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RESEARCH ARTICLE

IMPACT OF PHYSICOCHEMICAL PARAMETERS IN THE DEVELOPMENT OF *Culex quinquefasciatus Say* LARVAE IN THEIR BREEDING SITES IN MONO AND COUFFO DEPARTMENTS IN SOUTH-WESTERN REPUBLIC OF BENIN, WEST AFRICA

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Abstract

Background and Aims: Lymphatic filariasis is a disease of great public health importance. The current study aims to establish the correlation between the presence of physicochemical parameters in breeding sites of *Culex quinquefasciatus* and the larval development.
Methods: *Culex quinquefasciatus* mosquito larvae were collected from September to November 2024 during the small rainy season and from March to July 2025 during the great rainy season in two districts of Mono department which were Lokossa and Comè and in two districts of Couffo department which were Dogbo and Djakotomey. Then, the measurements of physicochemical parameters in breeding sites were done in laboratory using a spectrophotometer DR5000. The other methods employed were: Thermometric, Potentiometric, and Electrical conductometric.
Results: The results showed that the breeding sites with higher physicochemical parameters such as: conductivity, total dissolve solids, total hardness, dissolved oxygen and alkalinity conferred the development to *Culex quinquefasciatus* larvae. However, there was a negative correlation between some parameters such as Turbidity and Salinity and *Culex quinquefasciatus* larval development. Different ions such as Ammonia, Calcium, Magnesium, Iron and Total Phosphate were present in *Culex quinquefasciatus* larval habitats and served as nutrient composition to the larvae.
Conclusion: The breeding sites of *Culex quinquefasciatus* are influenced by many physicochemical parameters and there is a relationship between the presence of physicochemical parameters in *Culex quinquefasciatus* breeding sites and the development of these mosquito larvae.
Keywords: Benin, *Culex quinquefasciatus*, larval development, physicochemical parameters.

INTRODUCTION

Mosquitoes bite and noise nuisance have contributed to the cause of sleeplessness and disease transmission, thus seen as public enemies[1]. Many species of mosquitoes transmit animal diseases like heart worm diseases of dogs, the fowl pox of poultry, rift-valley of fever of sheep and myxomatosis of rabbit[2]. Mosquitoes of the *Culex pipiens* complex require a wide range of habitats with varying breeding water parameters to complete their lifecycles. The physicochemical parameters of mosquito breeding habitats are determined by the underlying rocks and microclimate[3]. Urbanization, industrialization, and human activities can also change water systems, resulting in varied physicochemical characteristics of water ecosystems[3]. Physicochemical parameters such as temperature, turbidity, conductivity, and pH have significant

influence on mosquito larval abundance[4]. Natural or artificial collection of water serves as an optimum habitat that supports their production, oviposition, and emergence, while savannah, grasslands or shady low woodlands supports their resting activities, swarming and mating[5].

Very few researches were published on the impact of physicochemical parameters in the development of *C. quinquefasciatus* larvae in Republic of Benin. Therefore, there is a need to carry out new researches for this purpose. The goal of the current study is to investigate on the environmental physicochemical parameters in breeding sites of *C. quinquefasciatus* mosquito larvae influencing their development.

MATERIALS AND METHODS

Study area

The study area is located in Republic of Benin (West Africa) and includes the departments of Mono and Couffo. Mono department is located in the south-western Benin and the study was carried out more precisely in Lokossa and Comè districts. Regarding Couffo department, it is also located in the south-western Benin and the study was carried out more precisely in Dogbo and Djakotomey. 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 evaluate the impact of physicochemical parameters in the development of *C. quinquefasciatus Say* larvae in their breeding sites in Mono and Couffo departments in south-western Republic of Benin. Mono and Couffo have 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.

