Research Article

Phytochemical Screening of *Artemisia annua* (Asteraceae) and *Carica papaya* Linn (Caricaceae) Leaves for Malaria Vector Control in Couffo Department in South-western Republic of Benin, West Africa

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Received: 05-03-2026; **Revised:** 26-05-2026; **Accepted:** 03-06-2026; **Published online:** 20-06-2026.

ABSTRACT

Background: 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.

Objective: The current study was aimed at investigating on phytochemical screening of two plant leaves for malaria vector control.

Materials & Methods: The leaves of two plants which were *Artemisia Annua* and *Carica Papaya* Linn were collected in their predilection areas in Couffo department in south-western Republic of Benin. Aqueous extracts of both plant leaves were done and the phytochemical screening analysis was performed through the quantitative and qualitative analysis of the phytoconstituents.

Results: The results showed that the aqueous extract of *A. annua* had the highest tenor in total polyphenolic, tenor in flavonoids and tenor in condensed tannins. Both samples had cristal aspect. In addition, the sample of *A. annua* had the highest extraction produce. The phytochemical screening analysis of the dry leaf powder extracts of both plants showed that these leaves contained secondary metabolites such as alkaloids, gallic tannins, anthocyans, saponins, mucilages, reducer compounds, flavonoids, coumarins and steroids.

Conclusion: Secondary metabolites present in the dry leaf powder extracts of the plants studied in the current study have potential insecticidal activities. However, further study is recommended to identify the active ingredient of aqueous extracts of both plant leaves and their mode of action.

Keywords: Phytochemical screening, *Artemisia annua, Carica papaya*, malaria, Benin.

INTRODUCTION

Globally, in 2023, the number of malaria cases was estimated at 263 million, with an incidence of 60.4 cases per 1000 population at risk. This is an increase of 11 million cases from the previous year and a rise in incidence from 58.6 cases per 1000 population at risk in 2022.

The WHO African Region continues to carry the heaviest burden of the disease, accounting for an estimated 94% of malaria cases worldwide in 2023. The WHO Eastern Mediterranean Region has experienced a 57% increase in incidence since 2021, rising to 17.9 cases per 1000 population at risk in 2023[1].

Globally, in 2023, the number of deaths was estimated at 597 000, with a mortality rate of 13.7 per 100 000. The number of malaria deaths and the mortality rate steadily decreased from 622 000 and 14.9 deaths per 100 000, respectively, in 2020. The WHO African Region continues to carry the heaviest burden of mortality, with 95% of estimated malaria deaths worldwide[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 two plant leaves for malaria vector control in Couffo department in south-western Republic of Benin, West Africa.

MATERIALS AND METHODS

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 two 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.

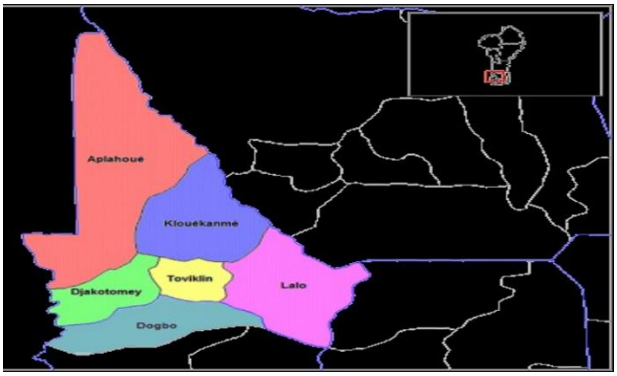

Figure 1: Map of Republic of Benin showing the six districts surveyed in Couffo department

Collection of the plant leaves

The leaves of both plants were collected in their predilection areas in Couffo department (Figure 2 and Figure 3)

Figure 2: Farm of *Artemisia annua*

Figure 3: Tree of *Carica papaya*

Plant leaves extraction

We collected fresh green leaves of the both plants which were *Artemisia Annua* and *Carica Papaya* Linn 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.

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 both studied 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].

RESULTS

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 both 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)
C. papaya	0,0350±0,003	1,0758±0,0007*	0,4587±0,186**
A. annua	0,2406±0,003**	1,2812±0,0008*	0,4919±0,196**

The analysis of table 1 showed that the aqueous extract of *A. annua* had the highest tenors in total polyphenolic, in flavonoids and 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
C. papaya	8.87	Cristal
A. annua	16.54	Cristal

The analysis of table 2 showed that both samples had cristal aspect. In addition, the sample of *A. annua* had the highest extraction produce.

Qualitative phytochemical screening

The table 3 showed the results of the qualitative characterization of different phytochemical compounds containing in the dry leaf powder of both plants.

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

Phytochemical compounds	*C. papaya*	*A. annua*
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 chemical compounds such as the alkaloids, gallic tannins, anthocyans, saponins, mucilages and reducer compounds were present in both analyzed samples. The flavonoids present in powder sample of *C. papaya* were those of flavons (orange color). Coumarins were present in the sample of *A. annua* whereas steroids were present in the sample of *C. papaya.* However, chemical compounds such as catechic tannins, leuco-anthocyans, free anthracenic and chemical compounds with high toxicity such as cyanogenic derived and O-heterosids were absent in both analyzed samples.

DISCUSSION

In the current study, the phytochemical screening analysis of aqueous extracts of both plant leaves showed that these leaves contained secondary metabolites such as alkaloids, gallic tannins, anthocyans, saponins, mucilages, reducer compounds, flavonoids, coumarins and steroids which contributed to the dead of larvae of *Anopheles gambiae* s.l.

The results obtained in the current study corroborated with those obtained by Ogbonna *et al*[9] who reported the presence of these phytochemical compounds in the leaves of *Artemisia annua* which conducted to high toxicity on larvae of *Anopheles gambiae*. In fact, in their study, these authors showed that the plant was found to contain alkaloids, flavonoids, glycosides, phenols, resins and tannins.

Artemisinin, a secondary metabolite which is essential for the production of antimalaria drugs was extracted from the plant. The plant was also found to contain oil (essential oil). The extracts were found to have lethal effects on the larvae, pupae and adult females of *A. gambiae*. A combination of the leaf and seed extracts was found to be more lethal than the singler effects of either of the extracts. The smoke from the burning dry leaves of the plant was found to have lethal and repellent effects on the mosquitoes. The volatile nature of the constituents of the leaf and seed extracts may have been responsible for their insecticidal actions.

In addition, Oladimeji *et al*[10] also had reported the presence of these phytochemical compounds in the leaves of *Carica papaya* which conducted to high toxicity on larvae of *Anopheles gambiae* sensu lato. In fact, in their study, these authors had investigated into the larvicidal potential of crude extracts of Nigerian plants carried out against the fourth instar larvae of *Anopheles gambiae* mosquito. The phytochemical screening revealed that both anthraquinones and cyanogenic glycosides were absent in *Carica papaya* organs. However, alkaloids, saponins, tannins, cardiac glycosides, terpenes and flavonoids were either present or absent. The larvicidal activity was concentration and incubation-time dependent. At 5% w/v (12 and 24h), only *Carica papaya* plant demonstrated remarkable larvicidal activity of 40% and 55%.

CONCLUSION

Secondary metabolites such alkaloids, gallic tannins, anthocyans, saponins, mucilages, reducer compounds, flavonoids, coumarins and steroids which have potential insecticidal activities are found in the powder extracts of the plant leaves studied in the current study. However, further study is recommended to identify the active ingredient of aqueous extracts of both plant leaves and their mode of action.

Source of Support: The author received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest: The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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