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Ethnomedicinal And Phytochemical Screening Of Loranthaceae In Tombel Subdivision, Cameroon

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ABSTRACT

Loranthaceae causes abnormal growth and decrease in plant productivity. Despite their harmful character, mistletoes are widely used throughout the world in traditional medicine. This study was conducted to explore baseline data on ethnomedicinal and phytochemical characteristics of Loranthaceae. A survey was done in forty (40) villages to identify species of Loranthaceae and host plants. Questionnaires were administered to obtain information about ethnobotany as well as diseases targeted by mistletoes. Loranthaceae species which had medicinal uses together with their respective host plants were screened for the presence of flavonoids, alkaloids, tannins, steroids, phenols, cardiac glycosides, and saponins. Ethnobotanical results showed that 3 species of Loranthaceae (*P. capitata, T. ogowensis* and *T. apodanthus*) were used to treat 40 human diseases. The most used organs were the leaves (91.11% response). Concoction (50.37% response), was the most commonly used method of preparation of recipe. The mistletoe species with the highest relative frequency of citation was *Phragmanthera capitata* (45.19). Phytochemical analysis showed that these plants were rich in phenols and steroids together with their host plants, but the quantity of these chemicals were higher in the mistletoes than their respective host. Caution should be exercised in the use of Loranthaceae as phytomedicine.

Keywords: Loranthaceae, Ethnomedecine, secondary metabolites, Cameroon

INTRODUCTION

A parasitic plant is a plant that directly attaches to another plant through haustorium, which is a specialized structure that forms a morphological and physiological link between the parasite and host (Yoshida *et al*., 2016) [(1)]. Parasitic interactions between organisms play a very important role in ecosystems. All parasites induce marked changes in the dynamics of host population through the action of increase mortality, lower competitive ability and reduced fecundity (Dibong *et al*., 2010). These parasites penetrate the vascular tissues of their host with their haustoria and feed at the detriment of the host plant. This trophic embezzlement generally leads to reduction of biomass of the host plant that results to yield reduction (Ondoua *et al*., 2016) The Loranthaceae, locally and commonly called "African mistletoe" are phanerogams, hemiparasites, chlorophyllian and epiphytes that attach to the branches of their hosts through a sucker called the haustorium, which establishes contact with the host at the level of the xylem conductive tissues (. This haustorium penetrates into the vascular system of the host tree and absorbs water, inorganic (Malani *et al*., 2017) ions, sugar, amino acid and other essential nutrients from the host xylem and phloem. These parasites take high quantities of mineral macro elements such as Na, K, Ca and Mg from their hosts (Dibong *et al*., 2010)

In Cameroon, this family is represented by 26 species in 7 genera: *Agelanthus, Englerina, Glometula, Helixanthera, Phragmanthera, Tapinanthus* and *Viscum* (Balle, 1982) and in Tombel eight (8) Loranthaceae species were identified, distributed in five (5) genera: *Globimetula*, *Englerina*, *Helixanthera*, *Phragmanthera* and *Tapinanthus* (Ondoua *et al*., 2024).

Despite their harmful character, mistletoes are widely used throughout the world in traditional medicine in the treatment of a broad spectrum of diseases such as cancer, rheumatism, disorders of the female reproductive system, hypertension, hypotension, asthma, epilepsy, hemorrhoids, mental disorder, dysentery, swelling of feet, lower back pain, tooth decay, influenza, cough, stomach ulcers, infectious diseases, and many others (Ladoh *et al*., 2019).

Phytochemicals are chemical compounds produced by plants to help them defend against environmental challenges. These chemicals also provide humans with protection against various diseases. Phytochemical extraction carried out by (Wahab *et al*., 2010; Jemilat *et al*., 2017) on Loranthaceae proves that species of this family tend to possess secondary metabolites and essential oils. The presence of these chemicals explains why these plants are used in the treatment of various diseases. The same species of mistletoe on different host have different medicinal properties and different secondary metabolites.

According to WHO, 80% of the world's population used natural remedies and traditional medicines (WHO, 2003). In Cameroon herbs are traditionally used to meet health care needs and plans are on the way to integrate traditional medicine in the health care system, even though the plans have not been put into action yet. The country however has a rich biodiversity, with 8,620 plant species, some of which are commonly used in the treatment of several microbial infections and a range of diseases (Ntie-Kang *et al*., 2013).

In communities with weak and expensive health systems, local populations in villages still depend heavily on herbal remedies to manage health conditions. Not only are health facilities poorly equipped in terms laboratories, qualified personnel, equipment and consumable, they are also very far from most villages. Poor road networks and poverty compound the problem, leading to a very high level of dependence on herbal medicine

The aim of this study was to assess the ethno medicinal and phytochemical characteristics of Loranthaceae in the monomodal humid forest zone of Tombel, Cameroon.

MATERIAL AND METHODS

Site Description

The study was carried out in Tombel Sub Division, Southwest Region of Cameroon **(Fig 1)**. It is located between latitude 04º16' & 05º15' and longitude 09º13' & 09º15' (Melle *et al*., 2017). It covers a surface of 1007km² with a population estimate of about 130075 inhabitants (Tombel Council, 2010). The relief is dominated by uplands with the principal one being the Kupe Mountain (2050m). The landscape is generally characterized by gentle slopes, deep valleys and some seasonal streams which originates from the mountain. The climate is Equatorial type and is characterized by two seasons, dry season spanning from November to March and a raining season from April through October. Temperatures range from 23.9º C and 25.7º C all year round. The mean rainfall is about 2991mm a year (Melle *et al*., 2017). The soil is extremely fertile composed of volcanic ash supporting rich natural forest and a wide variety of tropical crops both for local consumptions and export (Nkouathio *et al*., 2002).

