



## **Ethnozoological Study on Ichthyotherapy among the Suku People (Feshi Territory, Kwango Province), Democratic Republic of the Congo**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors VPK, PK and WLS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SKM, CMK and AOY managed the analyses of the study. Authors VPK, KNN and JCM managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

A survey was conducted from August 15, 2019 to February 20, 2020 among 67 traditional healers in order to know the species of fish that are used in the composition of traditional medicines used to treat some diseases in the Kambundi-Nganga Group, Ganaketi Sector, Feshi Territory in Kwango (DR Congo). The results obtained show that seventeen (17) species of fish belonging to 14 genera, 12 families and 8 orders are used by traditional healers to treat 24 pathologies. The fish of the order Siluriformes offer eight (8) species of fish which are used in the preparation of

medicines for treating diseases. The fish species frequently used are respectively: *Parauchenoglanis punctatus* (31.3%), *Clarias ebraiensis* and *Gymnallabes typus* representing respectively 16.4% and *Malapterurus electricus* (12%). It is followed by the order of *Characiformes* and *Perciformes* with respectively two species of fish. Fish of the orders *Osteoglossiformes*, *Channiformes*, *Cyprinodontiformes*, *Symbranchiformes* and *Cypriniformes* are represented by one species. The most treated pathologies are: bronchitis, asthma, dysmenorrhea and rheumatism. The most used parts of the fish are bones (32%), head bones (24%), fins (19%), scales (6%) or sometimes the whole fish (15%). It is therefore desirable that in-depth chemical and pharmacological studies be conducted in order to scientifically validate the use of fish in ichthyotherapy and to identify the active principles with therapeutic value for each species.

**Keywords:** *Ichthyotherapy; traditional practitioners; Kambundi-Nganga; feshi; kwango; democratic republic of the Congo.*

## 1. INTRODUCTION

According to the World Health Organization, more than 80% of the population in Africa rely on Traditional Medicine (TM) to solve their primary health problem [1,2].

In the Democratic Republic of Congo (DRC), access to health care being beyond the reach of the low-income population, some people turn to TM, which is less expensive and which they also consider more effective than modern therapy [3,4,5,6,7]. In this case, traditional healers draw the raw material from the natural environment [8]. Thus, certain species of plants, animals in general and more particularly fish are used [9,10] to treat certain diseases.

Due to its faunistic and floristic diversity, the DRC constitutes an important reservoir of biological diversity [11,12], which allows it to occupy a privileged place among the countries of the Congo Basin with traditional know-how based on plants and/or animals [9].

The fish fauna of the ichthyological province of Congo is the most diverse in Africa [13,14]. There are, to date, about 1250 described fish species [15]. In the market, these fish are readily available fresh or smoked [16,17,18] and are used for food and feed, where they provide more than 60% of the protein [19,20,21], in aquaria, and they also provide the raw material in TM for the preparation of some medicinal recipes [22].

Most of the work done on the ichthyofauna of the Congo Basin is limited to systematics [23,24], the feeding ecology of a few groups of fishes [25,26,27] and the modes of adaptation of some of them to occupy different ecological niches [28]. In contrast, studies of fish used in Traditional Pharmacopoeia for medicinal

purposes are rare, if not almost non-existent. Yet, fish are sources of unsaturated fatty acids that can prevent consumers from cardiovascular diseases [29].

The present study aims to inventory the fish species used by traditional healers in the Traditional Pharmacopoeia in the Kambundi-Nganga group in the Kwango Province in the Democratic Republic of Congo.

More specifically, it involves collecting, identifying and listing the species of fish used to treat certain pathologies, listing the diseases treated with these fish, determining the parts of the fish used to treat diseases and the administration mode. To our knowledge, this is the first time that such a study has been carried out in DR Congo.

## 2. MATERIALS AND METHODS

### 2.1 Study Setting

This study was conducted in the Kambundi-Nganga groupement (Fig. 1), located in the Ganaketi sector, Feshi Territory, Kwango Province, DRC. This groupement is located 278 km south of the town of Kenge, capital of Kwango Province. It is bordered to the north by the Kakombi and Mwela groups; to the south by the Kitaka group; to the east by the Tsay (Inzia) River and to the west by the Bakali River, the Kambundi-Tumbi and Ngima groups. This group has 18 villages and was recognized as an administrative entity of the Ganaketi sector in 1957 by the Decree of May 10, 1957 on indigenous constituencies and, Decision No. 152 / F.226.3 / 1959 will confirm this recognition.

The Kambundi-Nganga group is bathed in an AW4 type climate according to the Köppen

classification. A humid tropical climate characterized by two main seasons, including four dry months (May, June, July and August) and eight rainy months (September to April) with a small dry season which runs between January and February [30]. The average annual rainfall is plus or minus 1600 mm. It reaches 1.700 mm in the central-eastern part of the region and 1500 mm in the southern part. This rainfall is spread from September to December, with abundant rainfall in November and from February to April, with abundant rainfall in April. The hydrography of this group consists of the Makaya, Lembwa, Lumbala, Tseyi, Mubidi and Musambu rivers. The majority of these streams flow into the Mbimbi River, which in turn flows into the Inzia River [30].

## 2.2 Biological Materials

The biological material for this study consists of 17 species of freshwater fish used in the PT of the Kambundi-Nganga cluster to treat common pathologies.

## 3. METHODOLOGY

### 3.1 Surveys

Data were collected from 67 traditional practitioners operating in the Kambundi-Nganga grouping using a survey questionnaire. The focus group was also used to collect data from sensitive and demanding individuals. The snowball sampling technique was used [10].

Before the actual survey, a pre-survey was carried out in October 2019 in the same environment to certify and confirm the presence of traditional healers. The survey itself was carried out between November 2019 and April 2020. The basic questions (appendix 1) of the research were those of knowing the species of fish used in the Traditional Pharmacopoeia in this grouping, the parts of fish used, the pathologies treated as well as the mode of administration.

To be part of this study, the following criteria were taken into account:

- To have the age of reason and not to be less than 18 years old.
- To be a native of the Kambundi-Nganga group or to have lived there for at least 25 years.

