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Research article

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Traditional Herbal Medicine in the Central African Republic : Ethnobotanical Survey And Prognosis of Children Hospitalized at the Centre Hospitalier Universitaire

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Abstract

Context : *Medicinal plants are a precious heritage for mankind, and more particularly for the majority of poor communities in developing countries who depend on them for their primary health care and subsistence.*

Objective : *To carry out a hospital-based ethnobotanical survey among parents of children having benefited from traditional phytotherapy prior to admission to the Centre Hospitalier Universitaire (CHUPB) in order to identify the prevalence, the nature of the product used, the proportion of prescriptions of plants presumed to be toxic, while assessing the effects on the children.*

Materials And Methods : *Cross-sectional study conducted at CHUPB over a 2-month period (March 1 to April 30, 2021). All children aged between 1 month and 15 years, admitted to intensive care regardless of diagnosis, with notion of exclusive traditional phytotherapy at home prior to therapeutic admission, were included. Data were analyzed using Epi-info software.*

Results : *Hospital frequency was 1.85% (n=50/2702) and mean age 2.2 years. The sex ratio was 1.38 and 62% of children lived in urban areas. Most parents were out of school (64%) and 80% lived in poor socio-economic conditions. The symptoms that prompted phytotherapy were anal pruritus (58%) and skin pallor (18%). The average duration of phytotherapy was 68.4 hours. It was administered by the parents in 86% of cases. The main route of administration was intra-rectal (36%). The plants used were harvested in the forest in 42% of cases. The main plants used were: Chromolaena odorata "BARABOKASSA" (22%) - Vernonia amygdalina "HONCKA" (14%) - Solanum lycopersicum "TOMATE" (12%) - Ocimum gratissimum "MATETE" (6%) - Jatropha curcas "KADA MONO" (4%) - Cassia siamea o Senna siamea "CASSIA" (2%) and Dioscorea bulbifera "KERERE" (2%). Organ failure was neurological in (62%), hepatic (48%), hematological (38%) and renal (16%) cases. Mortality rate was 26.0%.*

Conclusion: *Phytotherapy is frequently used in Bangui. The medicinal plants used must, like "conventional medicines", obey strict rules of cultivation, control and dispensing.*

Keywords: Phytotherapy, Children, CHUPB.

Abbreviations

CHUPB	:	Complexe Hospitalier Pédiatrique de Bangui	**%**	:	Percentage
CAR	:	Central African Republic	**g/l**	:	grams per liter
INR	:	International Normalised Ratio	**h**	:	hour
WHO	:	World Health Organization	**j**	:	Day
mg/dl	:	Milligrams per deciliter	**g**	:	Grams
mm^3	:	Cubic millimeter	**>**	:	Superior
g/dl	:	Grams per decilitre	**≥**	:	Greater than or equal to
dl	:	Deciliter	**<**	:	Lower
°C	:	Degrees Celsius	**≤**	:	Less than or equal to

1. Introduction

Medicinal plants are a precious heritage for mankind, and particularly for the majority of poor communities in developing countries, who depend on them for their primary health care and livelihood [1]. Traditional phythotherapy, which is not based on evidence-based medicine, is considered by the scientific community to be an unconventional medicine which, depending on the plants used, carries risks of toxicity, interaction with other medicines, or pollution by chemicals or heavy metals [2]. Its origins can be very ancient, based on the use of plants with virtues discovered empirically [3]. Whether they were healers, shamans, sorcerers or druids, the wise men of each people studied all the herbs they had at hand and passed on their knowledge, usually orally, to subsequent generations [3]. La phytothérapie moderne qui se base sur des preuves scientifiques sans récuser la tradition, fait appel aux recherches pour valider l'efficacité des principes actifs extraits des plantes mais les études et surtout les essais cliniques sont encore trop peu nombreux [4]. According to the WHO, in certain developing countries in Asia, Africa and Latin America, 80% of the population depends on traditional medicine, especially in rural areas, due to the proximity and accessibility of this type of care at affordable cost, and above all because of the lack of access to modern medicine for these populations [5-10]. In Africa, little is known about the toxic principles of plants, mainly due to their natural complexity. Like "conventional medicines", these medicinal plants must therefore obey strict rules governing cultivation, control and dispensing [10]. The World Health Organization has drawn up a list of monographs on medicinal plants, which is divided into three categories : plants whose use is supported by clinical data, those whose use is supported by pharmacopoeias and traditional systems of medicine, and those whose use is described in popular circles but not supported by clinical and experimental data [11]. In paediatric hospitals, it is often very difficult to get parents to confess to using traditional herbal medicine before admitting their child to hospital. According to a German study, patients rarely spontaneously inform nurses of their use of herbal medicine. Yet the risks of interactions between herbal medicines and drugs are real [9]. Several studies have shown that phytotherapy is not without risk. Toxic effects affect most organs. Examples include renal failure linked to Chinese plants, cardiac damage caused by aconite intoxication, and pulmonary damage linked to certain mints [10,12,13]. In many parts of the world, authorities, health professionals and the general public are grappling with issues relating to the safety, efficacy, quality, availability, preservation and regulation of traditional medicine [14]. In the Central African Republic, there are no data on the use of traditional herbal medicine in paediatrics, hence the aim of this study, which was to carry out a hospital survey of parents of children who had used this practice on their children prior to admission to the CHUPB in order to identify the prevalence, the nature of the product used, the proportion of use of plants thought to be toxic, and to gather information on the effects on children.

