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Snake bites frequency and ethnopharmacological study of plants used against ophidian's envenomation (Bassar District)

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ABSTRACT

The snake bites victims' proportion is not well known among the population and statistical values are not available to consider snake bites as a significant cause of death especially in rural Africa. In Togo, the rural population uses various plants for the treatment of snake bites. The objective of this work is to conduct two types of surveys, namely the prospective survey and the retrospective survey in Bassar district (Togo) to obtain scientific data on cases of snake bites in rural areas and plants species use in snake bites treatment. The results obtained show that the population at risk is made up of men (70.2%) aged between 20 and 40 years, mostly farmers (58.3%). There are more snake bites in the rainy season (80.8 %). *Echis ocellatus* is responsible for 78.3 % of bite cases followed by *Bitis arietens* (8.7%). Twenty-two plant species have been recorded and *Annona senegalensis*, *Securidaca longepedunculata* and *Hannoa undulata* are the most cited. These results prove that snake bites remain a significant public health problem, especially in rural areas.

Keywords: *Echis ocellatus*, Snake bites, *Annona senegalensis*, *Securidaca longepedunculata*.

INTRODUCTION

Ophidian envenomation results from the convergence between human occupations and snake activities. The worldwide number victims snake bites's in one year is estimated at five million, with nearly one hundred and fifty thousand deaths and as many permanent disabilities [1, 2]. The growing public interest in new pets such as venomous snakes is reflected in the increasing occurrence of so-called "hazardous" environments which are inflicted by exotic snakes [3]. Most of five thousand cases of snakebite are yearly registered officially in hospital in Togo [4]. Classified by the World Health Organization as a neglected disease, ophidian envenomation needs to be better assessed and considered by health authorities and international community [5]. In tropical regions, mainly in developing countries, accidents are much more related to occupational activities such as rural work, hunting and fishing.

Statistics provided by health services on snake bites largely under-estimate the proportion of actual cases that occur particularly in rural areas due to the constraints faced by victims. Moreover, modern medicinal management is difficult to access for African populations in general and Togolese in particular. The socio-economic environment characterized by the economic situation, the high cost of pharmaceuticals and even the frequency of stock breaking of anti-venoms in some health centers and particularly in those of countryside which makes treatment difficult. These populations, the majority of whom live in the countryside used medicinal herbal remedies to cure themselves in case of snake bite [6, 7]. Thus, traditional medicine becomes a non-negligible alternative for African population in terms of health coverage. The role of traditional medicine seems to be essential in the treatment of ophidian envenomations in Africa. Compounds with anti-venomous activity have been isolated from some plants considered to have anti-venomous properties [8, 9, 10]. This public health problem unfortunately poorly evaluated, even undervalued.

The aim of this study is to conduct a prospective and ethnopharmacological survey in Bassar district (Togo) in order to provide scientific data on epidemiological parameters such as the frequency of ophidian envenomation, types of treatments and plant species used in the treatment of ophidians envenomations. The various parameters related to snakes bite were evaluated as well as the census of the plant species used locally in this medium for the envenomation treatment.

MATERIALS AND METHODS

Study framework

The Bassar district is located about 380 km northwest of Lomé, capital of Togo. It has an area of

3.410 km². The district enjoys a tropical climate, with two distinct seasons: the rainy season, which runs from April to October, with a peak from July to September and the dry season, from November to March. The main activity of this population is agriculture, particularly the cultivation of groundnuts and *Dioscorea spp.* yams.

Prospective survey

The study took place in March 2016 in the district of Bassar. In order to carry out this work properly, ten (10) localities: Bassar, Kabou, Bitchabé, Dimori, Sanda, Bandjéli, Baghan, Kalanga, Bougabou and Tchapossi were randomly selected. The respondents were also selected randomly. The study is carried out in the form of an individual interview. Previously established survey forms are filled out during semi-structured interviews with the various witnesses [11]. Snake species causing the bites identification was carried out by asking the victims to choose from a set photographs of snake species the one that bit them. Pictures were collected with the assistance of Zoology Department at Lomé University (Togo). These photographs

include snake species that are present in this locality mixed with species that are absent in this locality for the reliability of the respondent's choice. The parameters sought are: age, sex, socio-professional status, type of treatment; motivations for choosing the type of treatment and the species of snakes that bit the victims.