- To be a traditional healer or an initiate of natural and traditional healings.

### 3.2 Ichthyological Sampling

After interviewing traditional healers, the vernacular names of the fish used were noted in the local language, Kisuku. Then, experimental fisheries were the local language, Kisuku. Then, experimental fisheries were organized to collect fish specimens. During sampling, nets with mesh sizes of 2, 3 and 10 cm between knots, hooks of numbers 20, 16 and 18 and pots were used. The collected fish were fixed with a 10% formalin solution and then preserved in 97% alcohol before being identified in the laboratory. The fish were collected in order to confirm their presence in the rivers of this grouping, but also to certify the claims of the traditional healers by asking them to identify the species they refer to by their vernacular names.

### 3.3 Identification of the Fish

The identification was made from the determination keys proposed by [14,31,32,33,34,35] available at the Laboratory of Limnology, Hydrobiology and Aquaculture of the Department of Biology of the Faculty of Science of the University of Kinshasa.

### 3.4 Analysis and Statistical Processing of Data

The data obtained were compiled according to the category of questions on the survey form and the systematic classification rank of the fishes and then encoded on the Excel spreadsheet. The relative abundance by order and family of fish species was calculated and expressed as a percentage. The absolute frequency (%) of the different categories of questions on the survey form was calculated. The results obtained were presented in tables and graphs using Excel 2013 and Origin 6.1 software.

## 4. RESULTS

### 4.1 Profile of Respondents

Table 1 gives the socio-demographic profile of the respondents.

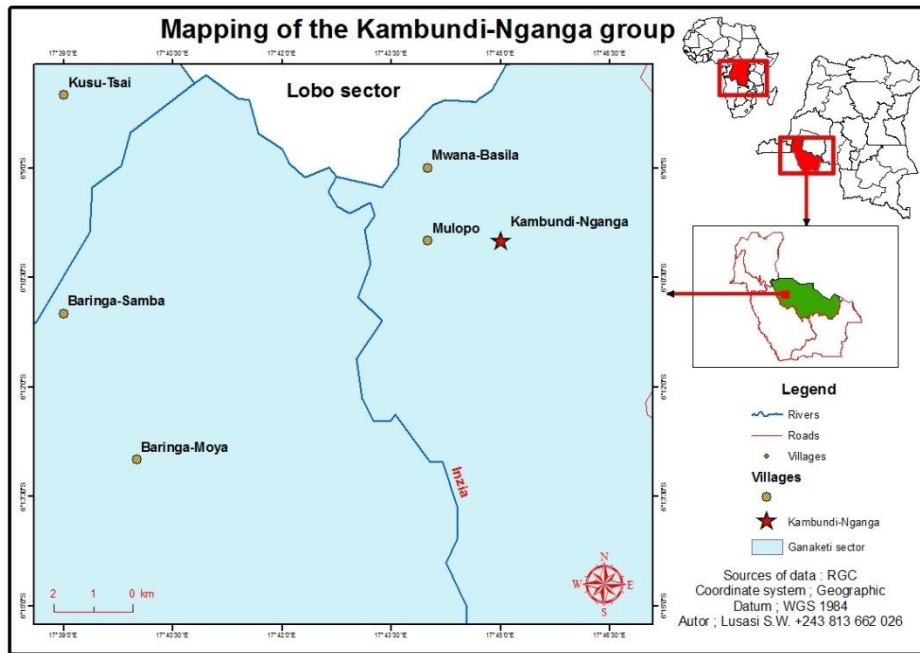


Fig. 1. Kambundi-Nganga grouping in the Ganaketi Sector, Feshi Territory

Table 1. Profile of traditional practitioners interviewed in the Kambundi-Nganga group

Age group (years)	Sex		Frequency of observation	Tradipratician	
	Male	Female		Yes	No
26-30	2	1	3	2	1
31-35	3	1	4	4	-
36-40	1	-	1	1	-
41-45	4	2	6	6	-
46-50	9	3	12	12	-
51-55	10	4	14	13	1
56-60	6	3	9	8	1
61 to more	8	10	18	18	-
<b>Total</b>	<b>43</b>	<b>24</b>	<b>67</b>	<b>64</b>	<b>3</b>
<b>%</b>	<b>64.1</b>	<b>35.8</b>	<b>100</b>	<b>95.5</b>	<b>4.4</b>

Of the 67 people interviewed, 53 people, or 71.1%, were between 46 years and older and 14 people, or 20.9%, were between 26 and 45 years old. There were 43 men (64.8%) and 24 women (35.8%). Regardless of the age group considered, the male gender dominates over the female gender. This trend is reversed for the age group of 61 years and older, where there are more women than men. Of the respondents, 64 (95.5%) are in fact traditional healers and 3 (4.5%) are not. The latter three are tradipracticitioner assistants.

#### 4.2 Information on Seniority in the Profession of Traditional Healer

The tradipracticitioners consulted have been in the profession from 0 to more than 25 years. A large

number have been in the profession for 26 years or more (16 out of 67, or 23.9%), followed by the 11-15 year age group (15 out of 67, or 22.4%), the 6-10 year age group (13 out of 67, or 19.4%), the 21-25 year age group (12 out of 67, or 17.9%), the 16-20 year age group (8 out of 67, or 11.9%), and finally the 0-5 year age group (3 out of 67, or 4.48%) (Fig. 2).

#### 4.3 Mode of Acquisition of Therapeutic Knowledge

The respondents acquired the knowledge of the tradipractor profession in three different ways: thirty-one (31) out of 67 (46.3%) benefited from a family legacy, 33 (49.3%) were initiated by

masters and 3 respondents (4.48%) were initiated by divine inspiration (Fig. 3).

#### 4.4 Other Professions Practiced by the Traditional Healers Surveyed

Table 2 presents the other professions practiced by the respondents.

The people surveyed do not only work as traditional healers but also perform other tasks. According to the same results, thirty-one (31)

people (46.26%) are farmers, 16 (23.88%) are teachers, 5 (7.46%) are herders, 5 others (7.46%) are traders and the other categories of professions are less representative.