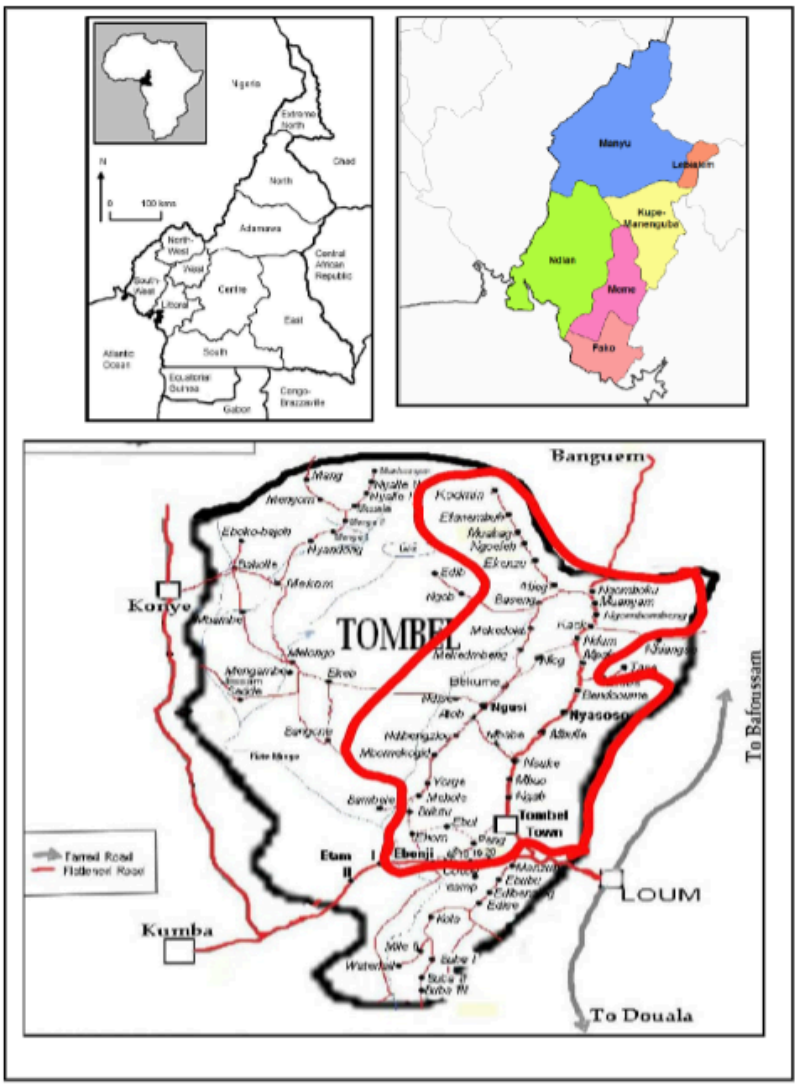

Figure 1: Location of study area (Tombel Council, 2010)

Ethnobotany and ethnomedicinal uses of Loranthaceae species

Of the 40 villages sampled during the survey of Loranthaceae in the Tombel Sub division (Tombel Council, 2010) 6 villages were chosen, (Bulutu, Ebonji, Ngusi, Ngab, Nyassoso, Ngomboku), based on population sizes and the availability of respondents who had knowledge on the medicinal uses of Loranthaceae. A Semi-structured as well as guided open-ended questionnaires were administered to the people of the six study villages to determine the medicinal uses of Loranthaceae. The questionnaires focused on the socio-demographic characteristics of respondents, biology and ecology of the Loranthaceae, and diseases that are targeted using species of Loranthaceae. A total of 135 questionnaires were administered with knowledge of the ethnobotany of Loranthaceae. Herbalists and traditional practitioners were interviewed additionally to get more information since they do not just use herbs for themselves but also on patients as healers. Administration of the questionnaires was random for both sexes from the age of 18 to 70+. Interviews were conducted in English and other local languages. In order to gain insight into the knowledge available from the respondents about Loranthaceae, samples and photographs collected of each mistletoe species were presented during interview as prescribed by the 'Show and Tell method.

Assessment of the phytochemical characteristics of some reported Loranthaceae used in medicine

Phytochemical analysis was carryout on the species of Loranthaceae that were most cited by respondents medicinal uses. Three Loranthaceae species which the highest citation for their medicinal uses together with two other Loranthaceae which were commonly confused with those that had medicinal uses in the show and tell investigation were screened phytochemically (qualitative) for the presence of alkaloids, flavonoids, saponins, steroids, tannins, phenols, cardiac glycosides. Active components found in this family of plants falls within these range of secondary metabolites (Jemilat *et al*., 2017). The respective host plants of these parasites were also phyto screened to compare the secondary metabolites of the host and those of the parasites.

Mistletoes leaves along with the leaves of their respective host were collected from the following species (*Phragmanthera capitata*, growing on *Persea americna* and *Theobroma cacao, T. apodanthus, T. bangwesis*, growing on *Theobroma cacao*; *T. preusii* and *T. ogowensis* growing on *Dacryode edulis) for phytochemical screening*. The haustorium of *P. capiata* growing on *T. cacao* was also harvested.

These materials were air dried at room temperature for 2 weeks in a well aerated atmosphere and prevented from direct sunlight to avoid denaturation of vital phyto-constituents. The dried samples were ground separately avoiding contatination by cleaning the machine thoroughly after each sample. One hundred grammes (100g) of each powdered plant materials was mixed sequentially with hexane solvent, followed by dichloromethane solvent and lastly distilled water in corked containers and allowed to stay for 72hrs. The mixtures were filtered and the filtrate concentrated under reduced pressure by rotary evaporator at appropriate temperature until the solvent was evaporated. Residual solvents were gotten rid of by exposure at room temperature (23º-25ºC). Aliquots of each crude extract obtained were used for phytochemical screening of plant secondary metabolites.

Seven major secondary metabolites screened were alkaloids, flavonoids, steroids, saponins, cardiac glycosides, phenols and tannins using standard methods with some modification as described by (Ndam *et al*., 2014).

Data analysis

Some ethnobotanical indices such as frequency of citation (FC), relative frequency of citation (RFC), use value index (UV) and informant consensus factor (ICF) were assessed as shown in equation 2, 3 and 4 (Souare *et al*., 2020).

To assess the local importance of the different species, the Relative frequency of citation (RFC) was calculated as;

RFC= FC/N (0< RFC < 1) ……...equation 2

Where, FC: The number of informants mentioning the use of the species. N: The total number of informants participating in the survey.

The use value (UV) demonstrates the relative importance of plants known locally. It was calculated using the following formula.

$UV = \sum(Ui/N)$**……...equation 3**

Where, $U_{i:}$ is the number of uses mentioned by each informant for a given species. N: is the total number of informants.

The Informants consensus factor was measured to study total usage of plant species according to cultural applicability. It was calculated as follows

ICF = Nur-Nt /Nur-1……..equation 4

Where; Nur: number of use citation Nt: number of used species

RESULTS

Ethnobotanical knowledge of Loranthaceae in Tombel sub division.

