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Physico-chemical water quality of the coastal lagoon of Benin *in Crassostrea tulipa* oyster farming areas.

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ABSTRACT

Objective: This study aims to assess the physico-chemical quality of the coastal lagoon waters of Benin in areas dedicated to the farming of *Crassostrea tulipa* oysters.

Methodology and Results: Physico-chemical parameters were measured on a monthly basis over a full annual cycle from January to December 2023, both . in situ (temperature, salinity, dissolved oxygen, pH, and water transparency) and in the laboratory (nitrites, nitrates, ammonium, and orthophosphates), within the oyster farming zones. The results showed that all evaluated parameters varied significantly across months and between farming zones, except for nitrites, ammonium, and dissolved oxygen, which did not show significant spatial variation. The Organic Pollution Index (OPI) calculated for the three oyster farming sites revealed moderate organic pollution levels in all zones (3.33 at Ahouandji and Djondji, and 3.67 at Dégouè on a 5-point scale).

Conclusions and Application of results: As the mangrove oyster (*C. tulipa*) is a highly valuable fishery resource in the Gulf of Guinea region, it is important to regularly monitor the physicochemical quality of the water in oyster production areas. Even slight variations in certain water parameters can greatly affect the reproduction and growth of these bivalve molluscs (oysters), as well as the quality of their flesh, which is consumed by coastal populations. While the values recorded for all physicochemical parameters generally remained within the tolerance ranges for *C. tulipa* oysters during the study period, indicating that the coastal lagoon offers environmental conditions conducive to oyster farming in Benin, moderate organic pollution shows that these oyster production areas are not pollution-free. In order to ensure sustainable, high-quality oyster production in Benin, it is necessary to implement specific measures for sustainable ecosystem management. These measures include regular monitoring of water quality, regulation of wastewater discharges and the use of organic and chemical fertilisers in the watershed, as well as community awareness programmes..

Keywords: Water quality, Physico-chemistry, Coastal lagoon, Oyster farming, *Crassostrea tulipa*.

INTRODUCTION

The lagoon and estuarine ecosystems of the Gulf of Guinea are characterized by a high diversity of aquatic species. They provide numerous ecosystem services to the coastal populations of the various countries in this region (Villanueva, 2004). Fishing in lagoon waters offers a wide range of fish, crustaceans, and molluscs, as these ecosystems serve as favorable habitats for the reproduction and growth of many aquatic species, both marine and freshwater. Despite their socio-economic importance, West African lagoons are increasingly subjected to anthropogenic pressures, primarily due to rapid urbanization along the coasts of various countries. In most countries in the region, cities considered economic and political hubs are predominantly located along the coastline and account for around half of each country's population (Gadal, 2011; Camara Monteiro, 2021; Agbemadon, 2024). Unfortunately, most coastal countries in West Africa lack effective waste management systems. Consequently, much of the urban waste is discharged into the environment without prior treatment and often ends up in surrounding aquatic ecosystems (Davies-Vollum *et al*., 2024). Human activities have a significant impact on the physicochemical characteristics of lagoon waters, resulting in major ecological disturbances such as nutrient enrichment, the proliferation of unwanted algal blooms and a decline in species diversity in aquatic ecosystems (Bricker *et al*., 2007; Zaldívar *et al*., 2008). Benin is no exception to this trend. Although its coastal lagoon system is of significant ecological and socio-economic importance, it is under increasing pressure from human activities, particularly urbanization, intensive agriculture and the discharge of unprocessed domestic and industrial waste (Agbossou *et al*., 2012; Hounkpe *et al*., 2017). The lagoon is known to provide favorable conditions for the growth of the oyster *Crassostrea tulipa* (Adité *et al*., 2013; Adité *et al*., 2021), a species that is widely consumed by local communities. However, the lagoon is exposed to various pollution pressures, including the discharge of untreated household wastewater, fertilizer- and pesticide-enriched agricultural runoff, and the persistent accumulation of plastic debris and organic matter within the ecosystem (Akognongbe *et al*., 2014). In addition to pollution-related concerns, it is equally important to monitor the key physicochemical parameters of lagoon water, as variations in these parameters can have a significant impact on the reproductive success and growth performance of oysters. Studies have shown that temperature and salinity strongly interact to control oyster metabolism, reproduction, growth and survival (Sehlinger *et al*., 2019). Salinity stress also impacts energy reserves and the immune response, thereby altering the susceptibility of species such as *Crassostrea gigas* to pathogens (Fuhrmann *et al*., 2018). Furthermore, variations in salinity, temperature, pH, dissolved oxygen and food availability at different times and in different locations govern larval settlement and juvenile development in Crassostrea species (Sampaio *et al*., 2020; Funo *et al*., 2015). Recent modelling efforts also predict that warming, acidification and nutrient shifts will reduce oyster shell and tissue growth, highlighting the need for high-resolution monitoring (Czajka *et al*., 2025). Collectively, this evidence indicates that fluctuations in environmental variables can induce physiological stress, or conversely support optimal physiological functioning, depending on whether conditions remain within species-specific tolerance ranges. For *Crassostrea tulipa*, it is therefore essential to ensure that temperature, salinity, dissolved oxygen and nutrient concentrations stay within optimal thresholds for sustainable oyster farming. Consequently, monitoring these variables in traditional farming areas is crucial for predicting growth dynamics and informing adaptive management practices. Although some studies have examined the water quality of West African lagoon ecosystems (Chouti *et al*., 2017; Viaho *et al*., 2020), few have specifically focused on areas suitable for the farming of the oyster *Crassostrea tulipa.* This study therefore aims to assess the physico-chemical quality of waters in these traditional oyster farming zones, based on the monitoring of key environmental parameters.