2. Patient And Method

The survey was carried out at the Centre Hospitalier Universitaire Pédiatrique de Bangui, the only referral hospital and facility specializing in the care of children in vital distress in the CAR. It receives children aged between zero and 15, from home or referred from a public or private health center in the capital and the provinces. The study was carried out in the intensive care unit. It was a monocentric, cross-sectional, descriptive and analytical study covering the two-month period (March 1 to April 30, 2021). We included in the study, after informed consent from parents or guardians, children aged from 1 month to 15 years, admitted to the intensive care unit of the CHUPB regardless of diagnosis with notion of exclusive traditional herbal medicine for therapeutic purposes at home prior to admission. We did not include in the study children who had received traditional phytotherapy combined with animal products or pharmaceutical molecules, or those who had received phytotherapy for preventive purposes.

- **Data Collection Began By Obtaining Research Authorization from the Deanship of The Faculty of Health Sciences in Bangui (CAR) ;** we then introduced ourselves to the head of the CHUPB intensive care unit. After explaining the purpose of the study, we were given access to the children's medical records, to their parents or legal guardians, and to the intensive care hospital wards. Confidentiality was also assured. Thus, for each child, data were collected from a pre-established survey form and entered using SPSS 20.0 statistical software. For word processing, we used Microsoft Word 2003. Results, presented in tabular and graphical form, were produced using Excel version 2003. The statistical test used was Pearson's chi^2. A value of $p < 0.05$ was considered statistically significant, and the Odds ratio was calculated with a 95% confidence interval. There were no conflicts of interest.

3. Results

3.1. Epidemiological Data

3.1.1. Hospital Frequency

Of the 2.702 children hospitalized during the study period, 50

had received traditional phytotherapy prior to admission, giving a hospital frequency of 1.85%.

3.1.2. Gender, Age and Place of Residence

The average age of the children was 2.2 years, ranging from 1 month to 13 years. Eighty-four percent of children 84%(n=42) were under 3 years of age, versus 16% (n=8) aged 3 years or over. There was a male predominance of 58.0% (n=29) versus 42.0% (n=21) for female children, with a sex ratio of 1.38. The children lived in Bangui's urban area in 62% (n=31) of cases, and in rural areas in 38% (n=19).

3.1.1. Socio-Demographic Characteristics of the Parents

The average age of the mothers was 28.5 years, ranging from 16 to 45 years. The average age of the fathers was 35.1 years, ranging from 17 to 56 years. Most of the mothers were unschooled or had primary education in 68% (n=34) of cases. Sixty percent of fathers (n=30) had no schooling or some education. Parents worked in the informal sector : 78% (n=39) of mothers versus 62% (n=31) of fathers. Eighty percent (n=40) of children lived in unfavorable socio-economic conditions. The distribution of children according to their parents' socio-demographic characteristics is shown in **Table I**.

Determinants (N=50)	Parents			
	Father Mother		Father Mother	
	(n)	%	(n)	%
Age in years				
<25	12	24	13	26
26-35	17	34	23	46
36-45	15	30	11	22
≥46	6	12	3	6
Education level				
Primary	16	32	17	34
Out of school	14	28	17	34
Secondary	18	36	16	32
Higher	2	4	0	0
Professions				
Informal sector	31	62	39	78
Manual/worker	13	26	1	2
No profession	5	10	10	20
Senior executive	1	2	0	0
Socioeconomic level				
Low	40	80	40	80
Medium	9	18	9	18
High	1	2	1	2

Table I: Distribution of children according to parents' socio-demographic characteristics.

3.2. Clinical data

3.2.1. Anamnestic data

The symptoms that prompted traditional phytotherapy were anal pruritus in 58% (n=29) of cases, skin pallor in 18% (n=9), suspected splenomegaly in 14% (n=7), fever in 6% (n=3) and diarrhea in 4% (n=4).

The average duration of traditional phytotherapy was 68.4 hours, with extremes ranging from 21.9 to 120 hours. The duration of phytotherapy was greater than or equal to 72 hours in 46% (n=23) of children, and less than 24 hours in only 4% (n=2). Traditional phytotherapy was administered by parents in 86% (n=43) of cases, and by the traditional phytotherapist in 24% (n=7). The two main modes of preparation of plants used for phytotherapy were decoctions in 74% (n=37) versus infusion in 26% (n=13). The main routes of administration of phytotherapy were intra-rectal in 36% (n=18) of cases, mixed in 28% (n=14) of cases, oral in 24%(n=12), nasal in 6%(n=3) and transcutaneous by scarification in 6%(n=3) of cases. The plants used were harvested in the forest in 42% (n=21) and in the family plot garden in 24% (n=12). In 20% (n=10), they were bought freely at the market by the parents, and in 8% (n=4) they were supplied by the phytotherapist, versus 6% (n=3) by a neighbor. The distribution of children according to anamnestic data is shown in Table II.

Parameters (N=50)	Number (n)	Percentage
Traditional herbal medicine motif		
Anal pruritus	29	58
Skin pallor	9	18
Suspicion of splenomegaly	7	14
Fever	3	6
Diarrhea	2	4
Duration of traditional phytotherapy in hours		
<24	2	4
[24-48[	15	30
[48-72[	10	20
≥72	23	46
Actors of the Phytotherapist		
Parents	43	86
Herbal therapists	7	24
Plant preparation methods		
Décoction	37	74
Infusion	13	26
Herbal medicine's path of admiration		
Intra-rectal	18	36
Mixed	14	28
Oral	12	24
Nasal	3	6
Transcutaneous (scarification)	3	6
Access to plants		
Forest	21	42
Family garden	12	24
Free purchase at the market	10	20
Provided by herbalist	4	8
Supplied by a neighbor	3	6

Table II : Distribution of children according to anamnestic data.