The populations of the study area had knowledge on the ethnobotanical uses of Loranthaceae, but this knowledge varied from one individual to another. All the respondents interviewed mentioned that mistletoe were highly medicinal, making 100% of the total respondents. The plants were also cited for their use as tea, enema, and energy boaster. However, none of the respondents indicated that it was used as food. According to some respondents, the berries of Loranthaceae are macerated and pressed to produce a gel-like substance "gum" used to trap birds, dragon flies and bats in some cases. Some of these respondents also mentioned that, Loranthaceae are being used in business places to attract customers, and to neutralize excessive alcohol in the system as summarized in Table 1.

Table 1: Ethnobotanical uses of Loranthaceae as derived from 135 questionaires administered to populations of six villages in the Tombel Sub Division, Camroon

S\N	**Uses**	No of respondents	FC
1	As energy boaster	1	0.74
2	As tea	52	38.52
3	As enema	21	15.56
4	To hunt birds, dragon flies and bats	10	7.41
5	To determine weather change	1	0.74
6	To neutralize excess alcohol	1	0.74
7	For magic and spiritual purposes	25	18.52
8	In business places to attract customers	1	0.74
9	As medicine	135	100.00

FC= frequency of citation

Host plants of Loranthaceae used in traditional medicine

Respondents cited 13 plants species, as the host mistletoes that are harvested for medicinal uses. Among these host plants, *Theobroma cacao* (48.15%) was the most cited host while *Carica papaya, Psidium guajava, Citrus lemon, Citrus paradise and Olea europaea* representing 0.74% of the respondents respectively were the list. 20% of the respondents also cited that any fruit host can be used for medicine. Table 2 presents the key findings of this section**.**

Table 2: Plant species that host Loranthaceae species used in traditional therapy

Host species	**No of repondents**	**Percentage (%)**
Theobroma cacao L.	65	48.15
Cola nitida (Vent.)Schott et Endl.	8	5.93
Persea americana Mill.	32	23.70
Coffea robusta L.	5	3.70
Citrus sinensis (L.) Osbek	10	7.41
Citrus paradise L.	1	0.74
Citrus limon (L.) Burm.f.	1	0.74
Dacryodes edulis H.J.Lam	4	2.96
Carica papaya L.	1	0.74
Manihot esculenta Cranz.	17	12.59
Psidium guajava L.	1	0.74
Mangifera indica L.	6	4.44
Bambusa vulgaris L.	2	1.48
Olea europaea L.	1	0.74
Any economic plant	27	20.00

These Loranthaceae species *Phragmanthera capitata, Tapinanthus apodanthus* and *Tapinanthus ogowensis and P. capitata* were cited by (45.19 %) of respondents them as being highly medicinal. The least used species was *T. ogowensis* representing 8.15% of the total respondents. Also, 38.52% mentioned that any species can be used in medicine (Table 3).

Table 3: Species of Loranthaceae used in medicine

Loranthaceae species	**No of respondents**	**Percentage (%)**
Phragmanthera capitata (Sprengel.) S. Balle	61	45.19
Tapinanthus apodanthus (Engler) Van Tieghem	30	22.22
Tapinanthus ogowensis (Engler) Danser	11	8.15
Any species	52	38.52

Medicinal uses of Loranthaceae

Information gathered from the survey showed that mistletoes have medicinal uses. Species of Loranthaceae were described as a "strong antibiotics" that can treat a wide range of ailments based on the composition of the concoction. Forty eight (48) ailments were relieved or treated by these parasites, ranging from hypertension (30.37%), fever (19.25%), typhoid (15.56%), malaria (14.07%) and diabetes (7.40%). The least responses on the various diseases it treats were from Aslo, obesity, HIV, palpitation, measles, infertility, urinary tract infections, sprain, stomach ache, diarrhea, filaria, airborne diseases, joint pains, gonorrhea, prostate, rheumatism, cardiac diseases and child that cannot walk, with 0.74% respectively (Tables 4).

Table 4: Ailments treated by species of Loranthaceae

Diseases	**No of respondents**	**Percentage (%)**
High blood	41	30.37
Diabetes	10	7.41
Fungi	6	4.44
Obesity	1	0.74
Aslow	1	0.74
Malaria	19	14.07
Body weakness	1	0.74
Fever	26	19.26
Typhoid	21	15.56
Body pains	3	2.22
Colic	12	8.89
Poison	5	3.70
Stomach ache	1	0.74
Sprain	1	0.74
Menstrual pain	1	0.74
Epilepsy	6	4.44

Table 4: Ailments treated by species of Loranthaceae

Diseases	No of respondents	Percentage (%)
Hernia	5	3.70
Appendicitis	3	2.22
Infertility	1	0.74
Kidney diseases	3	2.22
Measles	1	0.74
Filaria	1	0.74
Breast cancer	1	0.74
Palpitation	1	0.74
Cough	2	1.48
Earache	1	0.74
Diarrhea	1	0.74
Chest pain	1	0.74
Gastritis	2	1.48
Children that cannot walk	1	0.74
Excessive bleeding after birth	1	0.74
HIV	1	0.74
Urinary infections	1	0.74
Air borne diseases	1	0.74
Rheumatism	1	0.74
Joint pains	1	0.74
Cardiac diseases	1	0.74
Prostrate	1	0.74
Gonorrhea	1	0.74
Waist pain	9	6.67
Impotence	2	1.48
Nerve problems	1	0.74
Night fire	1	0.74
Irregular menses	1	0.74
Pile	3	2.22
Mischariage	1	0.74
Shortage of blood	1	0.74
Chlamydia	1	0.74

The plant parts used the most in the preparation of the medicated recipes were the leaves (91.11% responses). The haustorium was the least with 1.48 % responses (Figure, 2). Fruits and seeds recorded 0% usage in herbal medicine.

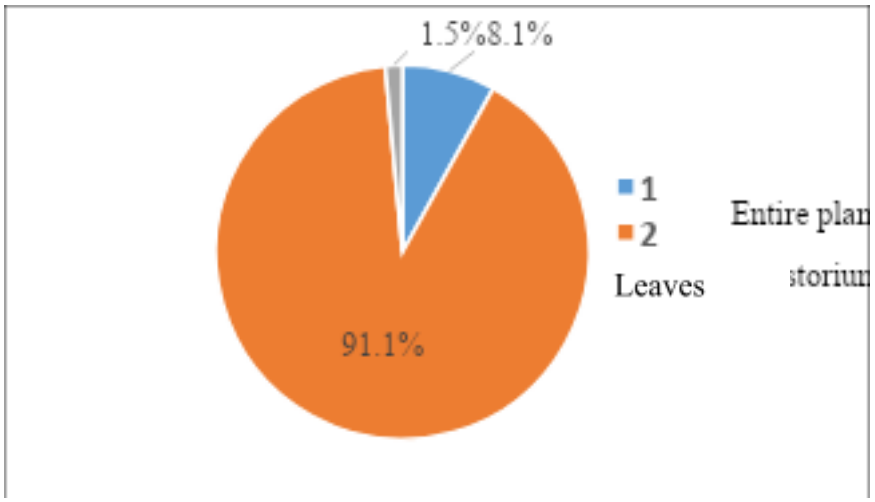

Figure 2: Plant parts of Loranthaceae used in medicine.