MATERIALS AND METHODS

Study area: This study was conducted within the coastal lagoon system of the western estuarine complex of Benin. It is located between longitudes 1°48′ and 2°16′ East and latitudes 6°16′ and 6°20′ North, and covers an area of approximately 55 km². The lagoon stretches almost parallel to the Atlantic Ocean for about 60 km between Grand-Popo and Togbin. The Grand-Popo lagoon receives inflows from the Mono River and Lake Ahémé, and discharges into the sea via the 'Bouche du Roy' outlet near the Avlo-Plage village (Viaho *et al*., 2014). This aquatic ecosystem is of internationally recognized ecological importance and has been designated a Ramsar site (Site No. 1017). The area experiences a sub-equatorial climate characterized by two rainy seasons and two dry seasons. The main rainy season, which occurs first in the year, accounts for 40–60% and sometimes up to 75% of the annual rainfall. The second, shorter rainy season contributes approximately 18% to 30% of the total annual precipitation (Boko, 1992). During these periods, average monthly rainfall often exceeds 170 mm (Sinsin *et al*., 2018). The local vegetation is highly diverse, though it is dominated by mangrove species such as *Rhizophora racemosa* and *Avicennia africana*. These species are under pressure from human activities, particularly for domestic uses such as collecting firewood (Adité *et al*., 2013). The coastal lagoon is renowned for its rich biodiversity, as evidenced by the prevalence of fishing activities in the area (Sinsin *et al*., 2018). Communities settled along the lagoon, positioned between the Atlantic Ocean and the lagoon itself, rely primarily on fishing for their livelihoods. Notably, oyster harvesting and marketing are particularly intense in this region (Adité *et al*., 2021).

Sampling and analysis of coastal lagoon water quality: For the purposes of this study, the coastal lagoon was divided into three sectors, each of which corresponds to a key oyster (*C. tulipa*) Figure 1 production area. This division reflects the region's traditional oyster farming zones, namely the Ahouandji, Dégouè and Djondji production sites. Three sampling stations were identified within each of these zones (Figure 2), based on parameters such as biotope characteristics, the presence or absence of mangrove stands, and land use practices along the lagoon banks.