3.2.2. Taxonomy of Plants Used for Phytotherapy

The scientific names and families of plants used for phytotherapy were identified by the botanical department of the University of Bangui in 62% (n=31) versus 38% (n=19) whose scientific names did not exist in the botanical repertory of the University of Bangui. For cases whose names (families) could be clearly identified (N=31), these were ***Chromolaena odorata (Asteraceae)*** with the Central African vermicular name "BARABOKASSA" in 35, 48% (n=11) of cases - ***Vernonia amygdalina (Asteraceae)*** of the Central African vermicular name "HONCKA" in 22.58% (n=7) of cases - ***Solanum lycopersicum (Solanaceae)*** of the Central African vermicular name "TOMATE" in 19, 35% (n=6) of cases - ***Ocimum gratissimum (Lamiaceae)*** of the Central African vermicular name "MATETE" in 9.68% (n=3) of cases - ***Jatropha curcas (Euphorbiaceae)*** of the Central African vermicular name "KADA MONO" in 6, 45% (n=2) of cases - ***Cassia siamea o Senna siamea (Fabaceae)*** of the Central African vermicular name "CASSIA" in 3.23% (n=1) of cases and ***Dioscorea bulbifera (Dioscoraceae)*** of the Central African vermicular name "KERERE" in 3.23% (n=1) of cases.

The remaining plants used for traditional phytotherapy (N=19) were known only by their Central African vermicular name: "BERA o BERERA" in 36.84% (n=7) of cases - "BOBO" in 21, 05% (n=4) of cases - "DIN" in 10.52% (n=2) of cases - "KIERE" in 10.52% (n=2) of cases - "NDIRI" in 10.52% (n=2) of cases and "NGBANDA" in 10.52% (n=2) of cases. The distribution of children according to the plants used for traditional phytotherapy is shown in figure 1.

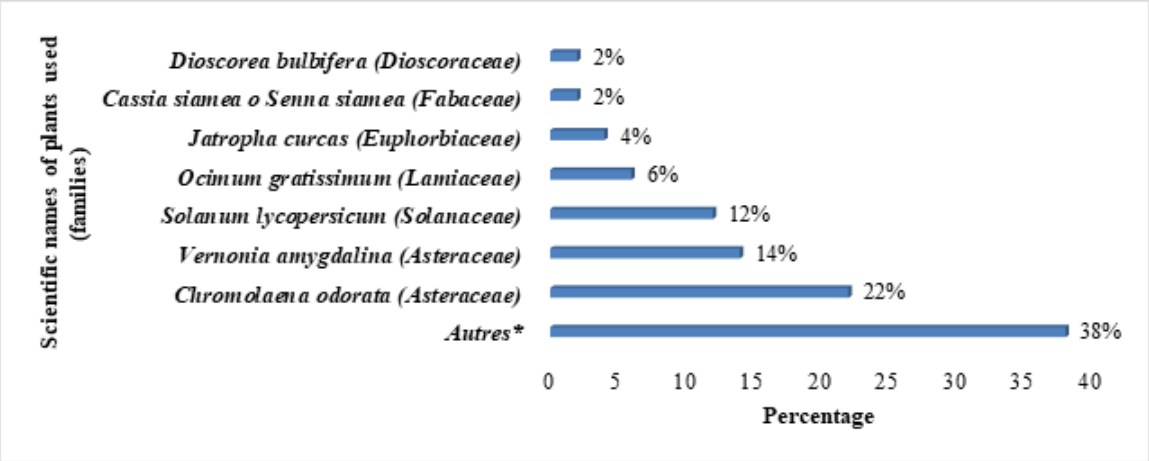

Figure 1 : Distribution of children according to plants used for traditional herbal medicine.

2.2.3. Reason for Consultation

Reasons for consultation included fever 92% (n=46), convulsions 40% (n=20), skin pallor 24% (n=12), agitation 24% (n=12), breathing difficulties 22% (n=11), level gaze 18% (n=9), dark urine 18% (n=9), diarrhea associated with vomiting in 10% (n=5), jaundice 10% (n=5), hemorrhage 4% (n=2), behavioral disorder 2% (n=1). The same child could have several reasons for consultation.

2.2.4. Vital Parameters

The children had fever in 92% (n=46) of cases, normal fever in 6% (n=3) of cases and below-normal fever in 2% (n=1) of cases. Tachycardia was noted in 90% (n=45), normo-thermia in 12% (n=6) and bradycardia in 2% (n=1). Children were eupneic in 78% (n=39), had tachycardia in 18% (n=9) and bradypnea in 4% (n=2). Desaturation was noted in 16% (n=8). Coma was noted in 62% (n=31) of cases, stage I in 26% (n=13), stage II in 18% (n=9), stage III in 7% (n=14) and stage IV in 4% (n=2). Vital parameters are shown in Table III.

Parameters (N=50)	Number (n)	Percentage
Temperature :		
High temperature	46	92
Normal temperature	3	6
Hypothermia	1	2
Heart rate :		
Tachycardia	45	90
Normal	6	12
Bradycardia	1	2
Respiratory frequency:		
Eupnea	39	78
Tachypnea	9	18
Bradypnéa	2	4
Oxygen saturation :		
≥ 95%	42	84
< 95%	8	16
Glasgow :		
15 14	19	38
13 - 10	13	26
9 - 6	9	18
5 - 4	7	14
3	2	4

Table III : Distribution of children according to vital parameters.

2.2.5. Physical Examination

The main signs on physical examination were splenomegaly in 54% (n=27) of cases, hepatomegaly in 46% (n=23), mucocutaneous pallor in 24% (n=12) of children, skin recoloration time greater than 3 seconds in 12% (n=6), severe respiratory distress syndrome in 12% (n=6) and cold extremities in 12% (n=6). Physical examination findings are shown in figure 2.