The leaves were mainly employed in the fresh state (73.3% responses), while 26 respondents (19.3%) mentioned that the plants were used dried. However 10 respondents (7.4%) mentioned both the fresh and dried state of the plant are effective (Figure 3).

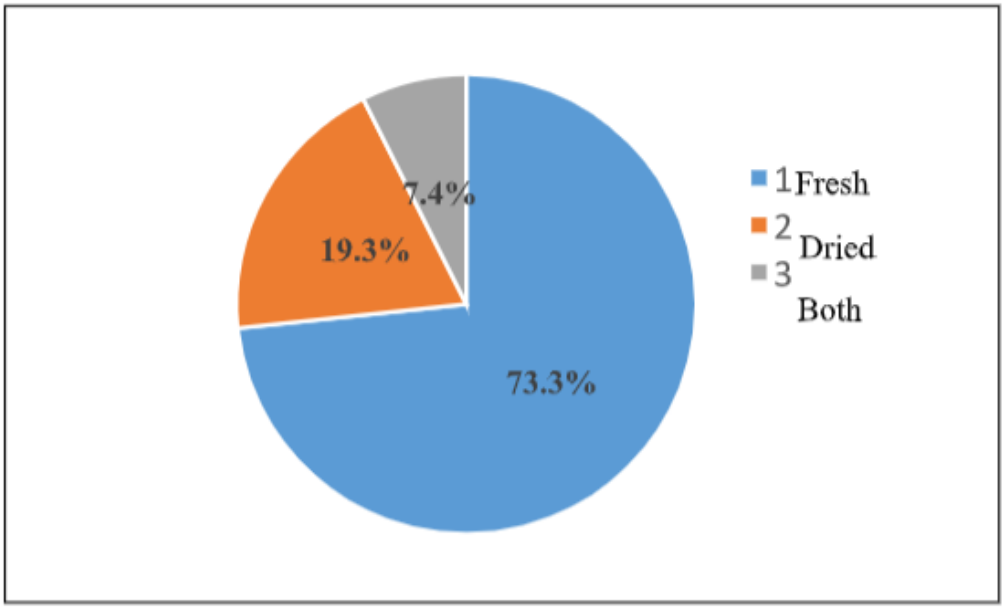

Figure 3: State of plant used in medicine

Different methods of preparing herbal recipes are illustrated in Figure 4. Concoction, decoction, maceration, eaten raw and burning were noted as the best method of preparing drug recipes. Concoction 5(0.37%), decoction (38.52% and maceration (10.37%) were the most popular methods of preparation of drug recipes.

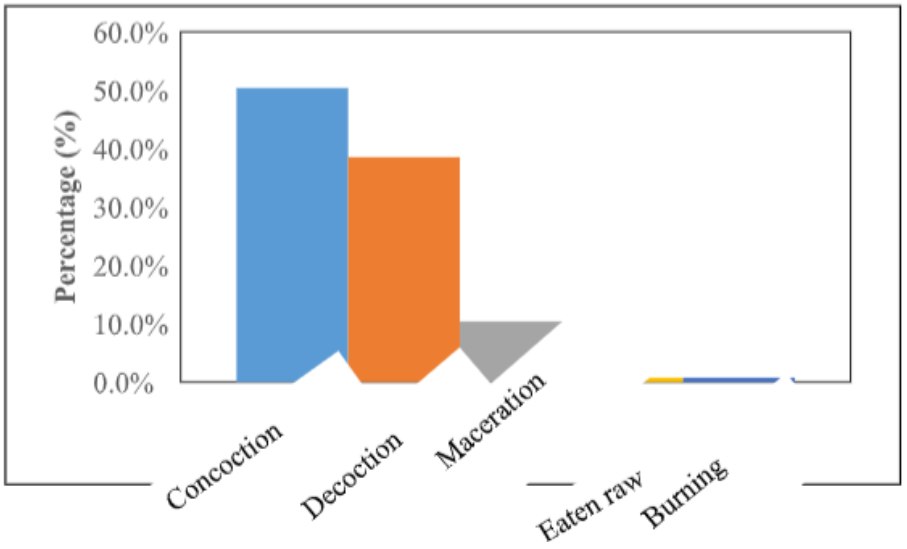

Figure 4: Method of preparation of herbal recipes.

The herbal were administered orally (85.9%), suppository (2.2%) and topical (14.8%). Drugs are administered in various forms of beverages (Figure 5).

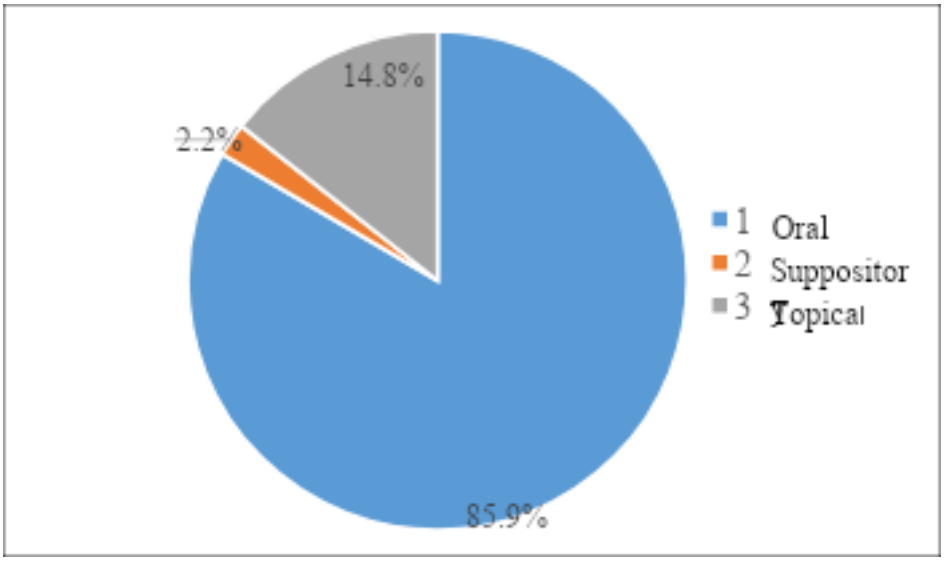

Figure 5: Mode of administration of herbal preparation.