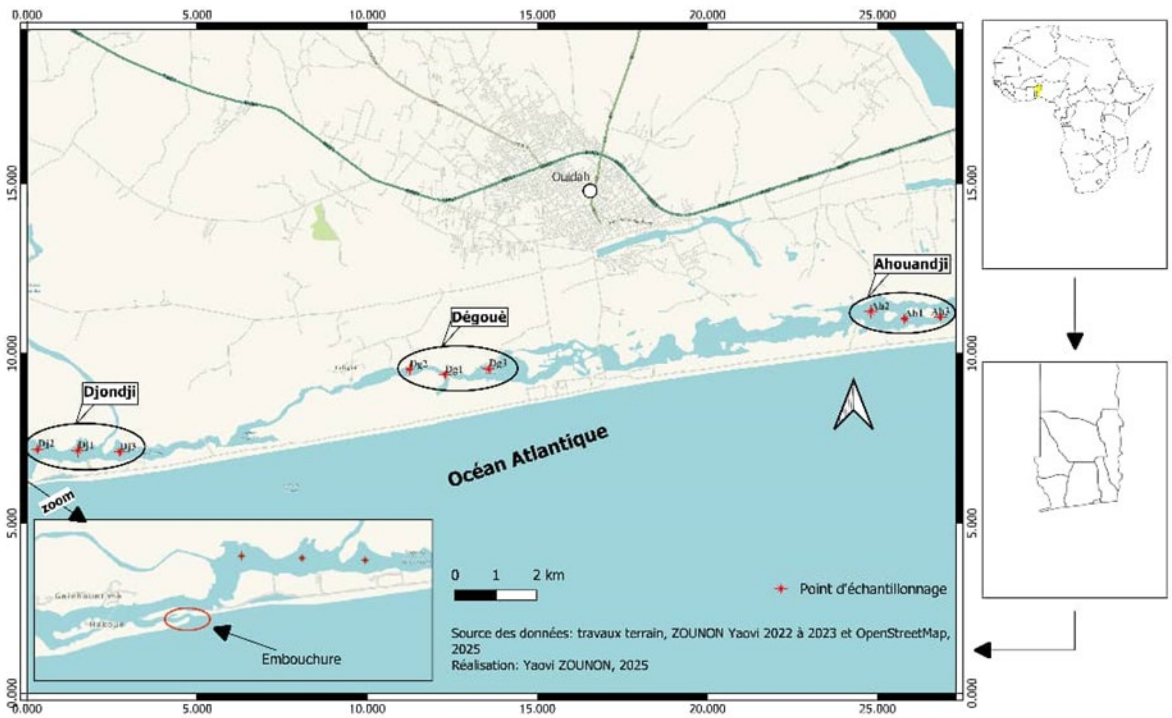

Figure 2: Map showing the geographical location of oyster production areas and sampling stations.

Figure 1: Photo of a *C. tulipa* oyster specimen (Photo, Zounon).

The physicochemical characteristics of the lagoon water were assessed monthly throughout the year, from January to December 2023. During each sampling campaign, the following parameters were measured in situ at three stations within each oyster production zone: temperature, pH, salinity and water transparency. Temperature, pH, salinity and dissolved oxygen were recorded using a multiparameter probe (Aquaread AP-700 and AP-800), while water transparency was determined using a Secchi disc. In addition to these in situ parameters, key nutrients, including nitrites, nitrates, ammonium and orthophosphates, were analysed in the selected production areas. To this end, water samples were collected during each monthly campaign using pre-washed and labelled plastic bottles, which were rinsed on site with the water to be sampled. The samples were kept cool in an icebox and transported to the laboratory for analysis. Nutrient concentrations were determined by colorimetric methods using a DR 3800 molecular absorption spectrophotometer.

Data analysis: The data collected throughout the study period were subjected to a descriptive statistical analysis using the R software package (version 4.3.3). Prior to any comparisons being made, the assumptions of normality and homogeneity of variance were tested using Shapiro–Wilk and Levene's tests, respectively. Once these assumptions had been validated, a one-way ANOVA was performed to compare the data across months and between oyster production zones. When significant differences were detected, the Least Significant Difference (LSD) test was applied to make pairwise comparisons. Spearman's correlation analysis was conducted to assess the relationships among the various measured parameters. The Organic Pollution Index (OPI), as proposed by Leclercq (2001), was also calculated to evaluate the degree of organic pollution in the lagoon waters at the *C. tulipa* production sites. Three parameters were used in the OPI calculation: ammonium ions (NH_4^+), nitrite ions (NO_2^-) and orthophosphate ions (PO_4^{3-}).

