*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*
*e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 19, Issue 12 Ser. 1 (December 2025), PP 67-71*
*www.iosrjournals.org*

# Assessment Of The Level Of Contamination Of Water And Oysters (Crassostrea Rhizophorae) With Pesticide Residues In Aquatic Ecosystems In Southern Benin.

Jules Hounsa[1], Armelle Sabine Yélignan Hounkpatin[1,2*], Amoussatou Sakirigui[3], Bernard Segnibo[1] Dossou Armel Géraldo Houndeton[1], Agbahoungba Hospice[1]

*[1] Pluridisciplinary Research Laboratory For Technical Education (LARPET), University Of Sciences, Technologies, Engineering And Mathematics Of Abomey (UNSTIM), Benin.*
*[2] Laboratory Of Hygiene, Sanitation, Toxicology And Environmental Health (HECOTES), Interfaculty Center For Training And Research In The Environment For Sustainable Development (CIFRED), University Of Abomey-Calavi, Benin.*
*3Kaba Research Laboratory In Chemistry And Applications (Lakreca), University Of Technical Sciences, Engineering And Mathematics (UNSTIM), Republic Of Benin*

***Abstract:***
***Background****: In Benin, poor farming practices pose significant health and environmental risks, particularly to aquatic ecosystems. The aim of this study is to assess the level of pesticide contamination in water and oysters in southern Benin. To carry out the study, samples of water and oysters (Crassostrea rhizophorae) were collected. Pesticide residue analysis was performed by gas chromatography at the Ghana Standards Authority (GSA) laboratory in Ghana. The data were processed using R 3.6 software. The results of the chromatographic analysis showed that the Environmental Quality Standard (EQS) had been exceeded. The levels of atrazine (0.7 µg/L) and DDT (1.50 µg/L) in the water were higher than the EQS (0.6 µg/L; 1 µg/L). In the case of oysters, the active ingredient levels are well below the Maximum Residue Limit. The analytical results therefore confirm that the water in aquatic ecosystems in southern Benin contains pesticide residues that exceed Environmental Quality Standards, unlike oysters, which contain only trace amounts. Monitoring of these ecosystems is therefore necessary*

***Key Word:*** *Intrathecal; Bupivacaine; Buprenorphine; Nalbuphine; Postoperative analgesia*

---

Date of Submission: 01-12-2025 Date of Acceptance: 11-12-2025

---

## I. Introduction

The water bodies of southern Benin are of great ecological and socioeconomic importance for the country and the subregion (Tossou, 2000; Hounsou, 2012). These aquatic ecosystems contribute to food security and represent a source of income for the majority of riverside populations (Orou Piami et al., 2022). They are involved in ecosystem services such as fishing, agriculture, aquaculture, river transport, cultural activities, and biodiversity protection. However, human activities such as intensive agriculture involving the use of chemical fertilizers and synthetic pesticides without knowledge or respect for recommended doses and precautions for use threaten their sustainability (Yehouenou et al. 2014; Adjovi et al., 2024). Indeed, intensive agricultural practices aim to meet the increased demand of populations.

Initially designed to prevent yield losses, the use of pesticides has nevertheless introduced new challenges and complications (Atlas des pesticides 2023). Pesticides are regularly implicated in the sustainability of ecosystem services and the decline in biodiversity (Compaore et al. 2019). While pesticides have promoted good agricultural yields, ensuring food security, their excessive use also impacts both the environment and health (Soro et al. 2019).

The active substances in pesticides and the molecules resulting from their degradation are found in all ecosystems, particularly in water and fish species (Adjagodo et al. 2016). Oysters, which are widely consumed by the population, offer remarkable nutritional benefits. According to Agadjihouede et al. (2017), oysters contain approximately  of high-quality protein and are low in calories, at aroundkcal. They are notably rich in essential minerals, particularly zinc (up to 45 mg/100g), iron, calcium, and magnesium, as well as vitamins B12, A, C, D, and omega-3 fatty acids A). These nutrients help boost the immune system, improve cardiovascular health, and reduce inflammation (Tu et al. 2024)

As a bioindicator of pollution, it is necessary to assess the quality of oysters. The species *Crassostrea rhizophorae*, which is most commonly consumed by the population, has not been studied for pesticides and heavy metals in order to protect consumers. It is in this context that this research aims to evaluate the level of pesticide contamination in water and oysters in southern Benin.

## II. Material And Methods

**Study environment**

The study area is the lower part of the Ouémé River in southern Benin, specifically the departments of Ouémé, Littoral, and Atlantic. It was chosen because it is the largest basin and because of its main sources of pollution (high agricultural production and numerous industrial discharges). Figure 1 illustrates the study area.