Information gathered from the survey showed that the dosage varied according to the type of ailment and the duration of the ailment (Figure 6). The drugs could be administered once a day (19.26% responses), twice a day (66.67% responses) and thrice a day (14.81% responses). The dosage given for a treatment was not standard.

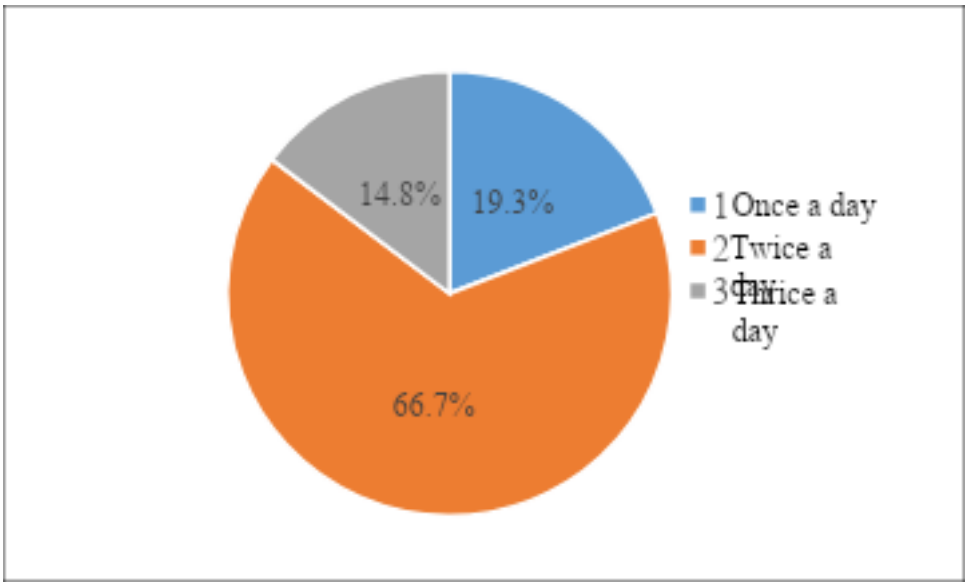

Figure 6: Dosage of drug administered

The duration of treatment was not standardized since it depends on the type and severity of the ailment. The duration ranged from 2 days to 3 months or after the lab result which shows negative symptoms as illustrated in Figure 7.

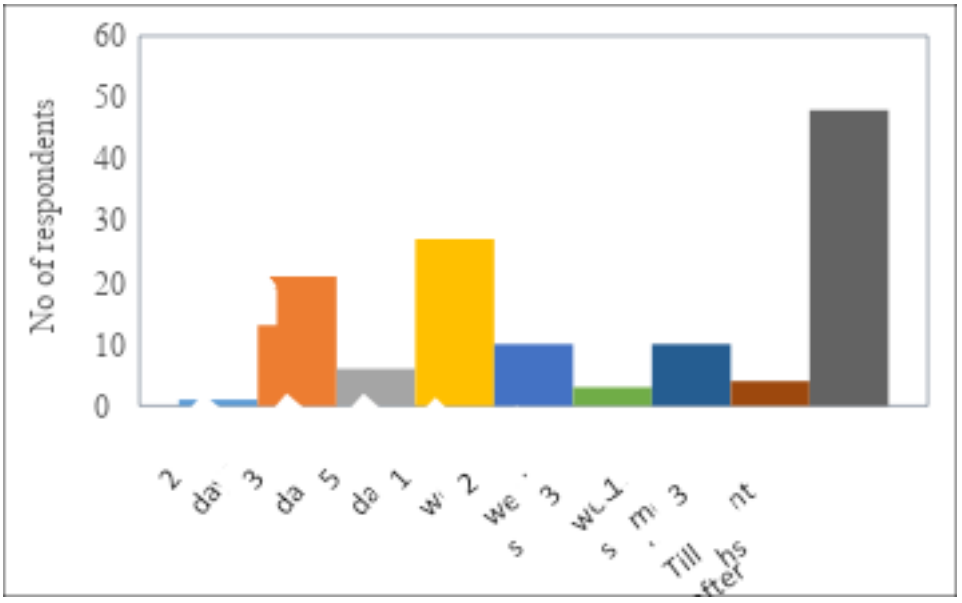

Figure 7: Duration of treatment of ailment

Table 5, shows some ethnobotanical indices that were assessed from the information gotten from the questionnaires. The mistletoe species with the highest relative frequency of citations was *Phragmanthera capitata* with 45.19, followed by *Tapinanthus apodanthus* with 22.22, while the least cited was *Tapinanthus ogowensis* with 8.19.

For the Use Value, the top species was *Phragmanthera capitata* with 0.20. Species with low use value was *Tapinanthus ogowensis* with 0.03.

Table 5: Quantitative Ethnobotanical information of Loranthaceae used in medicine in Tombel Sub Division.

No	Loranthaceae species	No of uses recorded per plant species	NIPS	RFC	UV
1.	*Phragmanthera capitata*.	27	61	45.19	0.20

Table 5: Quantitative Ethnobotanical information of Loranthaceae used in medicine in Tombel Sub Division.

No	Loranthaceae species	No of uses recorded per plant species	NIPS	RFC	UV
2.	*Tapinanthus apodanthus*	13	30	22.22	0.09
3.	*Tapinanthus oogowensis*.	4	11	8.19	0.03
4.	Any species	23	52	38.52	0.17

***RFC**: Relative Frequency of Citation, **UV**: Use Value, **NIPS:** Number of informant who cited the plant species.

According to the respondents, each plant species can be parasitized by the Loranthaceae and each parasite is named after the host that hosts it. In the study area, Loranthaceae are used to cure almost all diseases. The use categories of Loranthaceae vary according to the respondents (Table 6). Infectious diseases was largely treated by Loranthaceae according to the responses of respondents (0.96% responses). Sexual related disorder is poorly represented with 0.5% responses.