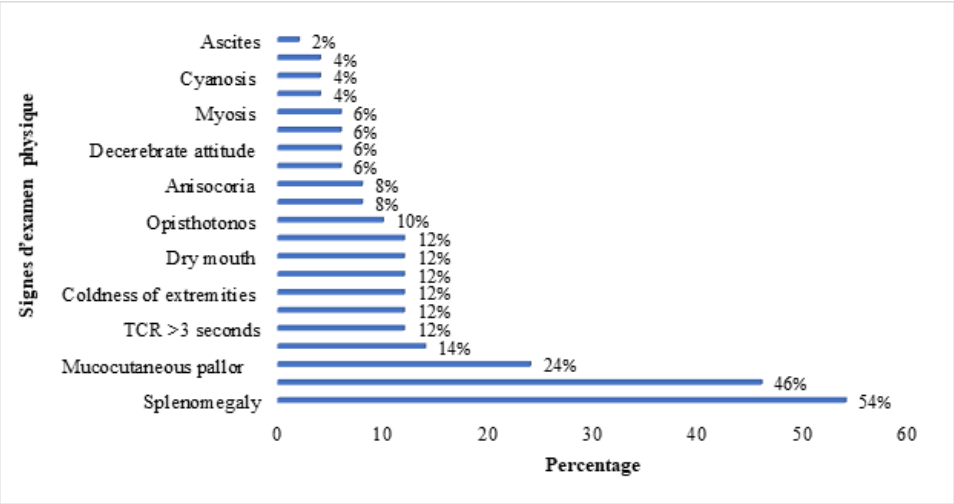

Figure 2 : Distribution of children according to physical examination signs

3.2. 6. Paraclinical Data

The malaria rapid diagnostic test was performed in all cases on admission and was positive in 50% (n=25) of patients. Thick drop tests for haematozoa were carried out in all cases and were positive in 40% (n=20) of cases. Mean parasite density was 118.5/mm3 with extremes [80- 1300/mm3]. A blood glucose test was performed on admission in all cases. The mean blood glucose level was 67.8±6.6 mg/dl with extremes (Lo - 270 mg/dl). A glycemic abnormality was noted in 22% (n=11) of cases. Refractory hypoglycemia was noted in 16% (n=8) of cases, and hyperglycemia in 6% (n=3). Lumbar puncture was performed in 12% (n=6) of cases. The appearance was clear in 6%(n=3), cloudy in 4%(n=2) and. All children had a complete blood count (CBC). The mean white blood cell count was 5955.5/mm3 with extremes (221 - 77000/mm3). They were normal in 46% (n=23) of cases, hyperleukocytosis in 38% (n=19) and leukopenia in 16 (n=8). The mean hemoglobin level was 8.8 g/dl with extremes (2.3 - 13.4 g/dl). This level was normal for age in 40% (n=20) of cases and less than or equal to 5g/dl in 22% (n=11). Hemoglobin levels were below normal for age, but above 5g/dl in 38(n=19). Mean Figurelet count was 146,000.68/mm3; extremes (1240 - 410000/mm3). Thrombocytopenia was noted in 38% (n=19) of cases. Blood ionograms were performed in 22% (n=11) of patients, with abnormalities noted in 12% (n=6). Creatinine levels were measured in 46(92%) children, with a mean value of 74.6±3 micromole/l. Mean glomerular filtration rate was 122 ± 29 ml/min/1.75m2. Decreased glomerular filtration rate was noted in 17.39% (8/46) of cases. Renal failure was mild in 37.5% (3/8) of cases, moderate in 25% (2/8), preterminal in 25% (2/8) and end-stage in 12.5% (1/8). Among the 47(94%) cases of International Normalized Ratio (INR) performed, hepatocellular insufficiency was noted in 51.06% (24/47) of cases. GeneXpert was performed in 3(6%) children. The result was positive in one case (2%). Bilirubinemia was performed in 37(74%) children, with a mean level of 5.79±3.3 extremes (0.7- 18.4 mg/dl).

3.2.7 Principal Organ Failures Noted

Organ failure was neurological in 62% (n=31) of cases, hepatic in 48% (n=24), hematological in 38% (n=19) and renal in 16% (n=8). It should be noted that the same child could have one or several organ failures.

3.2.8. Etiological Data

The main etiologies associated with phytotherapy were neuromalaria in 28% (n=14) of cases, sepsis in 18% (n=9), severe malaria anemia in 12% (n=6) of cases, septic shock in 10% (n=5) of cases, acute gastroenteritis with dehydration in 10% (n=5) of cases, severe acute pneumonia in 10% (n=5), bacterial meningitis in 4% (n=2), meningoencephalitis in 4% (n=2), febrile convulsion in 4% (n=2), hypoglycemia with severe emaciation in 4% (n=2) and pulmonary tuberculosis in 4% (n=2).

3.3. Progression

Progression was favorable in 68.0% (n=33) of cases. Complications occurred in 34.0% (n=17) of cases, with 8.0% (n=4) suffering neurological sequelae and 26.0% (n=13) dying. The mean time to death was 18.33±1.3 hours (range 2.6 - 123.3 hours), with 69.24% (n=9) of cases within the first 48 hours and 30.76% (n=4) after the 48th hour. The average hospital stay was 168.22 hours, ranging from 72.7 to 360.9 hours. It was less than 72 hours in 16%(n=8) of cases, between [72 - 120 hours] in 64%(n=32) of cases, between [120-168 hours] in 6%(n=3) and greater than or equal to 168 in 14%(n=7).