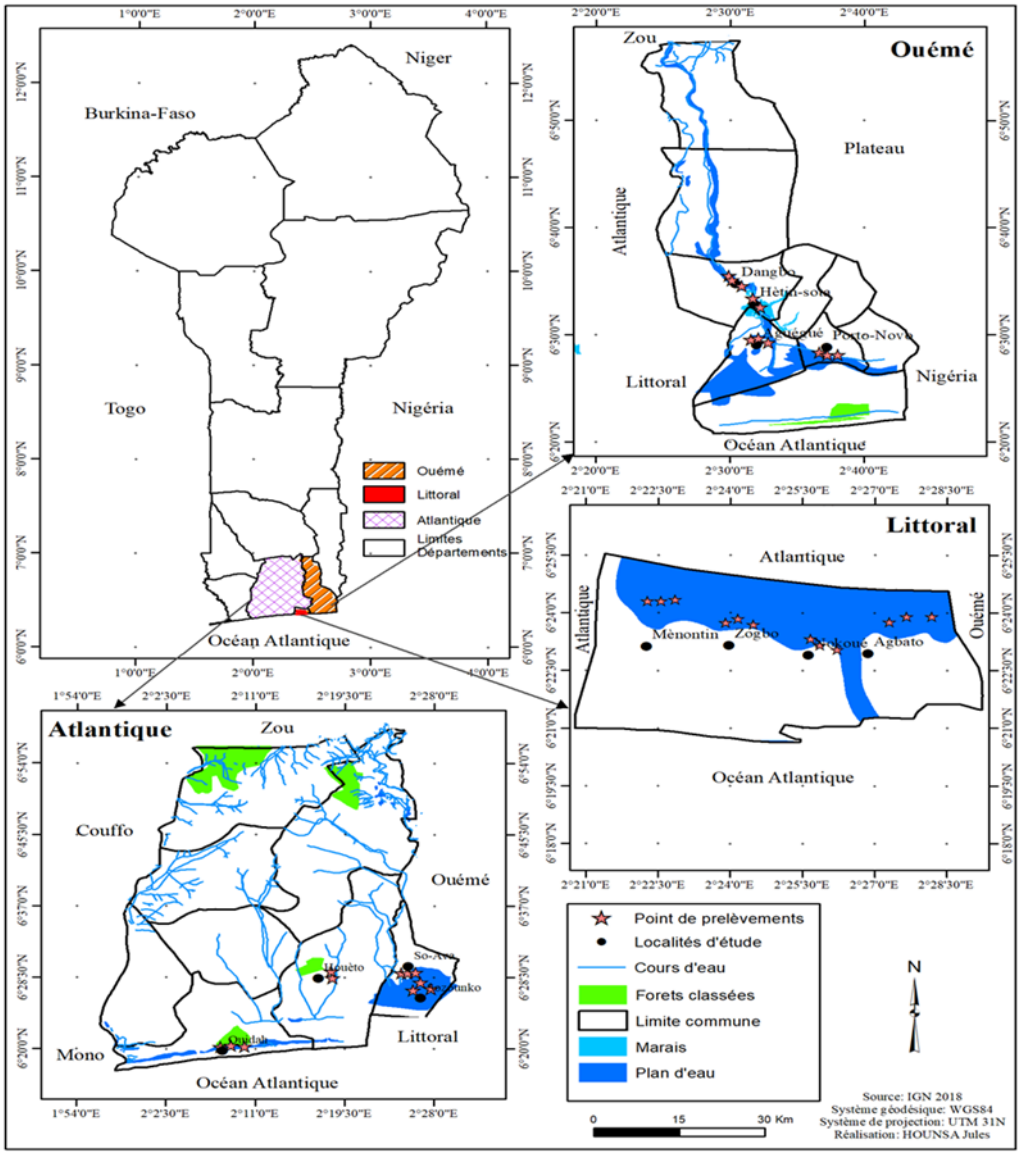


**Figure 1 :** Study area and sampling sites for water, sediment, and oyster samples

**Sampling**

This study focused on two components of the environment: water and oysters (Crassostrea rhizophorae). Samples were collected using a canoe. A total of 72 samples were collected (36 water samples and 36 oyster samples). The 36 samples per matrix were distributed as follows: 12 samples per department, with three samples taken per site at each of the four sites. Taking into account the three departments (Atlantic, Littoral, and Ouémé), 36 samples from each matrix were analyzed. At each site, each sample was labeled and stored at 4°C with ice packs in a cooler before being transported to the laboratory for heavy metal testing (lead, cadmium, and mercury). in a cooler before being transported to the laboratory for heavy metal testing (lead, cadmium, and mercury).