#### 4.5 List of Fish Used in the Traditional Pharmacopoeia

The list of fish used to treat common diseases in the Kambundi-Nganga group is shown in Table 3.

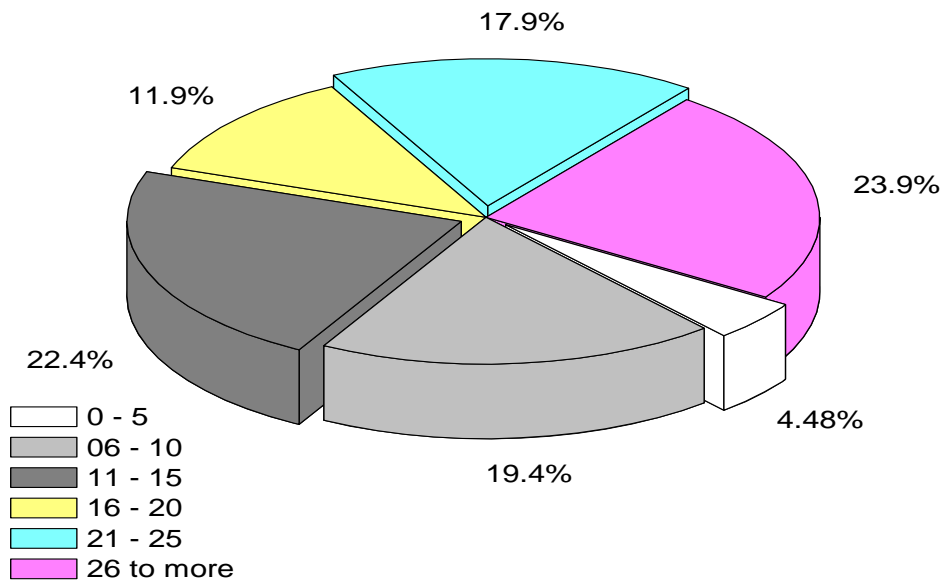


Fig. 2. Length of time in the traditional medicine profession

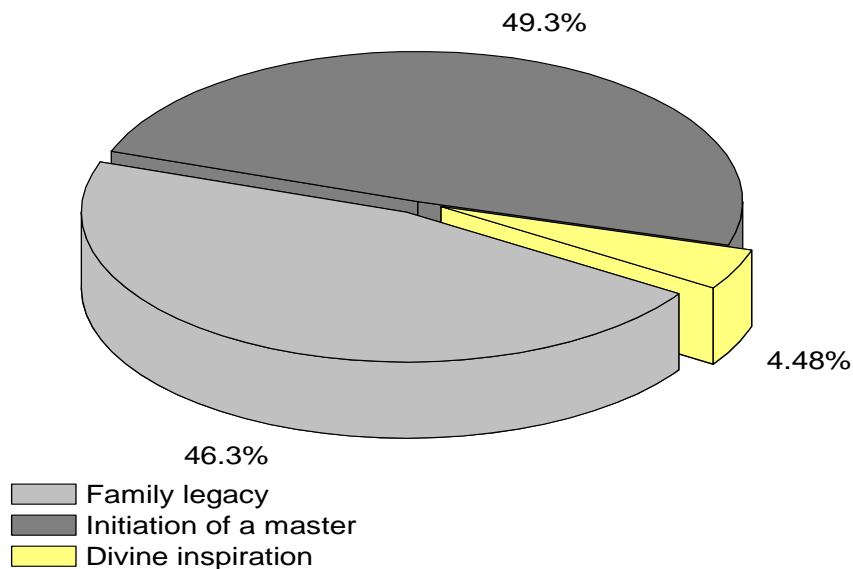


Fig. 3. Mode of acquisition of therapeutic knowledge

**Table 2. Other occupations of respondents**

Occupation	Frequency	Sex		Percentage (%)
		Male	Female	
Farmer	31	13	18	46,26
Teacher	16	15	1	23,88
Breeder	5	5	-	7,46
Trader	5	5	-	7,46
Nurse (midwife)	3	-	3	4,47
Customary chief	3	2	1	4,47
Student	2	1	1	2,98
Veterinarian	1	1	-	1,49
Police officer	1	1	-	1,49
<b>Total</b>	<b>67</b>	<b>43</b>	<b>24</b>	<b>99,96</b>

**Table 3. List of fish used in the traditional pharmacopoeia in the Kambundi-Nganga group**

Orders	Family	Genus	Species	Vernacular names		
				Kisuku	Kikongo	
<i>Siluriformes</i>	<i>Amphylidae</i>	<i>Doumea</i>	<i>Doumea sp</i>	Mukhukuti	Mukulukul u	
	<i>Claroteidae</i>	<i>Parauchenoglanis</i>	<i>P. punctatus</i>	Kikaka	Kikaka	
	<i>Clariidae</i>	<i>Clarias</i>	<i>C. anglensis</i>	Ngola	Ngolo	
			<i>C. ebriensis</i>	Kitsinga	Kakunda	
			<i>C. .buthupogon</i>	Muzuka	Kakunda	
			<i>C. pachynema</i>	Ngani	Kakunda	
			<i>G. typus</i>	Tsombi	Musombi	
		<i>Malapteruridae</i>	<i>Malapterurus</i>	<i>M. electricus</i>	Nganzi	Nina
	<i>Perciformes</i>	<i>Anabantidae</i>	<i>Microctenopoma</i>	<i>M. nanum</i>	Kibadi	Kibadi
		<i>Cichlidae</i>	<i>Tilapia</i>	<i>T. sp</i>	Kikedia	Kimkata
<i>Cypriniformes</i>	<i>Cyprinidae</i>	<i>Raiamas</i>	<i>R. sp</i>	Musunza	Mubalo	
<i>Osteoglossiformes</i>	<i>Mormyridae</i>	<i>Marcusenius</i>	<i>M. sp</i>	Pimba	Lupimbi	
<i>Channiformes</i>	<i>Channidae</i>	<i>Parachanna</i>	<i>P. obscura</i>	Mungusu	Mungusu	
<i>Synbranchiformes</i>	<i>Mastacembelidae</i>	<i>Mastacembelus</i>	<i>M. niger</i>	Mudianga	Musanga	
<i>Characiformes</i>	<i>Alestidae</i>	<i>Alestes</i>	<i>A. inferus</i>	Tsodi	Kalakala	
		<i>Phenacongrammus</i>	<i>P. sp</i>	Tsemakhadi	Munganza	
<i>Cyprinodontiformes</i>	<i>Cyprinodontidae</i>	<i>Aphyosemion</i>	<i>A. australe</i>	Muthanda	Ndakala	
<b>8</b>	<b>12</b>	<b>14</b>	<b>17</b>			