Ethnopharmacological survey

The plant species used in the treatment of snake bites in this area were recorded from 17 traditional healers. These healers were indicated by the chief of each locality as being the healers in charge of snake bites in the area. The traditional healers were subjected to a semi-structured interview with a survey form which took into account: the plant species used to treat snake bites, the parts of the plant used and the methods of preparation [12].

The plant species listed were identified at the Laboratory of Botany and Plant Ecology (Lomé University).

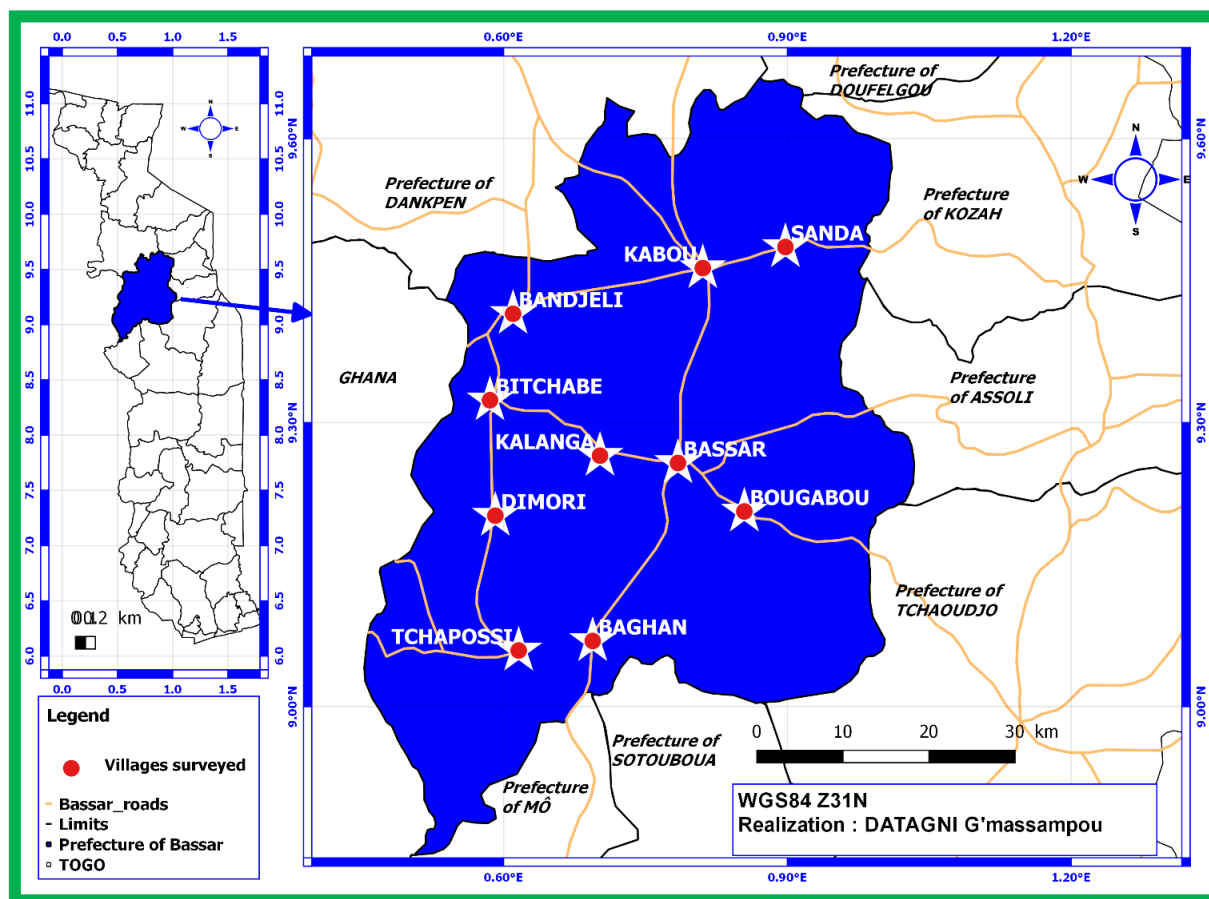


Figure 1: Map of the study area showing Bassar district, the localities and access roads realize by G'massampou DATAGNI