The analysis of water and oyster (*Crassostrea rhizophorae*) samples was carried out at the Ghana Standards Authority (GSA) laboratory in Accra, Ghana, using Varian CP-3800 GC-ECD gas chromatography, combined with CombiPAL sample changer.

## III. Result

**Quantification of pesticide residue levels in water and oyster samples**

In the laboratory, thirty (30) active pesticide substances were tested for, including Aldrin, Abamectin, Acetamiprid, Atrazine, Buthachlor, Chlordane-gamma, Lambda-Cyhalothrin, DDD, DDT, Cypermethrin, Chlorpyrifos-ethyl, Emamectin, Deltamethrin, Dieldrin, Endosulfan, Endrin, Imazethapyr, Fenthion, Glyphosate, Heptachlor, Isopropalamine, Lindane, Malathion, Monocozeb, Nicosulfuron, Oxyfluorfen, Parathion, Pendimethalin, Permethrin, and Propisochlor. These substances belong to the large families of organochlorine pesticides, synthetic pyrethroids, and organophosphates.

**Quantification of pesticide residue levels in water samples**

**Table I:** Average pesticide residue levels in water by site

| | Parameters | Departments | | | P |
|---|---|---|---|---|---|
| | | Atlantic | Littoral | Ouémé | |
| Oyster (mg/kg) | Acétamipride | - | 0,0433$^{a}$±0,0010 | 0,0052$^{b}$±0,0005 | 0,001 |
| | Atrazine | - | 0,0022±0,0003 | 0,0026±0,0002 | 0,308 |
| | Aldrine | - | 0,0015$^{a}$±0,0002 | 0,0031$^{b}$±0,0002 | 0,002 |

a, b et c : the averages assigned to different letters are significantly different at the threshold of 5%.

Analysis of water data shows that out of thirty (30) active pesticide ingredients tested for, three (03) were actually detected, namely: Atrazine, Aldrin, and DDT. Thus, in Ouémé, the Aldrin content of the water (0.0493 µg/L) is significantly higher than that observed in Littoral (0.0355 µg/L) and Atlantic (0.0148 µg/L). However, the DDT content of water samples from the Atlantic is significantly lower (0.0503 µg/L) than those from the Littoral and Ouémé (2.2380 µg/L and 2.2070 µg/L, respectively).

The variations in active ingredient content in the water in the departments indicate differentiated pollution of aquatic environments. Ouémé stood out for its high concentrations of aldrin and DDT, reflecting persistent agricultural pressure. Littoral also has high levels, particularly of DDT, while Atlantic remains less contaminated overall.

**Quantification of pesticide residue levels in oyster samples**

**Table II** shows the quantification of pesticide residue levels in sediments

| | Parameters | Departments | | | P |
|---|---|---|---|---|---|
| | | Atlantic | Littoral | Ouémé | |
| Water (µg/L) | Atrazine | 0,5920±0.0878 | 0,7163±0,0404 | 0,7498±0,0425 | 0,212 |
| | Aldrine | 0,0148$^{c}$±0,0028 | 0,0355$^{b}$±0,0023 | 0,0493$^{a}$±0,0031 | 0,001 |
| | DDT | 0,0503$^{b}$±0,0233 | 2,2380$^{a}$±0,171 | 2,2070$^{a}$±0,3700 | 0,001 |

a, b, and c: averages marked with different letters are significantly different at the 5% threshold.

Analysis of the data shows that the Atlantic department had no significant effect on the parameters studied. The concentration of acetamiprid is low in Ouémé (0.0052 mg/kg) and in Littoral (0.0433 mg/kg). However, for Aldrin and Atrazine, the levels are higher (0.0031 mg/kg and 0.0026 mg/kg respectively) in Ouémé than in Littoral (0.0015 mg/kg and 0.0022 mg/kg).

These results mean that oysters from the Atlantic department are not contaminated with the pesticide residues studied, while the high levels of acetamiprid in the Littoral department reflect contamination. The higher levels of aldrin and atrazine in the Ouémé department indicate pollution.