A total of 17 species of fish are used in the composition of medicinal recipes of traditional practitioners in the Kambundi-Nganga group to treat pathologies. These fish belong to 14 genera, 12 families and 8 orders.

#### 4.6 Relative Abundance of Fish Orders

The relative abundance of the orders of fish used in the composition of the medicinal recipes of traditional healers as visualized in Fig. 4 shows that the order *Siluriformes* is the most

represented (46.5%) followed by *Characiformes* (11.9%) and *Perciformes* (11.9%). The orders *Osteoglossiformes*, *Channiformes*, *Cyprinodontiformes*, *Synbranchiformes* and *Cypriniformes* are represented at 5.94% each.

#### 4.7 Relative Abundance of Fish Families

Of the twelve (12) families of fish identified, those of *Clariidae* (14.3%) and *Alestidae* (14.3%) are more abundant than the others which represent 7.14% respectively (Fig. 5).

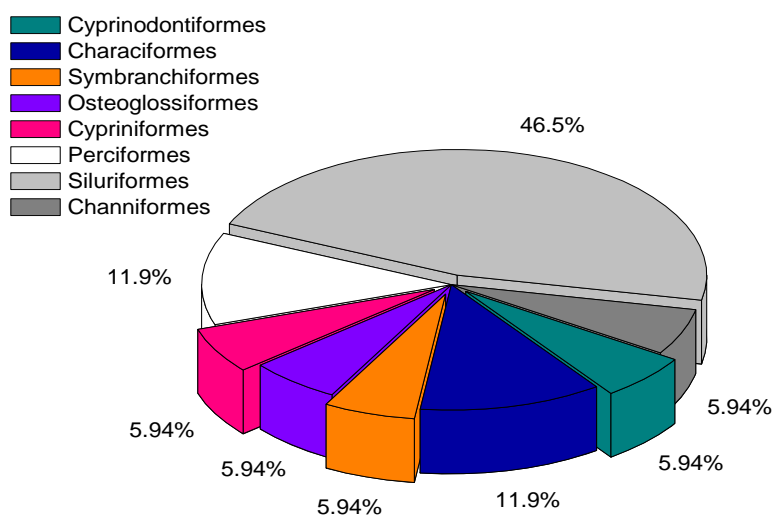


Fig. 4. Relative abundance of fish orders identified and used in the Traditional Pharmacopoeia

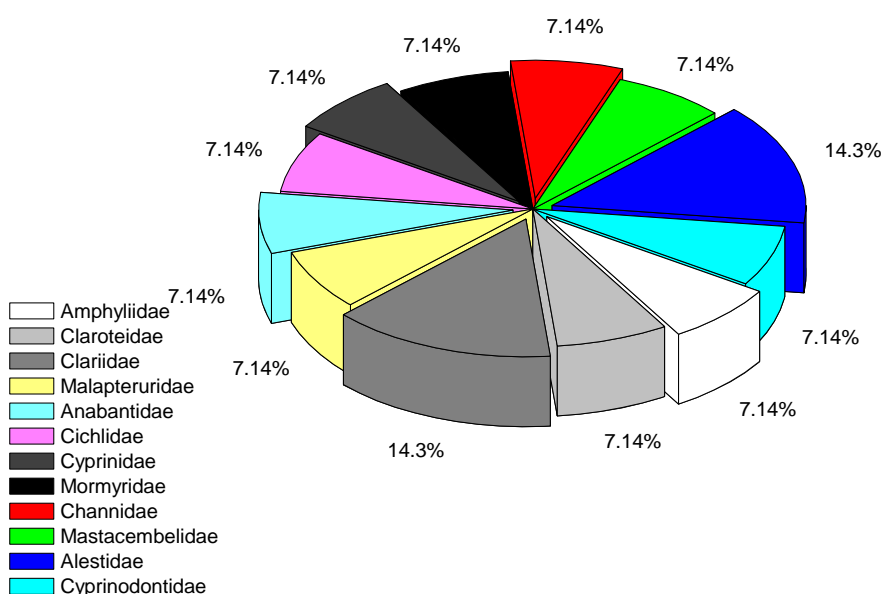


Fig. 5. Relative abundance of fish families identified and used in the traditional pharmacopoeia

#### 4.8 Frequency of Use of Species

With regard to the results visualized in Fig. 6, we note that the frequency of use of the fish *Parauchenoglanis punctatus* (31.3%) is the highest, followed by *Gymnallabes typus* and *Clarias ebriensis* (16.4%), *Malapterurus electricus* (12%); *Clarias angolensis* (10.4%), *Raiamas sp* (9%), *Phenacongrammus sp* (7.4%), *Marcusenius sp*, *Doumea sp* and *Microctenopoma nanum* (6%). The other species have a low frequency of use.

#### 4.9 Fish Parts Used to Treat Pathologies

According to the information in Fig. 7, several parts of the fish are used by traditional practitioners to prepare recipes that can be used to treat diseases. These are bones (32%), head bones (24%), fins (19%), whole fish (15%), scales (6%), muscles (2%) and finally fat and eggs (1% respectively).

#### 4.10 List of Diseases Treated with Fish

The list of diseases treated with the different fish parts is shown in Table 4.

