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PHYTOCHEMICAL SCREENING OF SIX PLANT LEAVES FOR MALARIA VECTOR CONTROL IN COUFFO DEPARTMENT IN SOUTH-WESTERN REPUBLIC OF BENIN, WEST AFRICA

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ABSTRACT

Mosquito vector control is facing a threat due to the emergence of resistance to synthetic insecticides. Safe and eco-friendly insecticides of botanical origin may serve as suitable alternative biocontrol techniques in the future. The current study was aimed at investigating on phytochemical screening of six plant leaves for malaria vector control. The leaves of six plants which were *Sida acuta* Burm F., *Eucalyptus globulus* Labill., *Anacardium* occidentale, *Allium sativum L.*, *Parkia biglobosa* and *Petroselinum crispum (Mill.*) Nyman were collected in their predilection areas in Couffo department in south-western Republic of Benin. Aqueous extracts of leaves of the six plants were done and the phytochemical screening analysis was performed through the quantitative and qualitative analysis of the phytoconstituents. The results showed that the aqueous extract of *A. sativum* had the highest tenor in total polyphenolic whereas the aqueous extract of *E. globulus* had the lowest tenor in total polyphenolic. The sample of *P. crispum* had the highest

extraction produce whereas the sample of *A. occidentale* had the lowest extraction produce. Chemical compounds such as alkaloids, tannins, flavonoids, anthocyans, mucilages, coumarins, steroids, saponins which have potential insecticidal activities were present in the dry leaf powder extracts of the almost studied plants. However, the chemical compounds with high toxicity such as cyanogenic derived and O-heterosids were absent in all analyzed samples. Secondary metabolites present in the dry leaf powder extracts of the almost studied plants in the current study have potential insecticidal activities. However, further study is recommended to identify the active ingredient of aqueous extracts of these six plant leaves and their mode of action.

KEYWORDS: Phytochemical screening, malaria control, *Anopheles gambiae*, Republic of Benin.

1. INTRODUCTION

Globally in 2024, there were an estimated 282 million malaria cases in 80 malaria endemic countries, an increase of about 9 million cases (3%) compared with 2023.[1]

Between 2000 and 2015, although the trend in case numbers fluctuated, there was a slight decrease overall of about 3.8%, from 239 million to 230 million cases, across the 108 countries that were malaria endemic in 2000. Since 2015, malaria cases have increased by 22.6%. Of the regions that showed an increase , most of this increase was observed in the WHO African Region (88%) and the WHO Eastern Mediterranean Region (12%).[1]

Globally in 2024, there were an estimated 610 000 malaria deaths, an increase of 12 000 compared with 2023. Between 2015 and 2024, deaths increased by 5.5%, with more than one-third of the increase occurring between 2023 and 2024. The mortality rate remained unchanged in 2024 compared with 2023, at 13.8 per 100 000 population at risk.[1]

Traditionally or culturally, different communities use different plants in various forms to protect themselves against mosquitoes and other insect bites.[2,3] Naturally occurring compounds and their derivatives are of increasing interest for the development of new insecticidal compounds against malaria vectors. Plants possess a wide range of bioactive phytochemicals that are selective, biodegradable and have minor or no adverse effects on non-target organisms and the environment.[4] Reports indicate that essential oils and extract

of local plants have a promising larvicidal, adulticidal and repellent activity against malaria vectors.[5,6]

Very few researches were published on the phytochemical screening of plant leaves for malaria vector control in Benin. Therefore, there is a need to carry out new researches for this purpose.

The goal of this study was to do the phytochemical screening of six plant leaves for malaria vector control in Couffo department in south-western Republic of Benin, West Africa.

2. MATERIALS AND METHODS

2.1. Study area

The study area is located in Republic of Benin (West Africa) and includes the department of Couffo. Couffo department is located in the south-western Benin and the study was carried out more precisely in the six districts of this department (Figure 1). The choice of the study site took into account the economic activities of populations, their usual protection practices against mosquito bites and peasant practices to control farming pests. We took these factors into account to study the phytochemical screening of six plant leaves for malaria vector control in Couffo department in south-western Republic of Benin, West Africa. Couffo has a climate with four seasons, two rainy seasons (March to July and August to November) and two dry seasons (November to March and July to August). The temperature ranges from 25 to 30°C with the annual mean rainfall between 900 and 1100 mm.

