, stomach ache and witches' attack | Seeds and fruits | BDCKN/EB/1747 |
| | | *Centuarea praecox* (Oliv. & Hiern) | Dayi | Thistle plant | Measles | Leaves and stem bark | BDCKN/EB/1745 |
| | | *Vernonia amygdalina* (Delile) | Shuwaka | Bitter leaf | Sickle cell, anemia | Leaves | BDCKN/EB/1750 |
| | | *Vernonia khotschyana* (Schreb.) | Dumashi | Dumashi | Sickle cell | Whole plant | BDCKN/EB/1764 |
| 9 | Balanitiaceae | *Balanites aegyptiaca* (L.) | Aduwa | Desert date | Jaundice and malaria | Stem bark and seeds | BDCKN/EB/1728 |
| 10 | Boraginaceae | *Cordia africana* (Lam.) | Alilliba | Abyssinica | Lateness walking | Stem bark | BDCKN/EB/1744 |
| 11 | Burseraceae | *Boswellia dalzielii* (Hutch.) | Ararrabi | African myrrh | Diarrhea, pile, heat rashes and umbilical cord complications | Stem bark | BDCKN/EB/1741 |
| | | *Balsamodendron africanum* (Var.) | Dashi | Myrrh | Bed wetting | Stem bark | BDCKN/EB/1752 |

**Table 2.** Continued.

| No. | Family | Plant name | Local name | Common name | Disease (s) | Part (s) used | Voucher number |
|---|---|---|---|---|---|---|---|
| 12 | Caricaceae | *Carica papaya* (L.) | Gwanda | Pawpaw | Fever, malaria and jaundice | Leaves | BDCKN/EB/1761 |
| 13 | Cleomaceae | *Gynandropsis gynandra* (L.) | Gasaya | African cabbage | Pneumonia | Whole plant | BDCKN/EB/1748 |
| 14 | Cochlospermaceae | *Cochlospermum planchonii* (Hook. f.) | Rawaya | Gbehutu | Jaundice | Root | BDCKN/EB/1730 |
| 15 | Combretaceae | *Anogeissus leiocarpus* (DC.) Guill & Perr. | Marke | Chewing Stick tree | Cough, jaundice, fever and pile | Leaves and stem bark | BDCKN/EB/1737 |
| | | *Combretum micranthum* (G. Don) | Geza | Kinkeliba | Stomach ache, meningitis and eye infection | Leaves and roots | BDCKN/EB/1757 |
| | | *Guiera senegalensis* (J.F.Gmel) | Sabara | Sabara | Stomach ache, impetigo and Bilharzia | Leaves and roots | BDCKN/EB/1770 |
| 16 | Cucurbitaceae | *Cucumis pustulatus* (Hook. f.) | Golon zaki | Wild cucumber | Headache | Roots | BDCKN/EB/1791 |
| | | *Momordica balsamina* (L.) | Garafuni | Balsam apple | Convulsion and headache | Whole plant | BDCKN/EB/1794 |
| 17 | Cyperaceae | *Cyperus articulates* (L.) | Kajiji | Jointed flat sedge | Fever | Stem bark | BDCKN/EB/1771 |
| 18 | Euphorbiaceae | *Chrozophora senegalensis* (Lam.) | Bauren kiyashi | Fig of red ants | Diarrhea and rashes | Whole plant | BDCKN/EB/1729 |
| | | *Jatropha curcas* (L.) | Bini da zugu | Barbados nut | Malaria and ringworm | Leaves and latex from stem | BDCKN/EB/1735 |
| 19 | Fabaceae | *Cassia singueana* (Delile) | Runfu | Scrambled egg | Malaria, kwashiorkor and stomach ache | Roots | BDCKN/EB/1736 |
| | | *Chamaecrista absus* (L.) | Fidili | Sensitive pea | Eye problem | Leaves | BDCKN/EB/1766 |
| | | *Detarium microcarpum* (Guill & Perr.) | Taura | Sweet detar | Heat rashes | Stem bark | BDCKN/EB/1788 |
| | | *Dichrostachys cinerea* (Wight et Arn.) | Dundu | Sickle bush | Ear infection, malaria and Kwashiorkor | Leaves and seeds | BDCKN/EB/1754 |
| | | *Faidherbia albida* (Delile) A. chev | Gawo | Winter thorn | Teething | Stem bark | BDCKN/EB/1762 |
| | | *Indigofera tinctoria* (L.) | Babaa | Indigo tree | Jaundice | Roots | BDCKN/EB/1774 |
| | | *Parkia biglobosa* (Jacq.) R. Br. Ex G. Don | Dorawa | African locust bean | Burns, malaria and measles | Seeds pod and stem bark | BDCKN/EB/1768 |