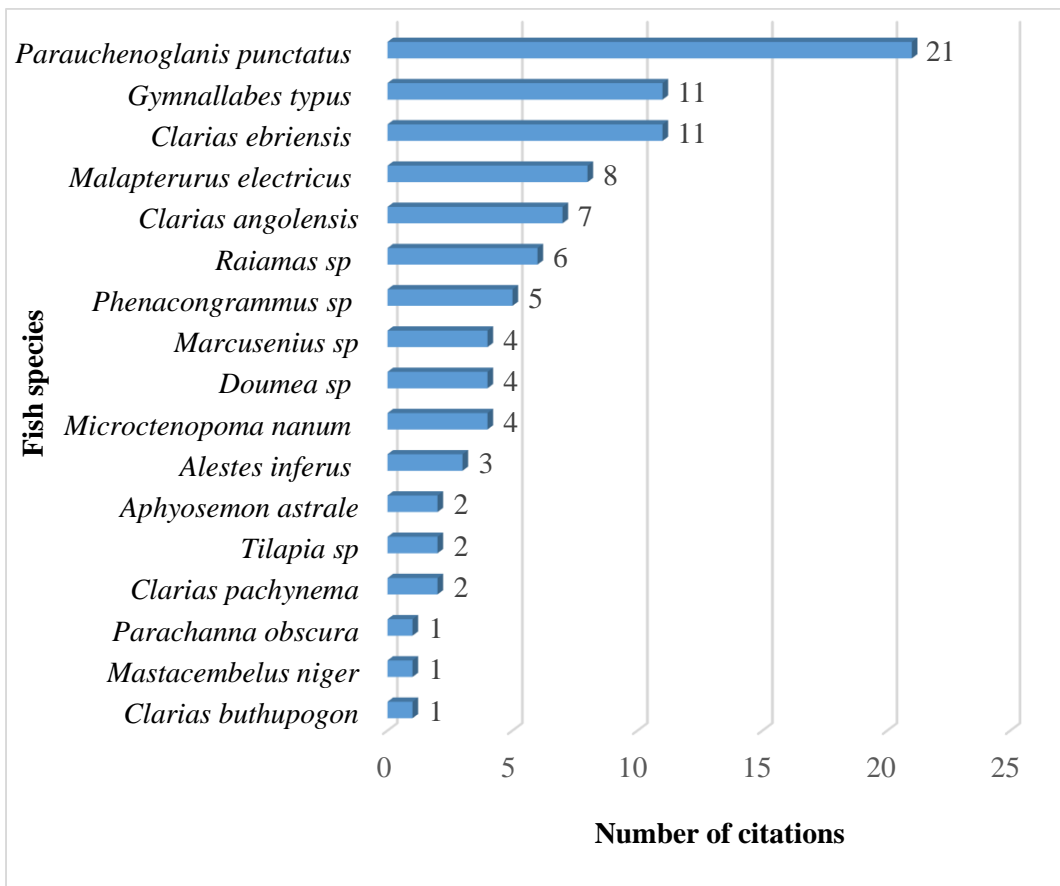


Fig. 6. Frequency of use of fish species in traditional pharmacopoeia

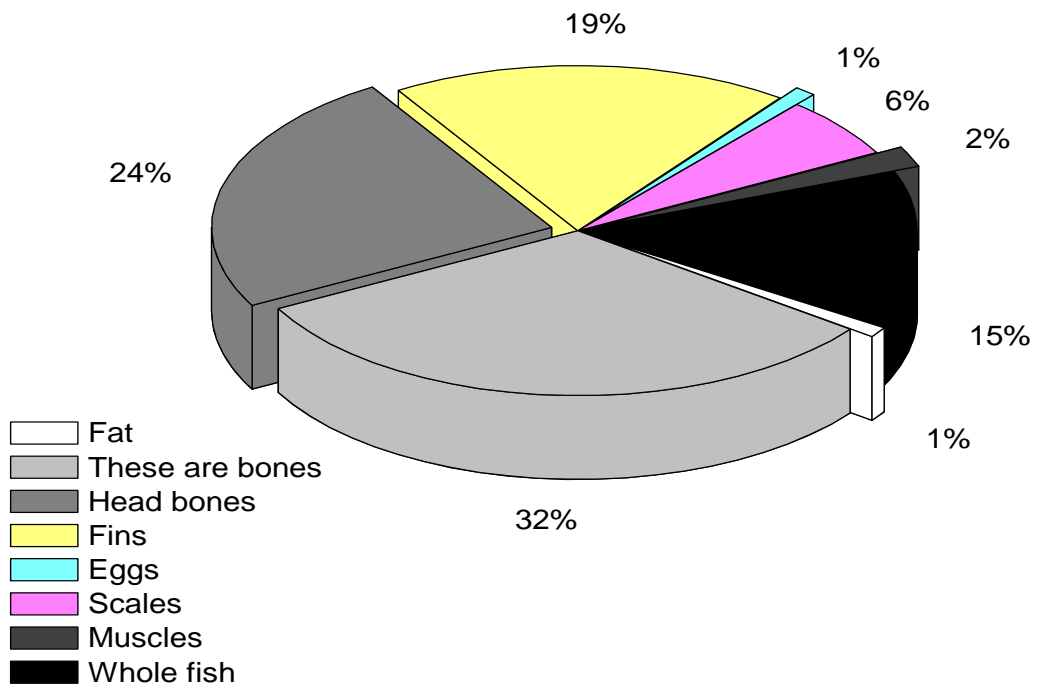


Fig. 7. Proportion (%) of fish parts used by traditional healers to treat diseases