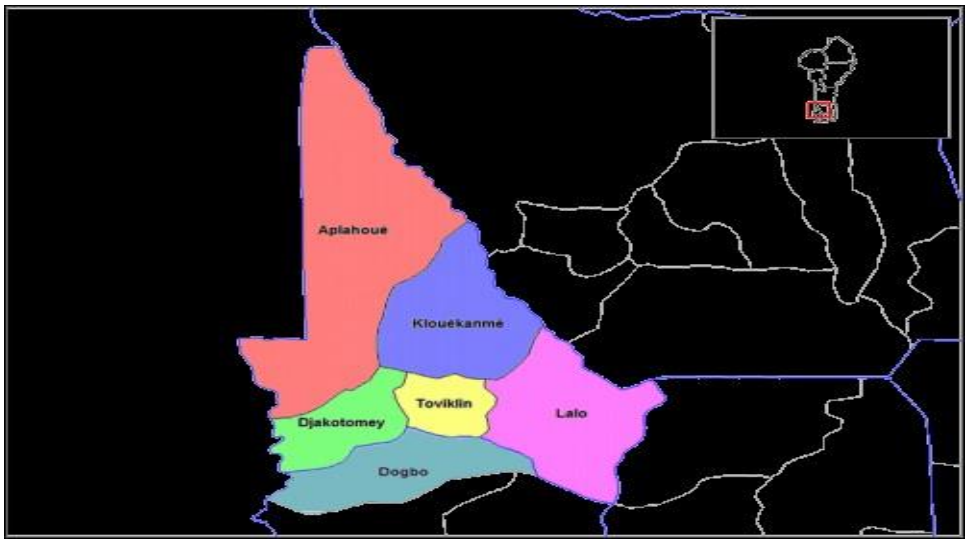

Figure 1: Map of Republic of Benin showing the six districts surveyed in Couffo department.

2.2. Collection of the plant leaves

The leaves of the six plants were collected in their predilection areas in Couffo department (Figure 2).

Figure 2: Trees which leaves were used.

2.3. Plant leaves extraction

We collected fresh green leaves of the six plants which were *Sida acuta* Burm F., *Eucalyptus globulus* Labill., *Anacardium* occidentale, *Allium sativum L.*, *Parkia biglobosa* and *Petroselinum crispum (Mill.*) Nyman and we washed them with tap water. The leaves were dried outside of the laboratory at ambient temperature in a class room for a period of 15 days. Then, the dried leaves were crushed or grounded into powder with an electronic mix and a weight of 25 grammes of the leaves powder of each plant was extracted with 500 milliliters of distilled water for a period of 72 hours. Each extract was then filtered with the aid of Whatman No.1 filter paper. Then, the mixture was dried at temperature of 49°C during 48hours and then stored in some labeled bottles for phytochemical screening analysis. The powder of each sample was used for qualitative analysis whereas the aqueous extract from each powder was used for quantitative analysis.

2.4. Phytochemical screening of crude aqueous extracts of test plants

The phytochemical screening analysis was performed through the qualitative analysis of the phytoconstituents. For that, crude aqueous extracts of all test plants were subjected to test the presence of major secondary metabolites following the procedures described by Houngton and Raman.[7] Regarding the qualitative analysis of the phytoconstituents, it was performed following the procedures described by Maïga *et al*.[8]

3. RESULTS

3.1. Quantitative phytochemical screening

Quantitative analysis was done through the measurement of the tenor of chemical components in the leaf extracts.

The table 1 showed the tenors in total polyphenolic, flavonoids and condensed tannins of the different aqueous extracts of the six samples used for the phytochemical screening.

Table 1: Tenors in total polyphenolic, flavonoids and condensed tannins of the different aqueous extracts.