**Table 2.** Continued.

| No. | Family | Plant name | Local name | Common name | Disease (s) | Part (s) used | Voucher number |
|---|---|---|---|---|---|---|---|
| | | *Parkinsonia aculeate* (L.) | Sarkin itatuwa | Jerusalem thorn | Measles | Stem bark | BDCKN/EB/1732 |
| | | *Piliostigma reticulatum* (DC.) Hochst | Kalgo | Abafe | Malaria and sickle cell anemia | Leaves and stem bark | BDCKN/EB/1739 |
| | | *Prosopis Africana* (Guill & Perr.) | Kirya | African mesquite | Burn and pile | Stem bark | BDCKN/EB/1746 |
| | | *Senna occidentalis* (L.) | Rai dore | Coffee senna | Bilharzia | Roots | BDCKN/EB/1789 |
| | | *Tamarindus indica* (L.) | Tsamiya | Tamarind | Bedwetting | Fruits | BDCKN/EB/1785 |
| 20 | Lamiaceae | *Vitex doniana* (L.) | Dinya | Black plum | Ringworm | Leaves | BDCKN/EB/1786 |
| 21 | Malvaceae | *Adansonia digitata* (L.) | Kuka | Baobab | Heat rashes | Stem bark | BDCKN/EB/1733 |
| | | *Waltheria indica* (L.) | Hankufa | Butt coat | Teething | Whole plant | BDCKN/EB/1783 |
| 22 | Meliaceae | *Azadirachta indica* (A. Juss.) | Darbejiya | Neem | Malaria, stomach ache and headache | Leaves | BDCKN/EB/1776 |
| | | *Khaya senegalensis* (Desr.) A. Juss | Madaci | Mahogany | Fever, malaria and stomach ache | Leaves and stem bark | BDCKN/EB/1765 |
| 23 | Mimosaceae | *Acacia nilotica* (Lam.) Willd | Gabaruwa | Gum arabic tree | Malaria | Leaves and seed | BDCKN/EB/1751 |
| 24 | Moraceae | *Ficus platyphylla* (Del.) | Gamji | Gutta percha | Malaria | Leaves and stem bark | BDCKN/EB/1742 |
| | | *Ficus thoningii* (Blume) | Chediya | Fig | Malaria, ringworm and jaundice | Latex | BDCKN/EB/1773 |
| 25 | Moringaceae | *Moringa oleifera* (Lam.) | Zogale | Moringa | Bilharzia and malaria | Roots | BDCKN/EB/1781 |
| 26 | Musaceae | *Musa sapientum* (Lam.) | Ayaba | Banana | Jaundice | Leaves | BDCKN/EB/1759 |
| 27 | Myrtaceae | *Eucalyptus globulus* (Labill) | Turare | Tasmania blue gum | Malaria and jaundice | Leaves | BDCKN/EB/1734 |
| | | *Psidium gaujava* (L.) | Goba | Guava | Headache and malaria | Leaves | BDCKN/EB/1793 |
| 28 | Olacaceae | *Ximenia americana* (L.) | Tsada | Yellow plum | Kwashiorkor | Roots | BDCKN/EB/1756 |
| 29 | Poaceae | *Echinochloa stagnina* (Retz.) P. Beauv. | Buruku | Burgu millet | Bilharzia and malaria | Roots and whole plant | BDCKN/EB/1731 |
| | | *Eragrostis cilianensis* (All.) Vign ex Janchen | Bunsurun fage | Candy grass | Headache | Whole plant | BDCKN/EB/1749 |
| | | *Tripogon minimus* (Roem. & Schult.) | Bubukuwa | Bubukuwa | Lateness walking | Whole plant | BDCKN/EB/1769 |