**Table 4. List of diseases treated by traditional healers using fish**

Medical expression	Vernacular names	
	Kisuku	Kikongo
Bronchitis	Tsuaswa	Kifwengi
Rheumatism	Ngwelumuna	Maladiyamikwa
Internal hernia	Mukawa	Mbumbi
Dysmenorrhea	Kilunza	Mengayampasi
Secondary sterility	Nzembakipakasa	Bukobo
Irregular contractions	Ndambi	Misongoyandambi
Dental caries	Kibadi	Mbumbuyameno
Asthma	Muthulu	Kihema
Kwashiorkor	Kimbengi	Kibuba
Accelerated or early contractions	Kafusu	Misongoyandundila
Epilepsy	Tsaku	Ngambu
Heavy and long-lasting periods	Kihati	Ngodayanda
Disseminated erythema	Bikwasa	Makwanzayanene
Enuresis	Kusuba	Kusuba na nzo
Weakness and crying in infants	Mulepa	Kulembayanitu
Ascites	Kisulu	Mbimbidi
Mental disorders	Bweni	Kilawu
Umbilical hernia	Mukumba	Mutolo
Hiccups	Kihikwa	Kishikushiku
Placental retention	Nangakibu	Kibuyakukangama
Leprosy	Bwasi	Wazi
Mycosis	Lota	Loto
Philtre	Pungu	Kimvangu
Sterility of small cola	Bukhobubwamungadiadia	Bukoboyangadiadia

The results of Table 4 above show that the traditional healers of the Kambundi-Nganga group treat 24 diseases with fish. They treat both somatic and psychic pathologies. This is the case of Bweni (mental disorders due to the transgression of traditional customs) and Pungu (philtre).

#### 4.11 Specificity of Fish in the Diseases Treated

Table 5 below matches the names of the fish species used with the diseases treated with them.

From this Table 5, we can note that some pathologies are treated with a single species of fish such as : rheumatism with *Malapterurus electricus*; dysmenorrhea with *Gymnallabes typus*; dental caries with *Microctenopoma nanum*; weakness and crying in infants with *Clarias angolensis*; enuresis with *Doumea sp*; umbilical hernia with *Gymnallabes typus*; placental retention with *Alestes inferus*; philtre with *Doumea sp*; mental disorder with *Phenacongrammus sp* and finally sterility of the small cola with *Clarias angolensis*. In the rest of the cases, for the same disease, an association

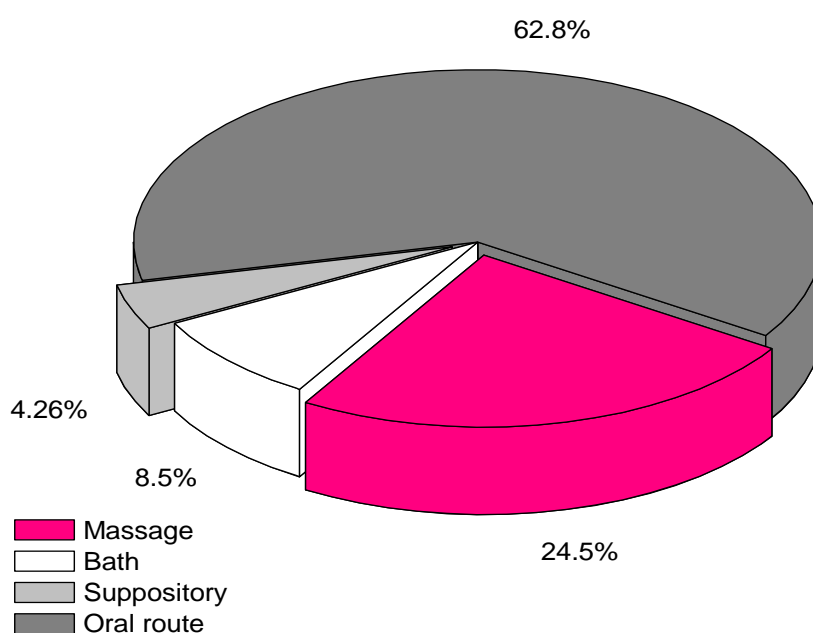
of two or three species of fish is made. And according to our respondents, the most treated pathologies are: bronchitis, asthma, dysmenorrhea, rheumatism and epilepsy.

#### 4.12 Method of Administration of Traditional Fish-Based Medicines

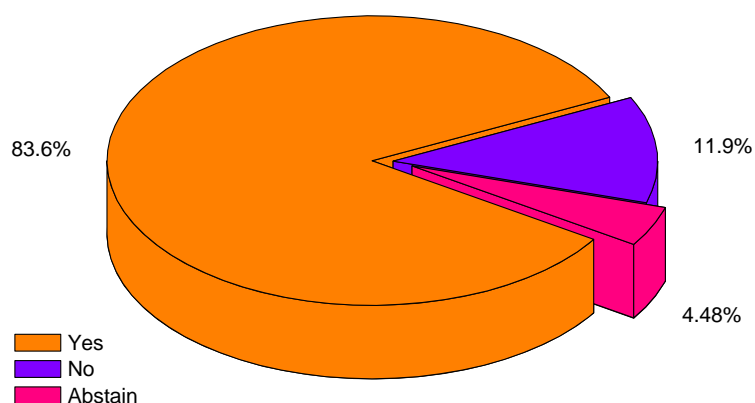
Traditional practitioners in the Kambundi-Nganga group use four modes of administration (oral, massage, bath and suppository) to treat their patients with medicines made from freshwater fish (Fig. 8). The most used mode of administration is the oral route with 59 citations or 62.8% (to treat bronchitis, asthma, hiccups, dysmenorrhea, epilepsy, tooth decay, enuresis, placental retention, secondary sterility, irregular contractions during childbirth, philtre, heavy and long-lasting menstruation) followed respectively by massage with 23 citations or 24.5% (to treat rheumatism, erythema, sterility of small cola, irregular contractions during childbirth, mental disorders, umbilical hernia, internal hernia and kwashiorkor), bath with 8 citations and 8.51% (to treat weakness and crying of infants) and suppository with 4 citations or 4.26% (to treat internal hernia).