3.4. Study of the Sample's Sub-Populations According to The Specific Use of Traditional Plants Whose Scientific Name Was Known

The 11 children who received phytotherapy with ***Chromolaena Odorata (Apolo o Barabokassa)***, the average age was 1.06 years, seven lived in rural areas, the plant was administered

exclusively by the parents (11), the route of administration was exclusively rectal for 5 children and mixed (per os and rectal) for 6 children. Plants were collected from the forest in the case of 7 children, and from the family garden in the case of 4. The average duration of treatment was 1.09 days and the average number of administrations was 1.09 per day. Malfunctions were multiplied in 4 children (hepatic/neurological in 3 cases and hepatic/renal in 1). They were exclusively hepatic in 3 children and neurological in one. The main diagnoses were: neuromalaria (9), sepsis (1) and severe acute pneumonia (1). Five of the 11 children died (45%). Of the 7 children who benefited from ***Vernonia Amygdalina (Honcka)*** phytotherapy, the average age was 3.07 years, five lived in urban areas, the plant was administered exclusively by the parents (7), the route of administration was exclusively rectal for 5 children and mixed (per os and rectal) for two children. Plants were collected from the forest in the case of 5 children, and from the family garden in the case of 2. The average duration of treatment was 1.02 days, and the average number of administrations was 1.14 per day. 3 children had multiple failures (hepatic/neurological/ hematological). Failure was exclusively hematological in 2 cases, hepatic in 2 and renal in one child. The main diagnoses were : Severe malaria anemia (3), Bacterial meningitis (2), Acute gastroenteritis (2). One child out of 7 died (14.28%). Of the 6 children who benefited from phytotherapy with ***Solanum Lycopersicum (Tomato),*** the average age was 1.2 years, four of them lived in urban areas, the plant was administered exclusively by the parents (6), the route of administration was exclusively oral for 3 children, rectal for one child and mixed (per os and rectal) for two children. Plants were collected from the family garden in 4 children and from the forest in 2. The average duration of treatment was 1.16 days, and the average number of administrations was 1.11 per day. Multiple failures occurred in 3 children (hepatic/ neurological/ hematological). Failure was exclusively hematological in 2 cases, hepatic in 2 and renal in one child. No child died. Of the 3 children treated with ***Ocimum Gratissimum (Matete)*** phytotherapy, the average age was 0.63 years, all lived in urban areas, the plant was taken by the parents (3), and the route of administration was mixed (per os and rectal) in all children. All children had their plants collected in the forest. The average duration of treatment was one day, and the average number of administrations was one per day. Multiple organ failure was observed in all children (hepatic and neurological) in one and (hepatic and renal) in two. One child out of three died (33.33%). The average age of the two children treated with Jatropha Curcas (Kada-Mono) was 3.35. The route of administration was mixed oral and rectal. Both cases had hepatic failure and the discharge diagnosis was neuromalaria. No deaths were observed. The child who received phytotherapy with ***Senna Siamea o Cassia Siamea (Cassia)*** was 4 years old, had no organ failure and was discharged alive with a diagnosis of pulmonary tuberculosis. Finally, the child who had received ***Dioscorea Bulbifera (Kerere)*** phytotherapy had liver failure and was discharged with a diagnosis of simple febrile convulsion.

3.5. Analytical Data

Death in children receiving traditional phototherapy was influenced by the young age of children under 3 (p=0.01 - OR=0.1[0.02-0.81]), parental administration of phytotherapy (p=0.004 - OR=0.09[0.01-0.055]), mixed route of administration (p=0.001 - OR=0.06[0.01-0.43]) and coma depth p=001. Septic shock increased the probability of death by a factor of 14 (p= 0.03 - OR=14[0.9-201.6]), severe malaria in the anemic form increased the risk of death by a factor of 20 (p=0.034 - OR=20[0.93-429.9]) and the neurological form by a factor of 24 (p=0.008 - OR= 24[1.6-341]), acute gastroenteritis with dehydration increased the risk of death by 16 (p=0.05 - OR= 16[0.72-354.8]), and long hospital stays of 72 hours or more multiplied the risk of death by 42 (p=0.00- OR=42[4.35-405.14]). Analytical data are shown in **Table IV.**

Features	Deaths (n=13)	Living (n=37)	P	OR	X^2
Male	6	23	0,16	0,5[0,14-1,87	1,01
Female	7	14			
Origin					
Urban	6	25	0,09	0,4[0,11-1,49]	1,87
Rural	7	12			
Age in years					
< 3	9	35	**0,01**	**0,1[0,02-0,81]**	**5,86**
≥3	4	2			
Duration of traditional phytotherapy					
<24	1	1			
[24-48[	2	13	0,17	6,5[0,27-151,1]	1,63
[48-72[	4	6	0,41	1.5[0,07-31,57]	0,06
≥72	6	17	0,28	2,8[0,15-52,7]	0,52
Actors of the Phytotherapists					
Parents	8	35	**0,004**	**0,09[0,01-055]**	**8,73**
Herbal therapists	5	2			

How to use					
Intra-rectal	2	16			
Mixed	9	5	0,001	0,06[0,01-0,43]	9,8
Oral	1	11	0,42	1,3[0,11-17,09]	0,06
Nasal	1	2	0,21	0,25[0,01-4,17]	1,03
Transcutaneous (scarification)	0	3	0,36	----------	0,36
Coma staging					
Stage I	1	18			
Stage II	5	8	0,01	0,08[0,008-0,8]	5.580
Stage III	6	3	0,0007	0,02[0,002-0,32]	12,28
Stage IV	1	1	0,09	0,05[0,001-1,7]	4,20
Diagnosis associated with intoxication					
Septic shock	4	1			
Sepsis	2	7	0,03	14[0,9-201,6]	4,38
Severe neurological malaria	2	12	0,008	24[1,6-341]	7,36
Severe malaria, anemic form	1	5	0,034	20[0,93-429,9]	4,41
Acute gastroenteritis with dehydration	1	4	0,05	16[0,72-354,8]	3,6
Bacterial meningitis	1	1	0,28	4[0,11-136,9]	0,63
Other	2	7	0,03	14[0,94-207,6]	4,38
Main organ failures					
Neurological	3	28			
Hematological	3	16	0,27	0,57[0,1-3,17]	0,41
Hepatic	5	19	0,13	0,4[0,86-1,9	1,35
Renal	2	6	0,15	0,32[0,04-2,36]	1,33
Hospital stay in hours					
≥72	7	1	0,00	42[4,35-405,14]	18,72
< 72	6	36			

Table IV: Distribution of children according to analytical data.