**Table 2.** Continued.

| No. | Family | Plant name | Local name | Common name | Disease (s) | Part (s) used | Voucher number |
|---|---|---|---|---|---|---|---|
| | | *Triticum aestivum* (L.) | Alkama | Wheat | Headache | Seeds | BDCKN/EB/1784 |
| | | *Urelytrum giganteum* (Pilg) | Jema | Jema | Headache | Whole plant | BDCKN/EB/1740 |
| 30 | Rubiaceae | *Mitracarpus hirtus* (L.) DC. | Gogamasu | Smear spear | Skin diseases | Whole plant | BDCKN/EB/1782 |
| 31 | Rutaceae | *Citrus medica* (L.) | Lemon tsami | Citron | Fever and jaundice | Leaves | BDCKN/EB/1753 |
| | | *Citrus sinensis* (L.) | Lemo | Sweet orange | Malaria and Catarrh | Leaves and fruits | BDCKN/EB/1778 |
| 32 | Sapotaceae | *Vitellaria paradoxa* (C.F. Gaertn.) | Kadanya | Shea tree | Chicken pox | Stem bark | BDCKN/EB/1779 |
| 33 | Solanaceae | *Solanum americanum* (Mill) | Gautan kaji | American Black night shade | Convulsion | Whole plant | BDCKN/EB/1775 |
| 34 | Sterculiaceae | *Sterculia setigera* (Del.) | Kukuki | Karaya gum tree | Cough | Leaves | BDCKN/EB/1787 |
| 35 | Verbenaceae | *Clerodendrum capitatum* (Willd) | Taba taba | Gung | Pneumonia, sickle cell anemia, ear infection | Leaves | BDCKN/EB/1767 |

Recipes were made from combination of different parts of two or more plant species, while some were made from single plant parts (table 3). Decoction, infusion, pounding, soaking, squeezing and boiling were the main methods of preparation in the management of pediatric ailments.

It is generally agreed that ethnomedicinal survey is one of the primary steps in the identification, selection and development of drugs from medicinal plants [10,11]. Thus, the main focus of this study was to document medicinal plants used to manage common childhood or pediatric ailments in Kano State, Nigeria. Previous ethnobotanical studies conducted in Kano State included the ethnobotanical survey of medicinal plants in metropolitan Kano, ethnobotanical survey of medicinal plants used for the treatment of malaria and ethnobotanical survey of medicinal plants used in the management of diabetes mellitus in Kano metropolis [12-14].

Majority of the respondents were females (63 %), married (97 %) and traditional medicine practitioners (50 %). Women have been identified as the main custodians of traditional knowledge of plants used to manage diseases among children [15-18].

The Fabaceae, Poaceae, Anarcadiaceae, Asteraceae, Combretaceae and Solanaceae families provided the highest proportion of plant species collected in this study. Previous studies also indicated that the families Fabaceae, Poaceae and Combretaceae have many species used in the management of different ailments including pediatric ailments [18-20].

The ethnomedicinal uses of some of the plant species identified in this study were also reported in previous ethnobotanical studies conducted in Kano State. These species include *A. sativum, B. dalzielii, C. papaya, C. singueana, F. thoningii, G. senegalensis, M. hirtus* and *P. biglobosa* [21,22].

*Anogeissus leiocarpus* was the most frequently mentioned plant species. Previous studies indicated that *A. leiocarpus* was used in African traditional medicine for the management of