**Comparison of pesticide residue contamination levels in water, sediment, and oyster samples with regulatory standards**

Comparison of pesticide residue contamination levels in water samples with the Environmental Quality Standard (EQS)

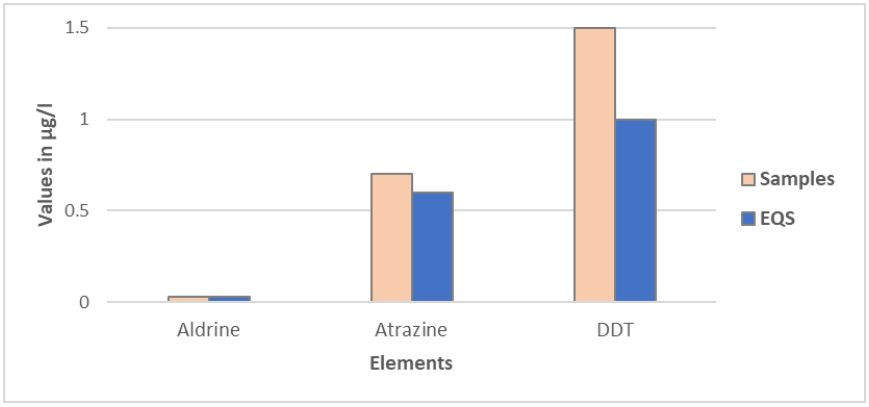


***Figure 1:*** *Comparison of pesticide residue contamination levels in water samples at the EQS*

Analysis of Figure 1 indicates that the levels of Atrazine and DDT in water (0.7 µg/L and 1.5 µg/L respectively) are significantly higher than the EQS (0.6 µg/L and 0.001 µg/L for Atrazine and DDT). Thus, the Atrazine content is approximately 1.17 times higher than the standard, and the DDT content is 1.5 times higher than the standard. This indicates a potential risk to ecosystems and, indirectly, to human health. However, the Aldrin content in water (0.03 µg/L) is similar to the Environmental Quality Standard (EQS).

**Comparison of pesticide residue contamination levels in oyster samples with Maximum Residue Limits (MRL)**

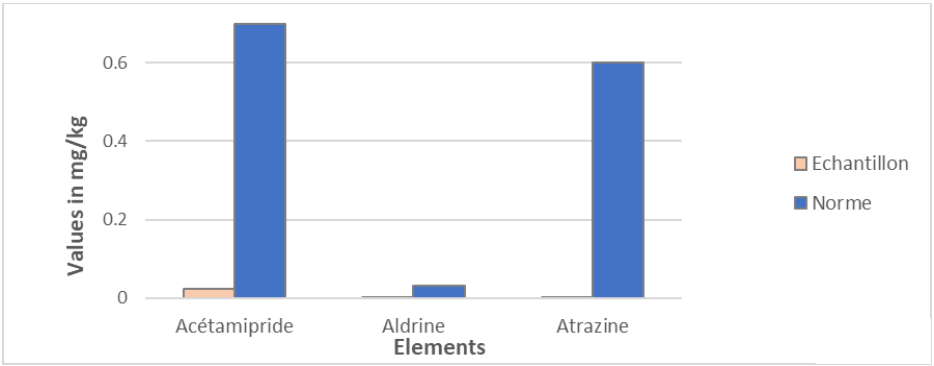


**Figure 2** : Comparison of pesticide residue contamination levels in oyster samples with MRL

Analysis of Figure 2 shows that the respective values of 0.024 mg/kg, 0.003 mg/kg, and 0.0023 mg/kg for the various active substances acetamiprid, aldrin, and atrazine are significantly lower than the MRLs (0.7 mg/kg, 0.03 mg/kg, and 0.6 mg/kg). These low levels limit the health risk but indicate diffuse pollution that needs to be monitored, as the presence of these residues remains a sign of environmental and health pollution.

## IV. Discussion

Analysis of the results obtained for water and oysters showed significant concentrations of pesticide residues, sometimes exceeding the standards recommended by NQE and MRL. For water, the measured concentrations of atrazine (0.7 µg/L) and DDT (1.50 µg/L) exceed the NQE standard (0.6 µg/L) and (1 µg/L), respectively. This indicates contamination of the water with atrazine and DDT. These atrazine values are higher than those reported by Yehouenou et al. (2014), which indicate water levels ranging from 0.05 to 0.475 µg/L in the Ouémé. This excess concentration could be explained by high agricultural activity year after year. The concentration of aldrin (0.04 µg/L) recorded is also slightly above the EQS (0.03 µg/L). Although this value is close to the regulatory limit, continuous monitoring is necessary.

As for oysters, the results obtained showed concentrations of acetamiprid (0.024 mg/kg), aldrin (0.003 mg/kg), and atrazine (0.0023 mg/kg) below the standards (0.7 mg/kg, 0.03 mg/kg, and 0.6 mg/kg, respectively). This means that the oysters are not contaminated. These results are similar to those of Pazou et al. (2006), who identified low levels of pesticide residues in fish from the Ouémé River. Although the study concluded that the levels were low, the persistence of these active pesticide ingredients in the aquatic environment and their bioaccumulation in the food chain could affect consumer health in the long term. Exposure leads to cognitive disorders and cancer and Neurotoxicity (Alavanja et al., 2024).