Table 6: Categories of diseases treated by Loranthaceae

Categories of diseases	(Nur)	(Nt)	ICF
Digestive system disorder: diarrhea, piles, gastritis, colic, hernia.	19	2	0.94
Pain: stomachache, earache, waist pain, joint pain, body pains, chest pain, nerves problems, menstrual pain.	18	3	0.88
Hereditary diseases: obesity, cancer, diabetes, high blood, cardiac disease, kidney disease.	47	3	0.95
Infectious diseases: cough, HIV, chlamydia, gonorrhea, typhoid, air borne disease, night fire, measles, fungal infections, malaria, filarial.	55	3	0.96
Non infectious diseases: rheumatism, prostrate, irregular menses, miscarriage, palpitation, body weakness, poison, appendix, fever, aslow, children that cannot walk.	46	3	0.95
Sexual and related disorders: infertility, excessive bleeding during child birth, impotence.	3	2	0.5

Nur = number of use citation, Nt = number of used species ICF = informant consensus factor

Table 7 shows some plant based recipes that were recorded during the survey. These plant based recipes vary with the different studied sites.

Table 7: Recorded recipes with their mode of preparation and route of administration

Loranthaceae species	**Parts used**	**Host plant**	**Ethnomedicinal uses**	**Mode of preparation**	**Mode of administration**
P. capitata	leaves	*P. americana*	high blood	decoction and concoction	oral
P. capitata	leaves	*T. cacao*	colic	decoction	enema
			high blood	decoction and concoction	oral
			pains	decoction and concoction	oral
any species	leaves	any host	rheumatism	maceration	topical
T. ogowensis	leaves	*D. edulis*	epilepsy	concoction	oral
any species	leaves	*M. indica*	impotence	decoction	oral
			infertility	concoction	oral and Bath
T. apodanthus	leaves	*T. cacao*	high blood	decoction	oral
			malaria	concoction	oral and steam bath
			typhoid	concoction	oral
any species	whole plant	any host	air burn diseases	burning	inhale
any species	leaves	*T. cacaco* and *C. papaya*	gastritis	concoction	oral
any species	leaves	*M. indica* and *M. esculenta*	kidney problem	concoction	orally
P.capitata	leaves	*T. cacao*	palpitation	chewing	oral

Phytochemical constituents of the Loranthaceae species used.

Five species of Loranthaceae together with their respective hosts were screened phytochemically. A total of 7 classes of secondary metabolites were detected from the phytochemical screening in different proportions (Table 8). Three solvents were used for the extraction process: Hexane, methylene chloride and distilled water. The extraction efficiencies varied with the different solvents used.

When hexane was used as solvent, it was found that the leaves of the host plants and the mistletoes on them contained steroids and phenols except for *T. preusii* and *T. oogowensis* on *D. edulis,* with the hastorium of *P. capitata* which had no phenols. While the leaves of *Theobroma* had no phenol, the mistletoes on it had phenols. Saponins, flavonoids, tannins and cardiac glycosides were absent (*T. cacao*) or present in small quantity (*P. americana* and *D. edulis*) in the host plants but some of the mistletoes on them had these compounds.

When methylene chloride was used as solvent, the leaves of the host plants and the mistletoes on them lacked saponins, flavonoids, and tannins. Alkaloids was present in the leaves of *D. edulis* but absent in the mistletoe on it. Cardiac glycosides was absent in all the host plants but present in the mistletoes on them except for *P.capitata* on *Theobroma cacao*. Steroids and phenols were present in all the host plants and mistletoes.

When distilled water was used, alkaloids were absent in all the host plants and their corresponding parasites. Saponins, steroids, and phenols were present in the leaves of the host and the mistletoes on them.

Theobroma cacao leaves and it parasites had different phytochemical constituents. *Dacryodes edulis* and *Persea americana* leaves had similar chemical constituents to that of their respective parasites.

From the results, the mistletoe plant extracts containing the largest number of active compounds were *Phragmanthera capitata* (15), and *Tapinanthus apodanthus*. The haustorium of *P. capitata* registered the lowest presence of these phytochemicals. The host plant extract with the largest number of active compounds was *Dacryodes edulis,* while the least was *Theobroma cacao*.

Table 8: Phytochemical characteristics of Loranthaceae species and host plants

Plants	solvents	Phytochemical constituents						
		saponins	flavonoids	tannins	steroids	cardiac glycoside	phenolics	alkaloids
leaf of *T. cacao*	hexane	-	-	-	+++	-	-	-
	methylene chloride	-	-	-	++	-	+	-
	distilled water	+	+	-	-	-	+	-
leaf of *P. americana*	hexane	+	-	-	++	-	+++	-
	methylene chloride	+	-	-	++	-	-	-
	distilled water	++	-	-	+	-	+++	-
leaf of *D. edulis*	hexane	+	-	-	+++	+	+	-
	methylene chloride	-	-	-	+++	-	+	+
	distilled water	++	+	+++	-	-	++	-
P.c on *T. cacao*	hexane	-	+	-	+	-	++	-
	methylene chloride	+	-	-	++	+	+++	-
	distilled water	++	++	+++	-	-	++	-
P.c on *P.americana*	hexane	-	-	-	+	++	++	-
	methylene chloride	-	-	-	++	-	++	-
	distilled water	+++	+	++	-	-	++	-
T.p on *T.cacao*	hexane	+	-	++	++	++	+	-
	methylene chloride	++	-	-	+++	+	+	+
	distilled water	+++	-	-	-	-	+	-
T.a on *D.edulis*	hexane	-	-	-	+	+	-	-
	methylene chloride	-	-	-	+++	-	+++	-

Table 8: Phytochemical characteristics of Loranthaceae species and host plants

Plants	**solvents**	**Phytochemical constituents**						
		saponins	**flavonoids**	**tannins**	**steroids**	**cardiac glycoside**	**phenolics**	**alkaloids**
	distilled water	+++	-	+	-	-	+++	-
T.b on *T. cacao*	hexane	+	-	-	++	-	+	-
	methylene chloride	-	-	-	++	-	+++	-
	distilled water	+++	-	++	-	-	+++	-
T.o on *D. edulis*	hexane	+	-	+	+++	+	-	-
	methylene chloride	-	-	-	++	+	++	-
	distilled water	++	-	+	-	-	+++	-
P.c H on *T. cacao*	hexane	+	-	-	+	-	-	-
	methylene chloride	-	-	-	-	-	-	-
	distilled water	++	-	-	-	-	-	-

Legend: + = Low concentration, ++ = Moderate concentration, +++ = High concentration, **-** = absent.