Mosquito sampling

C. quinquefasciatus mosquitoes were collected from September to November 2024 during the small rainy season and from March to July 2025 during the great rainy season in two districts of Mono department (Lokossa and Comè) and in two districts of Couffo department (Dogbo and Djakotomey). Larvae were collected from breeding sites using the dipping method and kept in labeled bottles. The samples were then carried out to the Department of Sciences and Agricultural Techniques in Normal High School of Technical Teaching (ENSET) of Lokossa located in Dogbo district.

Measurements of physicochemical parameters in breeding sites of *C. quinquefasciatus*

The measurements of physicochemical parameters in breeding sites of *C. quinquefasciatus* were done using spectrophotometer DR 5000. The other methods employed were: thermometric, potentiometric, electrical conductometric, ethylene diamine tetra-acetic acid and so on. The measurements of physico-chemical parameters were done in Laboratory of Applied Hydrology (LHA) at National Institute of Water (INE) in University of Abomey-Calavi (UAC). A total of nineteen (19) physicochemical parameters were measured in the water of the breeding sites of *C. quinquefasciatus* larvae. Parameters measured were temperature, hydrogen potential, conductivity, total dissolve solids, total hardness, dissolved oxygen, alkalinity, turbidity, salinity, nitrate, ammonia, calcium, magnesium, iron, chloride, total phosphate, sulphate, zinc and cadmium.

Statistical Analysis

Data collected in the current study were analyzed using SPSS software (version 10 for windows, SPSS inc. Chicago, IL) and Analysis of variance (ANOVA) was used as test statistics.

RESULTS

A total of nine (09) physicochemical parameters (which are not ions) were measured in the water of the breeding sites of *C. quinquefasciatus* larvae and the results obtained were showed in Table 1. The analysis of Table 1 showed that the values of physicochemical parameters (which are not ions) obtained in water contained *C. quinquefasciatus* larvae such as hydrogen potential, conductivity, total dissolve solids, total hardness, dissolved oxygen and alkalinity were superior to those obtained in water without *C. quinquefasciatus* larvae whereas the values of physicochemical parameters (which are not ions) obtained in water contained *C. quinquefasciatus* larvae such as temperature, turbidity and salinity were inferior to those obtained in water without *C. quinquefasciatus* larvae.

Table 1: **Influence of physicochemical parameters (which are not ions) in the development of *C. quinquefasciatus* larvae collected in their breeding sites.**

Parameters	Units	Symbols	Values obtained in water contained *C. quinquefasciatus* larvae	Values obtained in water without *C. quinquefasciatus* larvae
Temperature	°C	T	25.8	26.35
Hydrogen potential	-	pH	8.80	8.3
Conductivity	µS/cm	C	1497	< 900
Total dissolve solids	mg/L	TDS	748	561.9
Total hardness	mg/L	TH	659.959	312.8
Dissolved oxygen	mg/L	O2	1.80	0.30
Alkalinity	mg/L	HCO^{3-}	854.24	275.2
Turbidity	FTU	-	14	> 15
Salinity	%	-	0.07	0.225

Table 2: **Influence of physicochemical parameters (ions) in the development of *C. quinquefasciatus* larvae collected in their breeding sites.**

Parameters	Units	Symbols	Values obtained in water contained *C. quinquefasciatus* larvae	Values obtained in water without *C. quinquefasciatus* larvae
Nitrate	mg/L	NO^{3-}	<0.001	4.44
Ammonia	mg/L	NH^{4+}	4.848	<0.1
Calcium	mg/L	Ca^{2+}	249.93	<100
Magnesium	mg/L	Mg^{2+}	8.714	<5
Iron	mg/L	Fe	2.178	<2
Chloride	mg/L	Cl_2	0	0
Total Phosphate	mg/L	Pt	5.266	>2 (very pollued)
Sulphate	mg/L	SO_4^{2-}	5.173	>250
Zinc	mg/L	Zn	0.2312	0.1
Cadmium	mg/L	Cd	0.0091	0.000

A total of ten (10) physicochemical parameters (ions) were measured in the water of the breeding sites of *C. quinquefasciatus* larvae and the results obtained were showed in Table 2. The analysis of Table 2 shows the values of physicochemical parameters (ions) obtained in water contained *C. quinquefasciatus* larvae such as ammonia, calcium, magnesium, iron, total phosphate, sulphate, zinc and cadmium were superior to those obtained in water without *C. quinquefasciatus* larvae whereas the value of physicochemical parameter (ion) obtained in water contained *C. quinquefasciatus* larvae such as Nitrate was inferior to that obtained in water without *C. quinquefasciatus* larvae.