## V. Conclusion

The analytical results confirmed that the water in aquatic ecosystems contains pesticide residues that exceed Environmental Quality Standards, unlike those in oysters. Atrazine and DDT are the most concentrated active substances in the water. In oysters, all active substances (acetamiprid, aldrin, and atrazine) detected are in low concentrations compared to the Maximum Residue Limit.

## References


[1]. Adjagodo A, Agassounon Djikpo Tchibozo M, Kelome NC, Lawani R. Flux Of Pollutants, Linked To Anthropogenic Activities, Risks To Surface Water Resources And The Food Chain Around, The World: Bibliographic Review. Int J Biol Chem Sci. 2016, 10 (3):1459.

[2]. Adjovi ISM., Adjovi CYS., Ayi-Fanou L., Ayandji P, Et Sanni A. Les Pratiques D'utilisation Des Pesticides Par Les Maraichers Au Bénin : Perspectives Sociologiques, Global Journal Of Arts, Humanities And Social Sciences, 2020, 8 (2). 22-45.

[3]. Alavanja MCR, Hoppin J A, Kamel F. Health Effects Of Chronic Pesticide Exposure: Cancer And Neurotoxicity. Annual Review Of Public Health. 2024, 25:155-197.

[4]. Atlas Des Pesticides, Böll-Stiftung Paris H,La Fabrique Écologique. 2023, 66p.

[5]. Agadjihouede H, Akele DG, Gougbedji AUM, Laleye PA. Exploitation De L'huître Des Mangroves Crassostrea Gasar Dans Le Lac Nokoué Au Bénin. Eur Sci J ESJ. European Scientific Journal, ESJ, 13(12), 352.

[6]. Compaore H, Ilboudo S, Nati ADB, Dama MMB. Health Risks Associated With Pesticide Use In The Low-Lying Rice Fields Of The Commune Of

[7]. Hounsou M, Agbossou E, Ahamide B, Akponikpe I. Bacteriological Quality Of Water In The Ouémé Basin: Total And Fecal Coliforms In The Okpara, Djougou, And Savalou Reservoirs In Benin. Int J Biol Chem Sci. 2010 4, 377-390. Https://Doi.Org/10.4314/Ijbcs.V4i2.58128

[8]. Pazou E, Boko M, Vangestel C, Ahissou H, Laleye P, Akpona S. Organochlorine And Organophosphorous Pesticide Residues In The Ouémé River Catchment In The Republic Of Benin. Environ Int. 2006 (32): 616-623

[9]. Orou Piami Z, Akodogbo H, Gnohossou MP, Abahi KS, H S Sanni Worogo. Effect Of Drying On The Diversity Of Benthic Macroinvertebrates In Tributary Streams Of The Sota River In North-Eastern Benin. Bulletin De La Recherche Agronomique Du Bénin, 2022, 105-116.

[10]. Soro G, Koffi GM, Kone B, Kouakou YE. Utilisation De Produits Phytosanitaires Dans Le Maraîchage Autour Du Barrage D'alimentation En Eau Potable De La Ville De Korhogo (Nord De La Côte d'Ivoire): Risques Pour La Santé Publique. Env Risque Sante. 2018, 17 (2) 55-63. DOI:10.1684/Ers.2018.1147

[11]. Tossou S. Impact Du Trafic Des Produits Pétroliers Sur Les Écosystèmes Lacustres : Cas Du Lac Nokoué Et De La Lagune De Cotonou (Bénin). Mémoire De DEA En Gestion De L'environnement FLASH / Université d'Abomey-Calavi, 2000 132 P.

[12]. Tu Z, Yang J And Fan C. The Role Of Different Nutrients In The Prevention And Treatment Of Cardiovascular Diseases. Front. Immunol. 2024 (15) 1-15

[13]. Tu Z, Yang J And Fan C (2024) The Role Of Different Nutrients In The Prevention And Treatment Of Cardiovascular Diseases.

[14]. Tu Z, Yang J And Fan C (2024) The Role Ofdifferent Nutrients In The Prevention Andtreatment Of Cardiovascular Diseases.

[15]. Yehouenou A. Pazou E, Aléodjrodo PE, Azehoun JP, Van Straalen NM, Van Hattum B, Swart K, Pesticide Residues In Sediments And Aquatic Species In Lake Nokoué And Cotonou Lagoon In The Republic Of Benin. Environ Monit Assess. 2014 186(1):77–86. Available From: Http://Link.Springer.Com/10.1007/S10661-013-3357-2