4. Discussion

4.1. Epidemiological Aspects

Herbal medicine is one of the foundations of popular medicine and, like other alternative medicines, is considered particularly attractive in Africa. It is an important and often underestimated component of health services [9,10,13,14]. The WHO estimates that a considerable number of people in sub-Saharan Africa use traditional herbal medicine as a complementary and alternative means of meeting their primary healthcare needs [15]. The vast majority of the population, estimated at between 65% and 80%, rely on indigenous systems of medicine and use medicinal plants as first-line medicines [16,17]. In our series, the hospital frequency of use of traditional herbal medicine was 1.85%. This frequency does not reflect the use of herbal medicine among Central African children, as it is underestimated due to the fact that our work was carried out in a hospital setting with a short timeframe. On the other hand, Ethiopian highlanders reported the use of traditional herbal medicine among children in 71% of cases during a community study [18]. Several studies carried out in the same unit noted that the late admission of children to the CHUPB was explained by the importance attached to traditional phytotherapy inherited from ancestral cultures, the efficacy of which was not always proven [19,20]. Traditional medicine is still widely used in most countries, and its adoption is accelerating in others. At the same time, interest in this medicine is moving beyond products to practices and practitioners [21]. Various factors have contributed to the popularity of medicinal plants, in particular : the ecological movement that has been developing for several years in industrialized countries ; the idea that what is natural can only be beneficial ; the notion that medicinal plants, if not very effective, are at least completely harmless, unlike conventional medicines [10,12,13]. At the International Conference on Traditional Medicine for South-East Asian Countries, in February 2013, the Director General of the WHO, had asserted that "For many millions of people, herbal medicines, traditional treatments and traditional practitioners are the main if not the only source of health care. They are close to people, easily accessible and affordable. They are also culturally acceptable and trusted by a large number of people. Traditional medicine also appears to be a way of coping with the inexorable rise in chronic non-communicable diseases" [14]. The use of traditional herbal treatments in young children is a major concern ; therapeutic regimens, indeterminate dosage, immaturity of metabolic and excretory organs, content, preparation, quality of mixtures and duration of treatment may be important risk factors for adverse effects in this age group [22]. Early childhood was

the most affected by the traditional herbal medicine phenomenon in our series, with 84% under 3 years of age and 20% under 6 months. This observation corroborates the Nigerian study, which reports the use of phytotherapy in infants and children from the age of 6 months. The predominance of under-3s is probably due to this age group's greater susceptibility to fever-producing infections, which motivates parents to use plants as a therapeutic means. This is borne out in our study by fever (58%), which is the main reason for using phytotherapy. In addition, the martial deficiency that is rife in certain regions of the world, including the Central African Republic [23]. Is generally responsible for pallor, which was the second most common cause of phytotherapy in our series (18%). The low density of health facilities in certain regions of the country led the 38% of parents in our study who lived in rural areas to resort to phytotherapy, which was facilitated by their proximity to traditional healers. On the other hand, the 62% of parents living in urban Bangui resort to traditional herbal medicine to compensate for the long queues in Bangui's public health establishments for the 20% whose study had noted average socio-economic conditions. On the other hand, for the other 80% of parents with low socio-economic conditions, the use of herbal medicine is justified by the lack of means to access care in health facilities, although it must be stressed that the journey to these health facilities often depends on the availability of public or private motorized transport, which implies additional costs to be added to health costs. The low level of education observed in our series (68%) would also explain the use of herbal medicine by parents. Like our series, several African authors have noted in their work that the use of traditional herbal medicine was significantly associated with parental profiles : low level of education, unemployment or low-skilled jobs, low monthly income, ease of access, residence in rural areas, literacy with ancestral cultural belief in the merits of herbal medicine [15,18, 24].

4.2. Main Traditional Plants Identified and Their Phyto-Therapeutic Properties

Phytotherapy is an integral part of the development of modern civilization, and continues to be important worldwide [25]. Chromolaena Odorata (vernacular name in Sango common in the Bangui region: APOLLO or BARABOKASSA) was the most widely used plant in our series (22%). It is a tropical and subtropical plant belonging to the Asteraceae family, native to the Americas and widely introduced into western and central sub-Saharan Africa, tropical Asia and parts of Australia. [25,26]. Chromolaena odorata is a fast-growing, climbing perennial herb that can reach several meters in height. Leaves are opposite, triangular to elliptical with serrated margins. Flowers are tubular, white to pale pink in color Figure 1.