Data analysis

Histograms, tables and frequency of citation, were carried out with MS Excel spread sheet which allowed to analyze the results. The frequency of citation (FC) was calculated according to the formula used by Kantati *et al.*, [12].

$$FC (\%) = (NRP/TRC) \times 100.$$

NRP=Number of remedies containing the plant
TRC=Total of remedies collected

RESULTS

Snake bites according to the sex of the victims

A total of 682 people was surveyed in ten localities. Among them, 342 people were bitten by snakes. Males were the sex that recorded more snake bites with a frequency of 70.2%. Female recorded 29,80% the victims of snake bites (Figure 2).

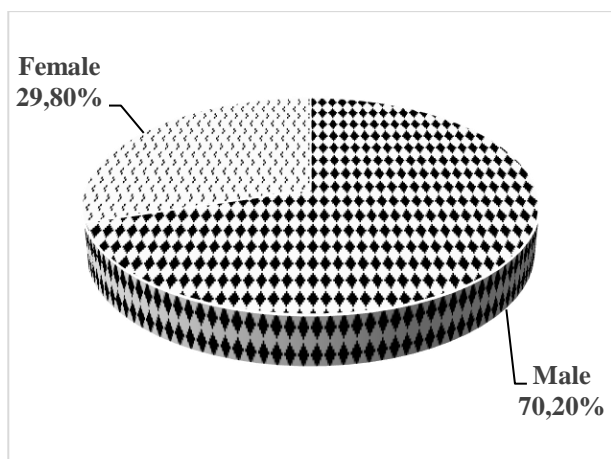


Figure 2: Distribution of bites according to the sex of the victims

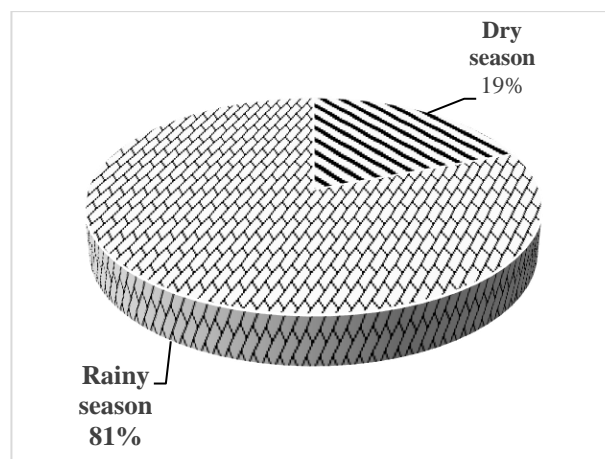


Figure 5: Breakdown of bitten people according to the agricultural seasons

Ages of snake bites victims

Victims aged of 20 to 40 years old are most represented with 43.5% of snakebite frequency. When looking at the 20 to 60 age groups, the victim frequency is 56.4% (Figure 3).

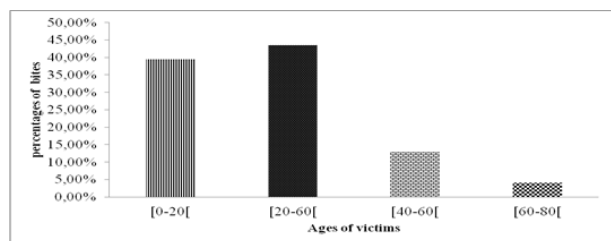


Figure 3: Ages of snake bites victims

Professional activities of snake bites victims

Farmers are the most affected by snake bites with a rate of 58.31%, followed by students 19.24% and housewives 9.91%. The 12.54% are housewives, teachers, carpenters, masons and other activities. Males were the sex that recorded more snake bites with a frequency of 70.2% (Figure 4).