Samples	Tenors in total polyphenolic (mg eqAG/g)	Tenors in flavonoids (mg eqQ/g)	Tenors in condensed tannins (µg eqAT/mg)
E. globulus	0,0250±0,003	1,9880±0,090**	0,0454±0,057
A.occidentale	0,1453±0,010*	2,5626±0,016***	0,3165±0,142
P. biglobosa	0,2105±0,010**	2,0693±0,006**	0,9035±0,325***
S. acuta	0,3584±0,035**	2,0253±0,002**	0,2124±0,109*
A. sativum	0,9550±0,007 ***	0,3311±0,007	0,2388±0,117*
P. crispum	0,1880±0,014*	0,6062±0,0006	0,0456±0,057

The analysis of table 1 showed that the aqueous extract of *A. sativum* had the highest tenor in total polyphenolic whereas the aqueous extract of *E. globulus* had the lowest tenor in total polyphenolic. Regarding the tenors in flavonoids, the aqueous extract of *A. occidentale* had the highest tenor whereas the aqueous extract of *A. sativum* had the lowest tenor in flavonoids. Regarding the tenors in condensed tannins, the aqueous extract of *P. biglobosa* had the highest tenor whereas the aqueous extract of *E. globulus* had the lowest tenor in condensed tannins.

The table 2 showed the extraction produce of different extracts of the samples

Table 2: Extraction produce.

Samples	Extraction produce in %	Aspects of extracts
E. globulus	7.74	Cristal
A. occidentale	3.55	Cristal
P. biglobosa	8.54	Cristal
S. acuta	7.46	Cristal
A. sativum	3.65	Paste or dough aspect
P. crispum	12.33	Paste or dough aspect

The analysis of table 2 showed that all the samples had cristal aspect except the samples of *A. sativum* et de *P. crispum* which had paste or dough aspect. In addition, the sample of *P. crispum* had the highest extraction produce whereas the sample of *A. occidentale* had the lowest extraction produce.

3.2. Qualitative phytochemical screening

The table 3 showed the results of the qualitative characterization of different phytochemical compounds containing in the powder of the six plant leaves.

Table 3: Qualitative evaluation of phytochemical compounds containing in the six plant leaves.

Phytochemical compounds	*E. globulus*	*A. occidentale*	*P. biglobosa*	*S. acuta*	*A. sativum*	*P. crispum*
Alcaloids	+	+	+	+	+	+
General tannins	+	+	+	+	+	+
Gallic tannins	+	+	+	+	+	-
Catechic tannins	-	-	-	-	+	+
Flavonoids	+	+	+	+	+	-
Anthocyans	+	-	+	-	+	+
Leuco-anthocyans	+	+	+	-	+	-
Cyanogenic derived	-	-	-	-	-	-
Quinonic derived	+	-	-	-	+	-
Saponins	-	+	+	+	+	+
Mucilages	+	+	+	+	+	+
Coumarins	+	-	-	+	-	-
Steroids	+	+	+	-	+	-
Triterpinoids	+	-	-	+	-	-
Reducer compounds	+	-	-	+	-	+
Free anthracenic	+	-	-	-	-	-
O-heterosids	-	-	-	-	-	-
C-heterosids	+	+	-	+	-	-
Cardiotonic derived	-	-	-	+	+	+

Legends: Presence (+), Absence (-)

The analysis of table 3 showed that the alkaloids and mucilages were present in all analyzed samples. Chemical compounds such as gallic tannins and flavonoids were also present in analyzed samples except the sample of *P. crispum*. Catechic tannins were present in the samples of *A. sativum* and *P. crispum.* The flavonoids present in powder samples of *E. globulus, A. occidentale, P. biglobosa, S. acuta* and *A. sativum* were those of flavons (orange color). Anthocyans and Leuco-anthocyans were present in the samples of *E. globulus, P. biglobosa* and *A. sativum.* Saponins were absent in the sample of *E. globulus*. Coumarins were present in the samples of *E. globulus* and *S. acuta*. Steroids were absent in the samples of *S. acuta* and *P. crispum.* Chemical compounds with high toxicity such as cyanogenic derived and O-heterosids were absent in all analyzed samples.