Figure 1 : Chromolaena odorata plant, leaves, fruits and seeds

With regard to the phyto-therapeutic properties of Chromolaena odorata, its leaves contain flavonoids (quercetin, kaempferol), terpenes, terpenoids, saponins and tannins responsible for antimicrobial, anti-inflammatory, antioxidant, healing, anti-parasitic, antioxidant, anti-convulsant and haemostatic properties [27,28]. They are used in the treatment of skin infections, burns, wounds, malaria, liver pathology, dysentery, headaches and toothache [25, 27]. While the use of Chromolaena odorata seems relatively safe at low doses, biochemical and histological evidence of its toxicity is beginning to emerge at high dose levels [29]. Among the 11 children who benefited from Chromolaena odorata phytotherapy in our series, multivisceral failure was noted in four cases, notably hepatorenal failure in one child and neuro-hepatic failure in 3. They were exclusively hepatic in 3 children and neurological in one. This finding corroborates the results of in vitro studies on albino rats, which showed hepatic, renal and intestinal toxicity, especially at high doses of Chromolaena odorata extract and for prolonged periods [25,29]. In our series, the average duration of Chromolaena odorata treatment was 1.09 days. The neurological failure noted in our series in children having received Chromolaena odorata could have a bias linked to neuromalaria (9/11 cases) or sepsis (1/11). The second most frequently used plant in our series was ***Vernonia Amygdalina,*** with the Central African vermicular name "**HONCKA**" in 14% (n=7) of cases. This medicinal herb is commonly known as bitter leaf in tropical Africa **[30,31].** Belonging to the Asteraceae family of the ***Vernonia genus***, named after the English botanist Sir William Vernon, who first characterized it. It grows throughout sub-Saharan Africa and much of South America, preferring forest, woodland or meadow edges in moist, sunny environments [31,32].

Figure 2 : Plant, leaves and flowers of ***Vernonia amygdalina***

The bioactive compounds identified in phytochemical and pharmacological studies of Vernonia amygdalina belong mainly to the flavonoids, terpenoids, saponins and tannins [31,32]. Extracts and compounds isolated from Vernonia amygdalina have been reported to possess several pharmacological properties, including cytotoxic and thus anticancer, antioxidant, anti-inflammatory, antimicrobial and antidiabetic activities [31,32]. The plant has a broad spectrum of uses in phytotherapy in Africa in the treatment of conditions such as malaria, fever, diabetes, constipation, hypertension and intestinal parasitosis [30]. With regard to toxicity, our series noted multiple toxicity with Vernonia amygdalina in 3 children, associating hepatic, neurological and hematological failure. This toxicity was mono-organic in five children, notably haematological in 2 cases, hepatic in 2 and renal in one. In our series, the fatality rate was 14.28%. Toxicity studies have shown that Vernonia amygdalina, commonly found in Malaysia, can only be harmful if consumed in very large quantities, and the presence of flavonoids as powerful antioxidants and terpenoids may contribute to the absence of direct organ toxicity at common ingestion doses [30]. Solanum lycopersicum was the third plant used in our series (6 cases). Widely known as the tomato, it is a plant belonging to the Solanaceae family, genus Solanum, to which other plants such as potatoes and eggplants belong [33]. This herbaceous perennial plant produces a large number of berries with 2-12 locules containing numerous small seeds. Most tomato varieties are red when ripe. **Figure 3.**

Figure 3 : Solanum lycopersicum plant, leaves, flowers and berries

The plant is commonly used in parts of Africa for the treatment of anemia, notably as an oral and rectal infusion of the leaves ; the red, blood-like color of the berries has led to the plant being thought to regenerate blood tissue [33]. Most sporadic cases of solanine toxicity involve children who have ingested toxic wild plant parts [33]. Clinical features of solanine intoxication include gastrointestinal symptoms and neurological symptoms, including vomiting, headache and flushing [33]. In our series, no deaths were reported in the seven children treated with Solanum lycopersicum physiotherapy. Liver damage was noted in 4 patients, renal failure in 1 patient, and nerve damage with reduced GCS in 2 patients and serous miosis in 2 patients, the seizures recorded being traceable to cerebral malaria. The fourth plant commonly used by parents in phytotherapy was ***Ocimum gratissimum (Lamiaceae),*** with the Central African vermicular name "MATETE" in 6% (n=3) of cases. It is also known as African basil (from the ancient Greek Okimon, basil). It is an annual herbaceous plant belonging to the Lamiaceae family. It is native to sub-Saharan Africa and widespread throughout much of Southeast Asia and South America [34]. It is a highly branched plant with a woody stem at the base, 1 to 3 meters high, with long-stalked opposite leaves and an elliptical to oval blade with a serrated margin and acute apex. The inflorescence is a whorl arranged in a single or branched terminal branch. The fruit is divided into 4 chambers, with one seed per chamber, **Figure 4 :**

Figure 4 : Detail of ***Ocimum gratissimum*** plant, leaves, inflorescence and flower.

In addition to its use as a food flavoring, Ocimum gratissimum is used in traditional medicine to treat a variety of ailments [34]. Leaves prepared by soaking, decoction or infusion in water or alcohol are used to treat inflammatory disorders such as rheumatism, arthritis and stomatitis [34]. In our series, the routes of administration were mixed (per os and rectal) in all children. Photochemical studies showed the presence of several classes of metabolites, including flavonoids, terpenes, fatty acids, saponins, tannins, alkaloids and oligosaccharides [35,36]. Recent work has identified and demonstrated that pomolic acid and tormic acid are the main anti-inflammatory constituents of Ocimum gratissimum extract [34]. Rare animal toxicity studies warn of the possibility of secondary effects on the liver and kidneys [35]. In our study, multiple organ failure was observed in all children. One child suffered from hepatic and neurological failure, while the other two suffered from hepatic and renal failure. One in three children treated with Ocimum gratissimum phytotherapy died. The fifth most commonly used plant in our study was ***Jatropha curcas (Euphorbiaceae),*** whose Central African vernicular name is "KADA MONO" in 4% (n=2) of cases. Jatropha curcas is a large, perennial, drought-tolerant shrub up to 5 meters tall. It belongs to the Euphorbiaceae family and is native to Central America, from where it has spread to several other tropical and subtropical regions. Jatropha curcas is a multi-purpose plant, important both medicinally and biotechnologically [37]. The plant is also known in some countries as the Barbados hazelnut, due to the shape of the fruit, which can be confused with the normal edible hazelnut. **Figure 5.**

Figure 5 : Jatropha curcas plant, leaves, fruits and seeds.