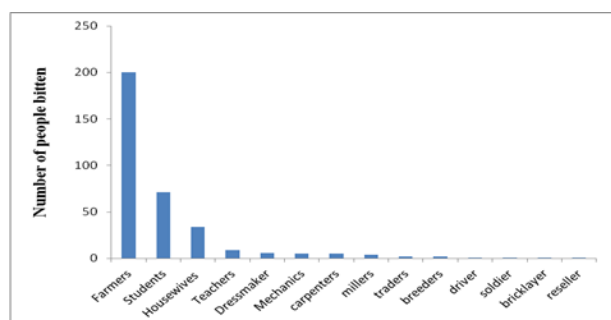


Figure 4: Breakdown of bitten people according to their professional activities

Bitten people according to the agricultural seasons

The rainy season is the season in which more cases of snake bites are recorded. In our survey, 81% of victims were bitten during the rainy season. During the dry season and 19% of victims were bitten during the dry season (Figure 5).

Snake bites according to place of accident

The agricultural fields were the bite sites by excellence with a bite rate of 68%, followed by the inhabited areas and the bush (Figure 6).

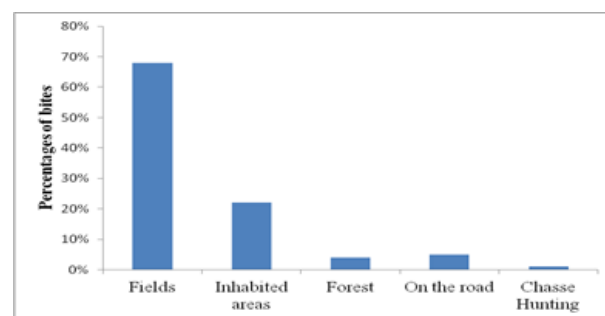


Figure 6: Distribution of snake bites according to place of accident

Choice of snake bites victims for treatment mode

Traditional treatment is the most commonly used treatment for snake bite victims with a frequency of 64.30%. Those who use modern treatment are almost one-third of those who use traditional treatment (Figure 7).

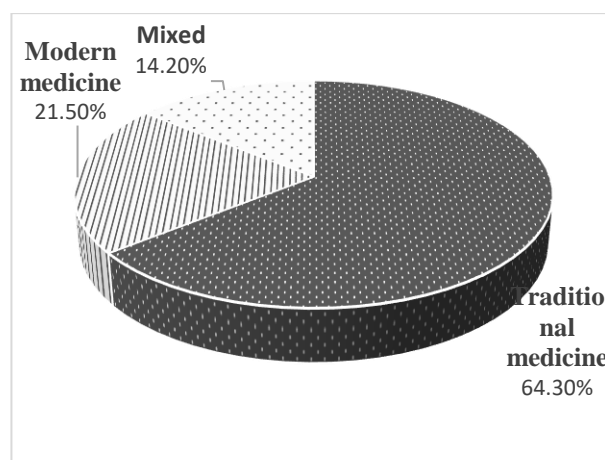


Figure 7: Types of treatment chosen by victims of snake bites

Reasons for the choice of treatment types

Lack of financial means with 52% appears to be the first cause for which victims choose their treatment. This is followed by distance

from health centres (26 %), trust in modern medicine (19%) and finally trust in traditional medicine (3%) (Figure 8).

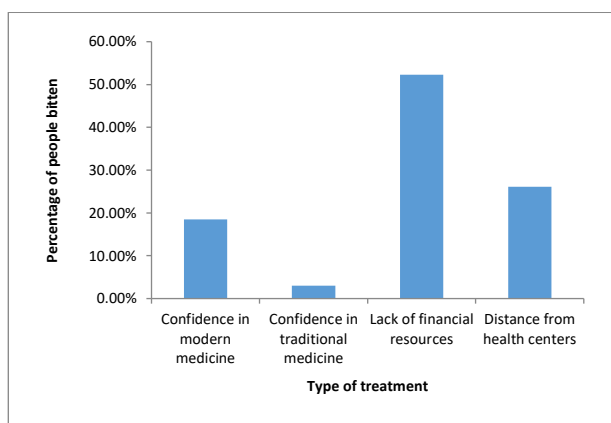


Figure 8: Reasons for the choice of treatment types

Snake species causing bites

The species of snakes that causes many bites in this district is *Echis ocellatus* with 78.3 % of bite cases. *Bitis arietens* (8.70%), *Amblyodipsas unicolor* (5.5%), *Naja nigricolis* (3.6%), *Dendroaspis viridis* (1.6%), *Atractaspis dahomeyensis* (1.2%) and *Atheris chlorechis* (1.2%) are species responsible for bites in this district (Figure 9).