P.c: *Phragmanthera capitata*, **T.o:** *Tapinanthus ogowensis*, **T.p:** *Tapinanthus preusii*, **T.b:** *Tapinanthus bangwensis*, **T.a:** *Tapinanthus apodanthus*

DISCUSSION

Ethnobotanical uses of Loranthaceae

Knowledge of Loranthaceae was influenced by the age of respondents. Our results showed that people over 40 years old constituted the major poles of possession of knowledge of uses of Loranthaceae and must therefore be taken into account in priority in the different strategies for valuing these hemiparasites. The high level of knowledge of the elderly can be explained by the experiences accumulated by them in an area where endogenous knowledge on the uses of Loranthaceae and plants in general is gradually delivered. These results are similar to the work of (Ogunmefun *et al*., 2013) on the ethnomedicinal survey on the uses of mistletoe in South-Western Nigeria who pointed out that our indigenous knowledge about plants (mistletoe and its host) may be lost if the young generations continue to show little or no interest to the practice of our rich cultures so that they are preserved for the future generation

Furthermore, it was observed that traditional practitioner, herbalist and farmers are familiar with the plant especially through their inflorescence, leave sizes and nature of growth on their host. The strong knowledge that traditional healers and herbalist have of the Loranthaceae is said to be due to their strong direct dependence on plant resources. However, this strong dependence of the respondents on Loranthaceae coupled with an indiscriminate use of parasitic species in the study area constitute a threat to the survival of certain Loranthaceae species with high parasitic specificity.

The population of the study area knows the Loranthaceae well and they designate them by different names from their local dialects. This confirms the remarks that local populations do not name plants they do not use (Adjanohoun, 2001). Loranthaceae are named according to the host species and each ethnic group has its own designation. This knowledge of Loranthaceae by different ethnic groups was also confirmed by (Azo'o *et al*., 2013) studying the Parasitism and Ethnobotany of Loranthaceae in Lokomo, East Cameroon.

Mistletoes are found on many trees and shrubs of economic importance. In this study, the respondent were familiar with mostly the cash crop as host plants vulnerable to mistletoes infestation. Amongst which *Theobroma cacao, Persea americana*, *Cola nitida* and *Citrus spp* were the most cited crops. Other host like *Bambusa vulgaris* and *Mangifera indica* mentioned by the respondents were said to be very difficult to find mistletoes on and are of high medicinal values. The ability to identify these host is tied to the fact that majority of the respondents are farmers.

Loranthaceae species were involved in nine (09) categories of uses in Tombel sub division, namely as energy boaster, tea, enema, to determine the climatic condition, to neutralized excessive alcohol, business boaster, human traditional pharmacopoeia, bird hunt, ritual and mystical uses. This diversity of categories of uses is similar to that found in Nepal where Loranthaceae were used in traditional medicine, as fodder, food, for ritual purpose and as bird catching equipment (O'neill and Rana, 2016). On the other hand, this diversity of categories of uses of Loranthaceae was higher in the northern part of Benin. A total number of six (06) categories of uses was indicated, namely traditional medicine, veterinary medicine, magic, food, fodder and cosmetics (Ahamidé *et al*., 2017). From the ethnobotanical survey, it was concluded that mistletoe is not consumed as food by humans. None of the mistletoe's part is used to prepare any delicacy. The berries of mistletoes are macerated and a gel like substance is produced which is used to trap birds, dragon fly, and bats in some cases. The gel like substance is usually applied on the bark of trees or branches where the bird perch or feed. This exercise is usually carried out for fun. It was also observed that the mistletoe plant was used in business places to attract customers.

The host from which mistletoes are harvested from for medicinal purposes includes: *Theobroma cacao, Persea americana, Citrus* spp*, Mangifera indica* and *Bambusa vulgaris.* This could be because of the availability of the host plants and the secondary metabolites they secretes.

This work allowed to record three species of Loranthaceae used in traditional medicine by the populations to treat various human diseases, compared to 7 cited by (Amon *et al*., 2015) in the treatment of diseases throughout the Sud-Comoé region. The involvement of these plants in drug recipes to treat the symptoms of certain diseases has already been confirmed by (Amon et al., 2020; Dibong et al., 2008)**.**

Mistletoes is of botanical interest as it possesses medicinal properties properties making it valuable in ethnopharmacology. The therapeutic properties of the species of Loranthaceae given by the peasants and traditional therapists of the Tombel sub division are presented as solutions to large groups of ailments. Mistletoes are known as a "strong antibiotics" which cures all sickness and have been found beneficial to the society as it treats more than forty (40) health problems. However, the species vary in their medicinal activities sometimes in correlation with the species from same locality or host plants due to variation in chemical profiles. It appears that the species of Loranthaceae are used in preparations according to the hosts and certain cases of diseases. Furthermore, the medicinal properties of mistletoes treats more than 40 diseases ranging from hypertension, malaria, typhoid, diabetes, infertility, kidney disease and many others. This corroborate with the study of (Dibong *et al*., 2009; Djibrilla *et al*., 2019 ; Amon *et al*., 2020), who demonstrated that Loranthaceae species are used to treat nerve attacks, measles, epilepsy, chronic wounds and abscesses hypertension and hypotension, back pain, kidney pain, menopause, migraine, heart palpitations, purification general, and perform mystical practices. According to (Olapade, 2002), traditional medicine has higher benefits than orthodox medicine and any other health care system as it is readily available, cheaper and could cure permanently.

Host species like *Mangifera indica, Bambusa vulgaris* and *Manihot esculenta* were widely cited by local populations because of the important role of the mistletoes they could host. It results that Loranthaceae harvested from *Mangifera indica* and *Bambusa vulgaris* are used to protect the patient against evil spirits, brings an almost death person back to live and used to acquire power. They are highly sought after by traditional therapists because of their rarity and the specific powers they contain. This is in line with the information gathered by (Amon *et al*., 2015).

Regarding the organs of Loranthaceae used by the respondents, the leaves are the most used. The use of leaves is mainly because the leaves are the main photosynthetic organs and contain active secondary metabolites as compared to other parts and also for their regenerative ability. These results corroborate those obtained by (Houenon *et al*., 2012), who found that leaves (25%) are the most used organs. The result is different from those obtained by (Djibrilla *et al*., 2019; Souare *et al*., 2020) who found that stems are the most used organs.