**Table 5. Association of diseases with fish used**

<b>Pathology</b>	<b>Caring fish</b>
Bronchitis	<i>P. punctatus</i> et <i>C. ebriensis</i>
Rheumatism	<i>Malapterurus electricus</i>
Internal hernia	<i>P. punctatus</i> , <i>C. ebriensis</i> , <i>C. pachynema</i> , <i>Phenocongrammus sp</i> et <i>Marcusenius sp</i>
Dysmenorrhea	<i>Gymnallabes typus</i>
Secondary sterility	<i>P. punctatus</i> et <i>C. ebriensis</i>
Irregular contractions	<i>G. typus</i> , <i>A. inferus</i> , <i>Tilapia sp</i> et <i>Raiamas sp</i>
Dental caries	<i>Microctenopoma nanum</i>
Asthma	<i>P. punctatus</i> , <i>C. ebriensis</i> , <i>C. pachynema</i> et <i>C. buthupogon</i>
Kwashiorkor	<i>C. angolensis</i> , <i>C. ebriensis</i> , <i>Phenacongrammus sp</i> et <i>Aphyosemion australe</i>
Accelerated or early contractions	<i>G. typus</i> et <i>Mastacembelus niger</i>
Epilepsy	<i>Raiamas sp</i> et <i>Aphyosemion australe</i>
Heavy and long-lasting periods	<i>P. punctatus</i> et <i>G. typus</i>
Disseminated erythema	<i>Marcusenius sp</i> , <i>P. obscura</i> et <i>A. australe</i>
Enuresis	<i>Doumea sp</i>
Weakness and crying in infants	<i>C. angolensis</i>
Ascites	<i>G. typus</i> et <i>P. punctatus</i>
Mental disorders	<i>Phenacongrammus sp</i>
Umbilical hernia	<i>G. typus</i>
Hiccups	<i>G. typus</i> , <i>Marcusenius sp</i> , <i>P. punctatus</i> et <i>C. ebriensis</i>
Placental retention	<i>G. typus</i>
Leprosy	<i>Phenacongrammus sp</i> , <i>Marcusenius sp</i> , <i>Tilapia sp</i> et <i>A. australe</i>
Mycosis	<i>Phenacongrammus sp</i> , <i>Marcusenius sp</i> , <i>Tilapia sp</i> et <i>A. australe</i>
Philtre	<i>Doumea sp</i>
Sterility of small cola	<i>C. angolensis</i>



**Fig. 8. Methods of administration of traditional fish medicines**



**Fig. 9. Patients' testimonies on the effectiveness of traditional fish remedies**

#### 4.13 Testimony of the People on the Effectiveness of the Treatment with Fish

The testimonies of the people surveyed in relation to the effectiveness of the traditional treatment with fish show that 83.6% of the population think that the remedies administered by the traditional healers bring healing, but 11.9% think that there is no satisfaction and 4.4% of the respondents abstain (Fig. 9).

#### 4.14 Contra-indications or Prohibitions to Consumption

Traditional healers recommend that patients who are undergoing treatment or who have received it should not consume the fish used to prepare the remedy for treatment, either for life or for a time. This position is supported by 56 respondents, or 88% of our sample. For some remedies this requirement does not count. This version is collected from 8 respondents, or 11.9%.

### 5. DISCUSSION

Fish is one of the most valuable food resources in both developed and developing countries. Not only that fish are the main source of protein with the highest protein content per gram and per calorie of all usual food products [20], but also, they render great services by contributing to the fight against diseases. This is what our research in the Kambundi-Nganga cluster revealed. In total, 17 species of fish are used in the composition of the medicines of the traditional practitioners of the said group to treat pathologies. These fish belong to 14 genera, 12 families and 8 orders. From the point of view of

relative abundance, the order *Siluriformes* was the most represented (46.5%) followed by the orders *Perciformes* and *Characiformes* (with 11.9% respectively). The orders *Osteoglossiformes*, *Channiformes*, *Cyprinodontiformes*, *Symbranchiformes* and *Cypriniformes* were represented at 5.94% each.

Indeed, fish oils (omega-3 fatty acids), vitamins and their mineral salts (calcium, phosphorus, iron, copper, fluorine, iodine and selenium) are used by modern medicine because the original proteins ichthyology allow cells to function properly and lead to their rapid renewal by successive mitoses. They are also very bioavailable because they are easily absorbed by the body. This explains the longevity of human life in fish consumers [36]. Elsewhere, traditional medicine uses the skin of some fish species such as *Malapterurus electricus* to heal wounds, and in Brazil, the skin of *Tilapia* to treat patients with burns. And other species such as *Clariallabes* and *Distichodus sp* are used to treat malnutrition [37].

In the present study, traditional healers in the Kambundi-Nganga group in the DRC treat 24 diseases with the 17 species of fish identified. They treat somatic as well as psychological pathologies such as rheumatism with *Malapterurus electricus*; dysmenorrhea with *Gymnallabes typus*, dental caries with *Microctenopoma nanum*, placental retention with *Alestes inferus*; philtre with *Doumea sp*; mental disorders with *Phenacongrammus sp*; bronchitis and asthma with *Parauchenoglanis punctatus*, etc. It has been established that to treat a pathology, traditional practitioners of the Kambundi-Nganga group use one or more species of fish. The frequency of use of all

species in traditional medicine in this group differs.

The fish species most frequently used in traditional pharmacopoeia in the Kambundi-Nganga group are *Parauchenoglanis punctatus* (31.3%), *Clarias ebriensis* (16.4%), *Gymnallabes typus* (16.4%) and *Malapterurus electricus* (12%). Regarding the method of learning therapeutic practice, the majority of traditional healers in the Kambundi-Nganga group, i.e. 49.3%, were initiated by masters, followed by those who benefited from a family inheritance, i.e. 46.3% and the minority of traditional healers or 4.48% initiated by divine inspiration. These results confirm the observations made by [9] in a study devoted to an ethnobotanical and ecological study of plants used in traditional medicine in the Lukunga District of Kinshasa in the D.R. Congo. According to the results obtained by the latter, 20% of the respondents inherited the knowledge of medicinal plants from their ancestors (revelation), 19% of the respondents inherited this knowledge from their families, 18% of the respondents from books, 15% of the respondents from herbalists, 14% of the respondents from friends, 13% of the respondents have for therapeutic references themselves, and finally 1% of the respondents from vendors.