In phytotherapy, this plant has been applied since ancient times for the treatment of various ailments ranging from simple fevers to infectious diseases, including sexually transmitted diseases, in many African and Asian countries [37,38]. Photochemical studies on Jatropha curcas have isolated numerous compounds, including diterpenes, sterols, flavonoids, alkaloids and peptides [37,38]. Many of these compounds have shown diverse biological activities ranging from antimicrobial to anti-tumor cytotoxic actions. Among these compounds, an important role is played by curcosone isolated from stems, which has shown anti-tumoral activities and also suppression of metastatic processes [37,38]. The route of administration of the plant was mixed oral and rectal. Case reports of children presenting intestinal symptoms (abdominal pain, nausea and vomiting) following ingestion of Jatropha curcas seeds are reported in the literature [39]. In our series, both cases had hepatic failure and no deaths were observed. ***Cassia siamea o Senna siamea (Fabaceae),*** with the Central African vernicular name "CASSIA", was the sixth plant frequently used 2% (n=1) of the time. It belongs to the Fabaceae family and is native to South and Southeast Asia. The name Senna is derived from the Arabic word "sana", which designates certain medicinal properties, while "siamea" is an epitope alluding to the ancient name of Thailand, the plant's country of origin [40]. It is an evergreen tree of medium height, reaching 18 meters, with alternate, pinnate, reddish-green leaves, yellow flowers and pods containing edible seeds. Figure 6.

Figure 6 : Senna Siamea Plant, Leaves, Flowers And Pods

Its bark is traditionally used against fever and malaria, the roots are used as an antipyretic and the leaves for constipation, hypertension, insomnia and asthma [40,41]. Its analgesic and anti-inflammatory properties are attributed to four major families of compounds present in the plant : triterpenes (lupeol, oleanolic acid, ursolic acid (friedeline, betulin), flavonoids (apigenin, kaempferol, luteolin), anthraquinones (emodin), phytosterols (stigmasterol, beta-sitosterol) [40]. Strong antimalarial activity has also been demonstrated in vitro [42]. The various side effects associated with a possible toxicity profile appear to be reduced [41]. In our series, no side effects were noted. Finally, Dioscorea bulbifera (Dioscoraceae), with the Central African vernicular name "KERERE", was also used in a child. Commonly known as "air potato", it belongs to the Dioscoreaceaes family, a name

dedicated to Padanio Dioscorides Anazardeo, a Greek physician, botanist and pharmacist who lived in the 1st century AD [43]. Dioscorea bulbifera is a perennial vine that can reach over 60 feet in length when climbing trees; it has broad leaves and forms bulbils when the leaves emerge from the stem and tubers underground, some of which are edible. Figure 7.

Figure 7 : Dioscorea bulbifera plant, leaves and bulblets

Dioscorea bulbifera bulblets are traditionally used in Thai folk medicine as a diuretic and anthelmintic, in longevity preparations and for the treatment of wounds and inflammation [43]. In traditional Indian and Chinese medicine, the plant is also commonly used to treat sore throats, gastric cancer, rectal carcinoma and goiter [43]. In Cameroon and Madagascar, crushed bulbs are applied to abscesses, boils and wound infections [43]. Due to its many clinical uses, Dioscorea bulbifera has attracted increasing attention in recent decades ; numerous phytochemical and pharmacological studies have been carried out, leading to the isolation of numerous compounds from the plant, including steroids (diosgenin, beta-sitosterol, stigmasterol, etc.), terpenoids (disobulbin B, epidisiobulbin E acetate) and flavonoids (kempferol and quercetin) [43,44]. The flavonoids contained in the plant are the components with the greatest antioxidant, anti-inflammatory, antibacterial and even antioxidant activity [44]. Toxicity is also common. Clinically, hepatotoxicity is the most typical form of this plant's toxicity, manifesting itself mainly as nausea, vomiting, liver dysfunction or jaundice [44]. The terpenoids contained in Dioscorea bulbifera, in particular Diosbulin B, are thought to be the main cause of liver damage [44]. The mechanism of hepatotoxicity is linked to its inhibition of antioxidant enzymes in liver mitochondria, and to the activity of metabolic enzymes such as glutathione transferase, glutathione peroxidase, superoxide dismutase and glucose-6-phosphate dehydrogenase, which play a key role in the metabolism of components of many herbs [45]. According to clinical pathology studies, kidney damage caused by ***Dioscorea bulbifera*** takes longer to manifest itself, and tubular lesions are more frequent. The plant's toxic effects on the liver and kidneys, mainly due to diosbulbin B and epidioxibulbin E acetate, limit its therapeutic potential. Numerous cases of liver damage, often associated with mortality, have also been described, the latter being linked to excessive or prolonged exposure to diosbulbin [44,45]. In our series, the child who had received phytotherapy with DIOSCOREA BULBIFERA (Kerere) had liver failure and was cured.

5. Conclusion

The present study, which represents the first on the practice of herbal medicine in paediatric settings in the Central African Republic, has enabled us to note that it is a common practice among people with low levels of education and low monthly incomes. It is also used by people living in rural areas. Phytotherapy is not without risk, as this study shows, and like conventional medicine, it must obey strict rules of cultivation, control and dispensing.

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