The leaves and haustorium are harvested, washed, air dried and packaged as a method of preservation. These leaves are not exposed to direct sunlight because it is believed that UV radiation tend to destroy the healing power of the plant. The dried or fresh samples are usually used as concoction, decoction or macerated, and the dosage is not usually standardized as factors such as age, weight and the severity of infection are considered. The efficacy of infusions produced depends on the host plant, and that mistletoes harvested on a particular hosts are suited for the treatment of a particular disease. This finding corroborate with the report of (Dibong *et al*, 2009) in a study carried out on the hemi-parasites growing in Cameroon and brought out information on the biology, ecology and medicinal uses of Loranthaceae.

Base on UV, the most commonly used mistletoe plant species is *Phragmanthera capitata* (0.20). This is attributed to the abundance of this species in the study area. The lowest species was *Tapinanthus apodanthus*. Low UV are not necessarily unimportant but having low UV indicates that traditional knowledge about the species is at risk of not being transmitted and maybe gradually disappearing (Chaudhary *et al*., 2006). The value of UV was generally on the high side which emphasize that the informants have great rate of dispersal of knowledge about the species.

The RFC index gives the authenticity of frequency of citation of a species used for various ailments and other uses. The RFC of the reported plant species ranged from 0.22 to 0.45. RFC value varies from 0 (when nobody refers to a plant as a useful one), to 1 (with all the informants mentioning it as useful) (Tardío and Pardo-De-Santayana, 2008). The species *Phragmanthera capitat* and *Tapinanthus apodanthus* having high RFC values indicated their abundant use and widespread knowledge among the respondents.

The informant consensus factor indicated that infectious diseases are the most commomly treated ailments of Loranthaceae. This is different from the work of (Djibrilla *et al*., 2019) who found that infertility (male and female) are the well-treated ailments of Loranthaceae in Mandara Mountains.

Phytochemical Screening of Loranthaceae species and host plants

A total of seven groups of phytochemical were recorded from the 10 screened plant extracts. Some of these phytochemicals are similar to the study of (Jemilat *et al*., 2017) in Nigeria, where seven mistletoe plants were screened and found they have potential molecules for preparing a drug for the treatment of ailments.

The results obtained from the phytochemical screening showed that the chemical profiles of the different mistletoe species and host plants are variable. This may be as a result of their hemi-parasitic habit on the different hosts. The type of host seems to largely influence the chemical compounds found in the respective mistletoe. These variations indicate that the same species occurring on different hosts in the same locality have differences in their metabolites. Variation in secondary metabolites among the same mistletoe species occurring on different host plants have been observed in earlier studies (Ibrahim *et al*., 2009; Jemilat *et al*., 2017). The differences noted in the chemical constituents of this parasite present on different hosts might justify why the host is as important as the parasite in Pharmacognosy (Dibong *et al*., 2008) and why the use of these parasite in the treatment of an ailment is usually dependent on a particular or specific host (Ibrahim *et al*., 2009). The only consistent pattern from this study was the lack of alkaloids from almost all the specimens analyzed. The samples which tested slightly positive to Dragendorff for the presence of alkaloids did not show the actual orange color expected but the color obtained indicate the presence of alkaloid-related compounds in those samples. These are *Tapinanthus apodanthus* and the leaves of *Dacryodes edulis*. This corroborate the findings of (Jemilat *et al*., 2017), who recorded the absence of alkaloids for any of the Nigerian Loranthaceae specimens studied, but (Uddin *et al*., 2014) recorded the presence of alkaloids in *Stephania japonica* Linn in Bangladesh. However it is possible that they have other secondary metabolites which have not been detected in the present study. Quantitative and qualitative information on secondary metabolites is useful for taxonomic classification of plants (Harborne, 1964). Phenolic compounds were present in most of the specimens, and this further reinforced the fact that phenolic could be a source of analytical marker compound(s) for standardization of herbal preparations from these species. High amounts of phenolic have long been known to be a phytochemical feature of parasitic flowering plants and they are said to occur at a level that is generally higher than the host plant (Salaitino *et al*., 1993). The study reveals that *P. capitata* and *T. bangwensis* specimens irrespective of their hosts are rich in phenolic compounds as compared to other species while *T. apodanthus* and the haustorium of *P.capitata* are low in phenolics as compared to other species. This study has also shown that some species may not possess a particular metabolite that is common in other species. For instance, the absence of tannins in *Tapinanthus* species or tannins may result in major pharmacological differences. It is believed that the host plant play a

role in the observed chemical profile of the plant or species. The influence of host chemistry on the chemical constituents of the parasite on different hosts justify why the host is as important as the parasite in pharmacognosy, ethnopharmacology and ethnomedicine, and why the use of these Loranthaceae in the treatment of an ailment is often dependent on a particular or specific host (Preston *et al*., 2010). The similarities in chemical compositions found between the host plants and the mistletoe species are probably because both species are leaves and since these parasites attaches themselves to the branch where leaves grow.

The studied bioactive compounds have a broad range of biological activities. For example, phytochemicals such as saponins have anti-inflammatory effects (Veenendaal *et al*., 1996), hemolytic activity, and cholesterol binding properties. Glycosides are known to lower blood pressure (Marinkovic *et al*., 2008) and tannins exhibit antioxidant, antimicrobial and antiviral effects (Sayyah and Hadidi, 2004). The plant extracts were also revealed to contain steroids, which are known to produce an inhibitory effect on inflammation (Sayyah and Hadidi, 2004) and alkaloids that have been reported to exert analgesic, antispasmodic and antibacterial activities (Nyarko and Addy, 1990). The phytochemical screening results of the extracts are consistent with the results reported by (Jemilat *et al*., 2017) where authors mentioned the presence of tannins, alkaloids, saponin, cardiac glycosides, and flavonoids in screened Loranthaceae in Nigeria. According to some authors, the quantity and the composition of bioactive compounds present in plants are influenced by the genotype, extraction procedure, geographic and climatic conditions, and the growth phase of the plants (Trease and Evans, 1996).

This result validates the use of *Phragmanthera capitata* and *Tapinanthus apodanthus* from their host plant *Theobroma cacao* and *Persea americana* for the preparartion of herbal medicine, according to their high amount of active metabolites which is responsible for their antimicrobial activity, antiviral activity and other medicinal value.

CONCLUSION

Loranthaceae are certainly considered as pest plant species but have important secondary metabolites which differs from one species to the next due to variations which occur on same species from different hosts. The occurrence of similar metabolites like phenolics and steroids in most, if not all the species irrespective of the host is useful taxonomically as a marker for the group. Therefore, caution should be exercised in the use of Loranthaceae as phytomedicine because of the chemical variations which exist in the same species found on different hosts. The same species collected from two different hosts might have different pharmacological effects in the body.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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