**Table 3.** Ailments, recipes, method of preparation and mode of administration

| No. | Ailment | Recipe | Method of Preparation | Mode of Administration |
|---|---|---|---|---|
| 1 | Bilharzia | *Echinchloa stagnina* (root) + *Combretum micrantum* (root) + *Moringa oleifera* (root) + red potash | Decoction | Oral |
| | | *Gueira senegalensis* (root) | Decoction | Oral |
| 2 | Convulsion | *Pistia stratiotes* (whole plant) | Soaking | Oral |
| 3 | Cough | *Anogeissus leiocarpus* (leaves) + garlic + potash | Decoction | Oral |
| | | *Steculia setiga* (leaves) | Decoction | Oral |
| 4 | Diarrhea | *Boswellia dalzielii* (stem bark) | Infusion | Oral |
| | | *Artemisia absinthium* (seeds) | Soaking | Oral and bath |
| 5 | Ear problem | *Nicotiana tobacum* (leaves) + palm oil | Mixing | Dropping |
| | | *Clerodendrum capitatum* (leaves) | Squeezing | Dropping |
| 6 | Eye infection | *Dyschoriste perrotti* (seeds) | Crushing | Dropping |
| | | *Chamaecristus absus* (leaves) | Decoction | Dropping |
| 7 | Fever | *Mangifera indica* (leaves) + *Psidium gaujava* (leaves) + *Carica* papaya (leaves) + *Musa sapientum* (leaves) + *Eucalyptus globulus* (leaves) | Decoction | Oral |
| | | *Cyperus articulates* (stem bark) | Decoction | Oral |
| 8 | Headache | *Cucumus pustulatus* (root) | Pounding | Topical |
| | | *Urelytrum giganteum* (whole plant) | Decoction | Oral |
| 9 | Heat rashes | *Anarcadium occidantale* (stem bark) + *Scoparia dulcis* (whole plant) | Decoction | Oral and bath |
| 10 | Jaundice | *Balanites aegyptiaca* (stem bark) | Decoction | Oral |
| | | *Parkinsonia aculeate* (stem bark) | Infusion | Oral |
| 11 | Kwashiorkor | *Annona senegalensis* (root) | Decoction | Oral |
| | | *Cassia singueana* (root) + *Allium cepa* + *Vigna unguiculata* (offal) | Boiling | Oral and bath |
| 12 | Lateness walking | *Tripogon minimus* (whole plant) | Pounding | Bath |
| | | *Cordia Africana* (stem bark) | Boiling | Steam bath |
| 13 | Malaria | *Khaya senegalensis* (leaves) | Decoction | Oral |
| | | *Mangifera indica* (Leaves) | Decoction | Oral |
| 14 | Measles | *Centuarea praecox* (whole plant) | Infusion | Oral and bath |
| | | *Parkia biglobosa* (stem bark) + *Mangifera indica* (stem bark) + *Citrus medica* (stem bark) | Infusion | Oral |
| 15 | Meningitis | *Combretum micrantum* (root) + *Tamarindus indica* (root) | Infusion | Oral |
| 16 | Pile | *Boswellia dalzielli* (stem bark) + *Gueira senegalensis* (roots) + *Parkia biglabosa* ( seed pod) + Red potash | Decoction | Bath |
| | | *Anogeissus leiocarpus* (stem bark) | Decoction | Oral |
| 17 | Pneumonia | *Gyandropis gynandra* (whole plant) | Pounding | Topical |
| | | *Clerodendrum capitatum* (leaves) + *Momodica balsalmina* (whole plant) | Decoction | Oral |
| 18 | Ringworm | *Vitex doniana* (leaves) + *Vitellaria paradoxa* (Oil) | Pounding | Topical |
| | | *Ficus thoningii* (latex) | Cutting | Topical |
| 19 | Sickle cell disease | *Clerodendrum capitatum* (leaves) | Infusion | Oral |
| | | *Vernonia khoschyna* (whole plant) + *Clerodendrum capitatum* (leaves) + *Gyandropis gynandra* (whole plant) + Allium sativum | Infusion | Oral |
| 20 | Stomach ache | *Gueira senegalensis* (leaves) + Red potash | Infusion | Oral |
| | | *Momordica balsamina* (whole plant) | Soaking | Oral and bath |
| 21 | Teething | *Faidherbia albida* (stem bark) | Decoction | Oral |
| | | *Waltheria indica* (whole plant) | Pounding | Topical |
| 22 | Umbilical cord complications | *Boswellia dalzielli* (stem bark) | Pounding | Topical |
| | | *Calotropis procera* (latex) | Cutting | Topical |

various ailments, some of which have also been reported in this study [21]. Many pharmacological activities have been reported for this important plant which includes; antimicrobial, anthelmintic, antiplasmodial, trypanocidal, leishmanicidal, antioxidant and hepatoprotective activities [22-35].Therefore, *A. leiocarpus* could be considered as a promising candidate for further scientific evaluations in the search for new, effective and affordable drugs.

Malaria was the most frequently mentioned disease in this study (table 3). This finding was in agreement with the fact that malaria has been identified as one of the main causes of child mortality in developing countries [4].

Regarding the present study, it was observed that different parts of plants were reported to be used for the herbal preparations, with leaves and stem bark being the most frequently used parts. This finding is in agreement with other researches [36,37]. The use of leaves could be due to the abundance of phytochemical constituents [38]. Leaves are considered as the main synthesis site of phytochemical constituents and are the most commonly used plant parts by traditional medicine practitioners [39].

To the best of our knowledge, this is the first attempt to document the traditional knowledge and practices on the use of medicinal plants in the management of pediatric ailments in Kano State, Nigeria. Further studies should be conducted to evaluate the pharmacological activities of the plant species that have not yet been investigated and also to identify the phytochemical constituents responsible for their activities.

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**Declaration of interest**

The authors declare that there is no conflict of interest. The authors alone are responsible for the content of the paper.

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