4. DISCUSSION

In the current study, the phytochemical screening analysis showed that the chemical compounds such as alkaloids, tannins, flavonoids, anthocyans, mucilages, coumarins, steroids, saponins which have potential insecticidal activities were present in the dry leaf powder extracts of the almost studied plants. In fact, a recent study carried out by Honvoh *et al*[9] on Comparison of larvicidal activities of ethanolic extract of six plants leaves which are *Sida acuta* Burm F. (Malvaceae), *Eucalyptus globulus* Labill. (Myrtaceae), *Anacardium* occidentale, *Allium sativum L.* (Amaryllidaceae), *Parkia biglobosa* (Mimosaceae) and *Petroselinum crispum (Mill.) Nyman ex A.W. Hill* (Apiaceae) leaves in malaria vector control in Couffo department in south-western Benin, West Africa, showed that among the six ethanolic extracts of plants leaves used in the study, ethanolic extract of *Allium sativum* L. leaves was the most effective on *Anopheles gambiae s.l.* larvae following by ethanolic extract of *Sida acuta* Burm F. leaves, following by ethanolic extract of *Parkia biglobosa* leaves, following by ethanolic extract of *Petroselinum crispum (Mill.)* Nyman *ex A.W. Hill* leaves, following by ethanolic extract of *Eucalyptus globulus* Labill leaves and following by ethanolic extract of *Anacardium* occidentale leaves. They were found to be effective against the larvae of *Anopheles gambiae* sensu lato in laboratory conditions.

Regarding the phytochemical screening analysis of leaf extract of *Sida acuta Burm* F, Senthilkumar *et al*[10] had studied in India the phytochemical screening of aqueous leaf extract of *Sida acuta Burm*. F and had shown that the leaves of this plant contained alkaloids, steriods, flavonoids, phenols, terpenoids and glycosides. In addition, another study carried out by Oluleye *et al*[11] on phytochemical screening of ethanolic leaf extracts of *Sida acuta* from

North-Central Nigeria showed the presence of alkaloids, saponins, tannins, flavonoids, phenols, glycosides and terpennoids.

Regarding the phytochemical screening analysis of leaf extract of *Eucalyptus globulus* Labill, Abirami *et al*[12] had studied in India the phytochemical screening of acetone extract of *Eucalyptus* globulus and had shown that the leaves of *Eucalyptus globules* contained alkaloids, flavonoids, phenols, tannins, quinones, glycosides, steroids, terpenoids and leucoanthocyanides as constituents.

Regarding the phytochemical screening analysis of leaf extract of *Anacardium* occidentale, Abulude *et al*[13] had studied the phytochemical screening of leaves and stem of cashew tree (*Anacardium* occidentate) and their results revealed the presence of alkaloids, tannins, flavonoids, glycosides, steroids and saponins either in High (+++), moderate (++) and low (+) concentrations.

Regarding the phytochemical screening analysis of leaf extract of *Allium sativum* L, Sherkar *et al*[14] had shown that the qualitative phytochemical screening of *Allium sativum* aqueous and ethanol extracts indicated the presence of alkaloids, terpenoids, flavonoids, steroids, phenol, anthraquinones, saponins, tannin and glycoside.

Regarding the phytochemical screening analysis of leaf extract of *Parkia biglobosa*, Abioye *et al*[15] had shown that phytochemical screening of the methanolic extract revealed the presence of alkaloids, tannins, saponins, flavonoids, steroids, glycoside and sugars.

Ended, regarding the phytochemical screening analysis of leaf extract of *Petroselinum crispum (Mill.) Nyman ex A.W. Hill*, Chauhan and Aishwarya[16] had shown that the aqueous extract of leaves and flowers of *Petroselinum crispum* contained steroids, alkaloids, tannins, saponins. terpenoids, steroids, and flavanodis,

5. CONCLUSION

The indigenous plants with proven mosquito control potential can be used as an alternative to synthetic insecticides under the integrated vector. However, further study is recommended to identify the active ingredient of aqueous extracts of both plants and their mode of action.

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