According to [38], the therapeutic practice of Traditional Pharmacopoeia is often characterized by analogy. And in the case of this study, the analogy is based on name and ethological approximation. This research revealed that traditional practitioners of the Kambundi-Nganga group also use nominal analogy to treat certain pathologies. This is the case of dental caries treated with the fish *Microctenopoma nanum*. In fact, dental caries in Kisuku is called Kibadi; and in the rivers of the grouping under study, a species of fish bearing the same name of Kibadi has been identified. Thus, in order to treat this pathology, traditional practitioners have made a correspondence between the disease and the fish bearing the same name. The second analogy raised by this investigation is the ethological connection. For this case, some examples are also retained: (1) Rapprochement between rheumatism and the fish *Malapterurus electricus*. Rheumatism is an acute or chronic disease characterized by pain in the muscles or joints. This disease condemns the individual not to freely use the target organs (the limbs), thus reducing the patient's movements [39]. In the Kisuku language, this disease is called

Ngwelumuna, which means disarticulation, because it disarticulates the motor system of the individual affected by this disease, and the fish *Malapterurus electricus* (Nganzi in Kisuku) is said to be electric because it produces a discharge on any body that disturbs it [33,35]. For humans, this discharge creates a destabilizing effect on the joints like an electric current. In view of this ethological analogy, the traditional practitioners of the Kambundi-Nganga group felt that *Malapterurus electricus* would serve as a favorable remedy for rheumatism. (2) The connection between asthma and *Parauchenoglanis punctatus* (Kikhaka in Kisuku). Asthma is a disease of the bronchial tubes that manifests itself by intermittent breathing discomfort and suffocation. Hence the patient's breathing rhythm in case of an attack becomes very accelerated sometimes with opening of the mouth [40]. *Parauchenoglanis punctatus* on the other hand shows a similar behavior whenever it is placed outside its ecological niche. Thus, intense breathing is observed in this fish with opening of the opercules covering its gills [41]. These two fundamental aspects: rapid breathing and opening of the gills have made *Parauchenoglanis punctatus* an ideal candidate for alleviating asthma and bronchitis according to the traditional practitioners of the Kambundi-Nganga group. (3) Epilepsy and *Raiamas sp* (Musunza in Kisuku).

Epilepsy is a nervous disease characterized by generalized seizures with or without loss of consciousness, resulting from the sudden discharge of a brain nerve center [42]. For its part, the *Raiamas sp* is an indiscreet fish according to traditional healers, because it can be seen if it is present in a stream by its jumps or waves on the surface of the water. However, it is a fact that an epileptic in a seizure usually skips. This restless behavior has earned the *Raiamas sp* species a remedy for the care of epileptics. In traditional and modern pharmacopoeia, remedies based on plants or animals are prepared in various ways: decoction, infusion, cooking, fermentation [43]. Their modes of administration are also very varied: ingestion, scarification (for fractures and wounds, the healer being able to make an incision to deposit his preparation), undulation, poultice, friction, bath, spraying (the healer masticates and spits on the lesions), inhalation, insufflation (reserved for psychiatric pathologies), instillation (for ENT and eye pathologies) [9,44]. The same finding was noted in this study. The different remedies (except for umbilical hernia care) require the combination of

many other plant products. Their preparation is done by calcination, decoction and cooking. These drugs are administered by ingestion, by massage, by wearing it on the body, by bathing, by body contact (touch), by scarification, by anal route (suppository) and by fumigation. These different modes of preparation are in certain cases chosen according to the free will of traditional healers. The question of healing in traditional Suku medicine is dependent on the proxemics, which is the set of circumstances, events, times, places, words, positions, etc., that surround the treatment. And it is of strict observance [45]. This study in the Kambundi-Nganga group confirmed this reality.

## 6. CONCLUSION AND SUGGESTIONS

The objective of this study was to identify the different species of fish used in the traditional treatment of pathologies (ichthyotherapy) in the Kambundi-Nganga group in the Kwango province of DR Congo.

The results obtained showed that the traditional practitioners of this group know the fish that are used in the preparation of traditional medicines and use them in whole or in part to treat pathologies. Seventeen species of fish belonging to 14 genera, 12 families and 8 orders are used for this purpose. The order of *Siluriformes* offers an important ichthyotherapeutic diversity with 8 species, 5 genera and 4 families.

The species frequently used by traditional healers are: *Parauchenoglanis punctatus* (31.3%), *Clarias ebriensis* and *Gymnallabes typus* with respectively 16.4% and *Malapterurus electricus* (12%). A total of 24 diseases are treated with the identified fish. Common conditions treated with these fish are bronchitis, asthma, dysmenorrhea, epilepsy and rheumatism. In preparing recipes, caregivers most often use the hard parts of fish such as bones (23%), head bones (24%), fins (19%) and scales (6%) and sometimes whole fish (15%). Prepared by calcination, decoction and cooking, the remedies are administered by ingestion, massage, wearing to the body, bathing, body contact, scarification, anal tract (suppository) and fumigation.

It is therefore desirable that extensive chemical and pharmacological studies be conducted to scientifically validate the use of these fish in ichthyotherapy and to identify the active principles or compounds of therapeutic value for each species. This would provide a new source

of raw material compounds to the modern pharmaceutical industry.

## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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## APPENDIX 1

### Survey Sheet:

#### I. Identity

1. Age: .....
2. Profession :.....
3. Are you a Tradipratician? Yes.....No.....
4. How and/or from whom did you learn the trade of Tradipratician?.....

#### II. Use of fish in the traditional pharmacopoeia

1. Are you familiar with fish? Yes.....no.....
2. What do you think their use is? .....
3. Can you make a medicine with fish? Yes.....No.....
4. If Yes, are these fish used as a raw material or as an ingredient?.....
5. What fish do you use to prepare your remedies? .....
6. What parts of the fish do you use in the preparation of your remedies? Scale....., Fins....., Head bones....., Bones....., Muscles ....., Fats....., Whole fish....., Viscera.....
7. What diseases do you treat with fish products?.....
8. How do you administer these products? .....
9. Do your remedies give a good result (cure)? Yes.....No.....
10. How do you prepare the products for each type of disease listed above?.....
11. What is the dose needed for each treatment?.....
12. What are the contraindications for your products? .....

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