DISCUSSION

In the current study, the values of physicochemical parameters (which are not ions) obtained in water contained *C. quinquefasciatus* larvae such as hydrogen potential, conductivity, total dissolve solids, total hardness, dissolved oxygen and alkalinity were superior to those obtained in water without *C. quinquefasciatus* larvae whereas the values of physicochemical parameters (which are not ions) obtained in water contained *C. quinquefasciatus* larvae such as Temperature, Turbidity and Salinity were inferior to those obtained in water without *C. quinquefasciatus* larvae. Regarding the values of physicochemical parameters (ions) obtained in water contained *C. quinquefasciatus* larvae such as ammonia, calcium, magnesium, iron, total phosphate, sulphate, zinc and cadmium, they were superior to those obtained in water without *C. quinquefasciatus* larvae whereas the value of physicochemical parameter (ion) obtained in water contained *C. quinquefasciatus* larvae such as nitrate was inferior to that obtained in water without *C. quinquefasciatus* larvae. These results showed that the breeding sites with higher physicochemical parameters such as: conductivity, total dissolve solids, total hardness, dissolved oxygen and alkalinity conferred the development to *C. quinquefasciatus* larvae. However, there was a negative correlation between some parameters such as turbidity and salinity and *C. quinquefasciatus* larval development. Our results corroborated with those obtained in Nigeria by Auta *et al*[6]., who had shown that the physico-chemical parameters were associated with mosquito abundance in breeding sites of selected locations within three local government area of Kaduna state, Nigeria. So, prevailing physicochemical parameters in mosquito aquatic habitats for breeding are important factors for survival and development of mosquito. Another recent study carried out by Mbanzulu *et al*[7]., also showed that the Aedes breeding sites and mosquito density were significantly influenced by some physicochemical parameters.

Different ions such as ammonia, calcium, magnesium, iron and total phosphate were present in *C. quinquefasciatus* larval habitats and served as nutrient composition to the larvae. Our results corroborated with those obtained by Amao *et al*[8]., who had established the correlation between physicochemical parameters and larval abundance of *C. quinquefasciatus* Say in Lagos State, Nigeria. Their study revealed that *C. pipiens quinquefasciatus* is the most dominant and only member of the *C. pipiens* complex. In addition, Ammonia and sulfate have a significant impact on the abundance of *C. quinquefasciatus* immature stages. Another study carried out by Lawal *et al*[9]., had also shown that some physicochemical parameters including ions may be considered in larval mosquito control strategy in the Northwest Nigeria. In fact, **t**heir study provides information on mosquito breeding sites in relation to physicochemical parameters.

Limitations of the study

Only two departments on twelve departments of Republic of Benin concerned the current study. More departments and more physicochemical parameters will be taken into account with different mosquito's species in future studies.

CONCLUSION

The breeding sites of *C. quinquefasciatus* are influenced by many physicochemical parameters and there is a relationship between the presence of physicochemical parameters in *C. quinquefasciatus* breeding sites and the development of these mosquito larvae.

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AUTHOR'S CONTRIBUTIONS

Aïzoun LN: investigation, formal analysis, writing original draft. **Hounkpatin ASY:** validation, methodology, writing-reviewing. **Tamègnon MH:** methodology, writing-reviewing. **Adjatin RAF:** validation, methodology. **Chougourou CD:** supervision, review and editing. Final manuscript was checked and approved by all authors.

DATA AVAILABILITY

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

CONFLICT OF INTEREST

There are no conflicts of interest in regard to this project.

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