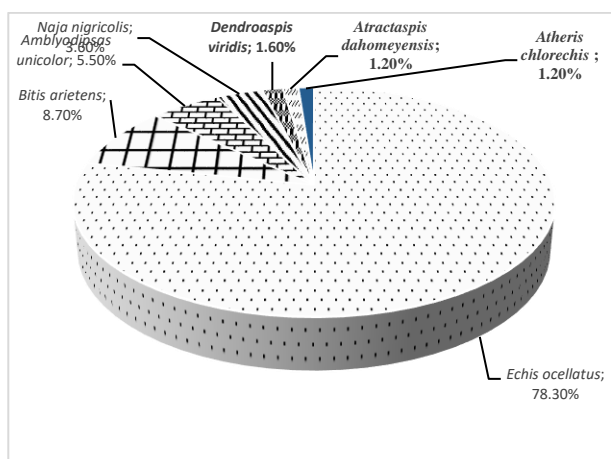


Figure 9: Distribution according to snake species causing bites

Plant parts reported

The roots and leaves of plants are the plant organs most used by victims. Among the parts of the plant used, the roots alone account for 50.9 % (Figure 10).

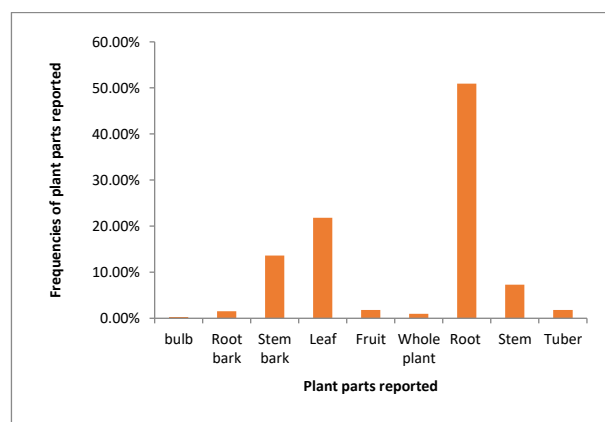


Figure 10: Frequencies of plant parts reported.

Modes of preparations

Maceration is the most commonly used method of preparation. It occupies 72.5% of the preparation methods, and is followed by decoction (16.5 %) and powders (11%) (Figure 11).

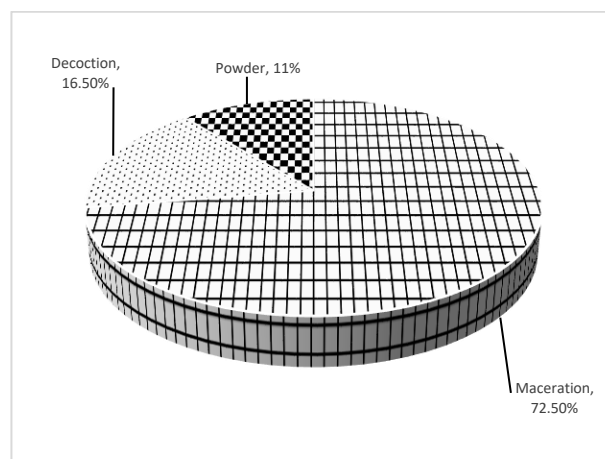


Figure 11: Modes of preparations frequencies

Table 1: Plants species traditionally used in folk medicine of Bassar district to treat snake bite

Plants species	Family	Voucher specimen number	Local name	Used parts	Modes of preparation	FC %
<i>Annona senegalensis</i> Pers.	Annonaceae	TOGO15673	Agnigli (E)	Le/Ro	Ma	53,33
<i>Securidaca longepedunculata</i> Fres.	Polygalaceae	TOGO15676	Metritou (E)	Rb/Sb	Ma	33,33
<i>Hannoa undulata</i> (Guill. Perr.) Planch.	Simaroubaceae	TOGO15677	Kiganligou (B)	Ro	Ma/De	20
<i>Cacia siberiana</i> DC.	Fabaceae	TOGO15678	Gati-gati (E)	Ro	Ma/De	15,55
<i>Parkia biglobossa</i> (Jacq.) Benth.	Fabaceae	TOGO15679	Soulou (K)	Rb/Sb	Ma/De	15,55
<i>Manihot esculenta</i> Crantz	Euphorbiaceae	TOGO15680	Agbéлити (E)	Tu/Le	Ma	13,33
<i>Hymenocardia acida</i> Tul.	Phyllanthaceae	TOGO15681	Kinakolegji (B)	Le/Ro	Po	8,88
<i>Spondia mombin</i> L.	Anacardiaceae	TOGO15682	Dighanlidi (B)	Ro	Ma	8,88
<i>Azelia africana</i> Sm. & Pers.	Fabaceae	TOGO15683	Wéré (K)	Sb	Po	6,66
<i>Diospyros mespiliformis</i> Hochst ex A. DC.	Ebenaceae	TOGO15684	Gabongue (M)	Ro	Po	6,66
<i>Entada abyssinica</i> Steus. Ex A. Rich	Fabaceae	TOGO15685	Bitchalejhou (B)	Le	Ma	6,66
<i>Isobertinia tomentosa</i> (Harms) Craib & Stapf	Fabaceae	TOGO15686	Dignori (B)	Ro	Ma	6,66

<i>Piliostigma thonningii</i> (Sch.) Miln. Redh.	Fabaceae	TOGO15687	Babakou (K)	Le/Ro	De/Po	6,66
<i>Sarcocephalus latifolius</i> (Smith) Bruce	Rubiaceae	TOGO15688	Kitchatchalou (T)	Le	Ma	6,66
<i>Vitellaria paradoxa</i> C. F. Gaertn	Sapotaceae	TOGO15689	Woussa (T)	Ro	Po	6,66
<i>Calotropis procera</i> (Aiton) R. Br.	Apocynaceae	TOGO15690	Kinabékotou (B)	Le/Ro	Po/Ma	4,44
<i>Allium cepa</i> L.	Amaryllidaceae	-	Saboulè (E)	Le/Bu	Ma	2,22
<i>Cola nitida</i> (Vent.) Schott & Endl.	Malvaceae	TOGO15691	Goroo (E)	Fr	Ma	2,22
<i>Icacina senegalensis</i> A. Juss.	Icacinaceae	TOGO15692	Kpadi (B)	Rb	Ma	2,22
<i>Jatropha curcas</i> Linn.	Euphorbiaceae	TOGO15693	Dnagbetrou (B)	Le/Ro	Po	2,22
<i>Nicotiana tabacum</i> L.	Solanaceae	TOGO15694	Ataba (E)	Le/ Ro	Ma	2,22
<i>Strophantus sarmentosus</i>	Apocynaceae	TOGO15695	Bibɔbou (B)	Le/Ro	De/Po	2,22

Local names: E=Ewe, B=Bassar, T=Tem, K=Kabyè, M=Moba.

Used parts: Le=Leaves, Sb=stem barks, Rb=Root barks, Ro=Roots, Fr=Fruit, Tu=Tuber, Bu=Bulbe.

Modes of preparation: Ma=Maceration, De=Decoction, Po=Powder.

FC = Frequency of citation for the species used in envenimations treatment.

22 plants species have been recorded. These species belong to 15 different families. The most represented family is the Fabaceae family with 6 species, followed by the Euphorbiaceae and Apocynaceae families with 2 species each. The three most cited species are: *Annona senegalensis* (FC=53,33 %); *Securidaca longepedunculata* (FC=33,33 %) and *Hannoa undulata* (FC=20 %).

DISCUSSION

The treatment of snake bite's victims remains unsatisfactory to this day. To improve the management and treatment of snake bites, it is important to have a general knowledge of the frequency of bites and the types of treatments used. For this, we have evaluated the frequency of snake bites and the types of treatment used; we have listed the plants used in the treatment of snake bites in this district.

The household survey provided us with five exact indicators, namely the frequency regardless of types of treatment, reasons for treatment choice, population at risk, different species of snakes responsible for bites in this area and the plants used in traditional treatment of this accident. These indicators allowed us to have epidemiological parameters such as frequency, treatments and mortality related to snake bite accidents.

In our study area, snake bites frequency is 50.4%. This is believed to be due to the destruction of snake's natural habitat by humans and snake's research of new habitat. This is a real factor which favors meeting between snake and humans which can lead to snake bites. The choice of victims is guided by certain factors that the survey results revealed, such as the lack of financial means (the predominant factor), then the distance from health structure [13] and finally cultural considerations. Indeed, 64.3% of victims for traditional treatment. This is comparable to studies carried out in Burkina Faso [14]. The cost of the anti-venomous serum, despite its subsidy by the Togolese state, is still very high for farmers, who constitute the socio-professional layer most affected by envenomation in this district with a rate of 58.31 %. We also noted that in this district, there is only one health center that possess an emergency service. All this shows that snake bites mainly affect people living in the tropical zone and that these people are poor and lack adequate health centers [15].

With regard to the victim profile, the sex most at risk is male with a high frequency of snake bites. This is consistent with that observed in Mali [16] but different from that observed in Gabon [17], which showed equality between the male and female sexes. The high number of male victims can be explained by the fact that this district has a large rural population of 80.6 % [18] and that men are the farmers by excellence in the area. This result is confirmed by the high rate of bites in the fields (68%). The higher rate of biting accidents is recorded during field work, which is contrary to the result found in Benin [19]. The rate is higher in the rainy month of April (12.9 %) because this month

corresponds to the beginning of agricultural activities in area. As the main crop in Bassar district is yam, it is in this month that farmers make the first mounds for their yam fields. The snake species recorded show that *E. ocellatus* (Viperidae family) more common in ecological zones I and II [21] is the one causing more accidents in the area (78.3%) followed by *Bitis arietens* (8.7 %). This result confirms that in Africa, the most widespread snake family is Viperidae family [20]. *E. ocellatus* is also cited in previous work as the snake that causes more bites respectively in rural areas in eastern Senegal, Benin and northern Cameroon [22, 23, 24]. Indeed, this species is savannah based and most often hides under rocks in Bassar district. This justifies the fact that most accidents occur during agro-pastoral activities [25].

There are 22 plants species traditionally used in the treatment of recorded snake bites. These species belong to 15 different families. The most represented family is the Fabaceae family with 6 species, followed by the Euphorbiaceae and Apocynaceae families with 2 species each. The three most cited species are: *Annona senegalensis* (FC=53,33 %); *Securidaca longepedunculata* (FC=33,33 %) and *Hannoa undulata* (FC=20 %). *Annona senegalensis* and *Securidaca longepedunculata* have been cited as plants with anti-venomous properties in previous work in other regions [26, 27, 28, 29, 30, 31]. The anti-venomous properties of these two plants have already been studied on venoms of different snake species [14, 32, 33, 34, 35]. The high frequency of use of these two plant species by rural populations is similar to the results obtained in the central region of Togo concerning traditional treatments of animal aggression [36]. Our study shows that the most commonly used plant organ is the root (50.9%), root removal leads to the destruction of plant species [37, 38]. Therefore, the treatment of envenomations by plants would be one of the factors that support the disappearance of the biodiversity, so it is important to preserve these plants species used in the treatment of ophidian envenomations in this area by using other part or by agricultural production of these medicinal plants.

CONCLUSION

Snake bites are a real public health problem in Bassar district. The frequency of bites, which exceeds half of the surveyed population proven that the treatment of this accident must be taken into account in primary health care politics. The results of the surveys show that male farmers are the population at risk and the fields are the most common snake bite sites. The majority of victims chose traditional treatment. The plant species anti-venomous properties must be

checked to ensure the well-being of the rural population that is most affected by this phenomenon. Concerning snakes species that causes more bites, our results showed that *E. ocellatus* is the species responsible for the majority of bites in this district. An in-depth pharmacological properties study of the plant species identified in this survey is necessary for a scientific verification.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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