RESULTS

Spatiotemporal Variation of Physico-Chemical Parameters in the Coastal Lagoon: Table 1 presents the spatial variation of physico-chemical parameters measured in the waters of the coastal lagoon over a full annual cycle.

Table 1: Spatial variation of physico-chemical parameters measured in the waters of the coastal lagoon.

Parameters	Ahouandji	Dégouè	Djondji
NO_3^- (mg/L)	1.37± 0.76b	1.75±0.68a	1.40±0.92ab
NO_2^- (mg/L)	0.02±0.01a	0.02±0.01a	0.02±0.00a
NH_4^+(mg/L)	0.26±0.27a	0.18±0.10a	0.22±0.27a
PO_4^{3-}(mg/L)	0.09±0.02b	0.06±0.03c	0.15±0.09a
Temp (°C)	29.93±1.12b	31.35±1.49a	29.99±1.21b
O_2 (mg/L)	5.26±1.09a	5.61±0.87a	5.60±0.80a
pH	7.18±0.32b	7.41±0.29a	7.28±0.32ab
Sal (g/L)	6.24± 5.90b	10.02±9.30ab	13.26±10.74a
Transp (cm)	70.91±12.69a	55.66±22.27b	54.75±33.58b

Temp = temperature; Transp = transparency; O_2 = dissolved oxygen; Sal = salinity; NO_3^- = nitrate ions; NO_2^- = nitrite ions; NH_4^+ = ammonium ions; PO_4^{3-} = orthophosphates.
For each row, means not sharing the same letter are significantly different ($p < 0.05$).

The analysis results show that the concentrations of nitrite, ammonium and dissolved oxygen in the coastal lagoon waters did not vary significantly between the oyster production areas during the study ($p > 0.05$). However, temperature values recorded in the Dégouè production zone differed significantly ($p < 0.05$) from those in the Djondji and Ahouandji zones, which did not differ significantly from each other ($p > 0.05$). The highest temperature value was recorded in the Dégouè production area (31.35 ± 1.49 °C), while the lowest value was observed in the Ahouandji production area (29.93 ± 1.12 °C).

Regarding salinity, values measured in the Djondji production area differed significantly ($p < 0.05$) from those in the Ahouandji and Dégouè areas, which did not differ significantly from each other ($p > 0.05$). The highest average salinity was recorded at Djondji (13.26 ± 10.74), while the lowest value was observed at Ahouandji (6.24 ± 5.90). The lagoon waters were generally near neutral across the different production zones. The pH value recorded in the Dégouè production area differed significantly ($p < 0.05$) from those at Djondji and Ahouandji, which did not differ significantly from each other ($p > 0.05$). The highest average pH value was recorded at Dégouè (7.41 ± 0.29), while the lowest value was observed at Ahouandji (7.18 ± 0.32). Regarding water transparency in the coastal lagoon, the values measured at Ahouandji differed significantly ($p < 0.05$) from those at Dégouè and Djondji, which did not differ significantly from each other ($p > 0.05$). The highest mean transparency was observed at Ahouandji (70.91 ± 12.69 cm), while the lowest transparency was recorded at Djondji (54.75 ± 33.58 cm). For the other nutrients analysed in the lagoon waters, nitrate and orthophosphate ion concentrations differed significantly between zones. The highest nitrate concentrations were found in the Dégouè production zone (1.75 ± 0.68 mg/L), while the lowest were recorded at Ahouandji (1.37 ± 0.76 mg/L). The highest orthophosphate concentrations were measured at Djondji (0.15 ± 0.09 mg/L) and the lowest at Dégouè (0.06 ± 0.03 mg/L). The temporal variations of physico-chemical parameters in the coastal lagoon are illustrated in the graphs shown in Figure 3.

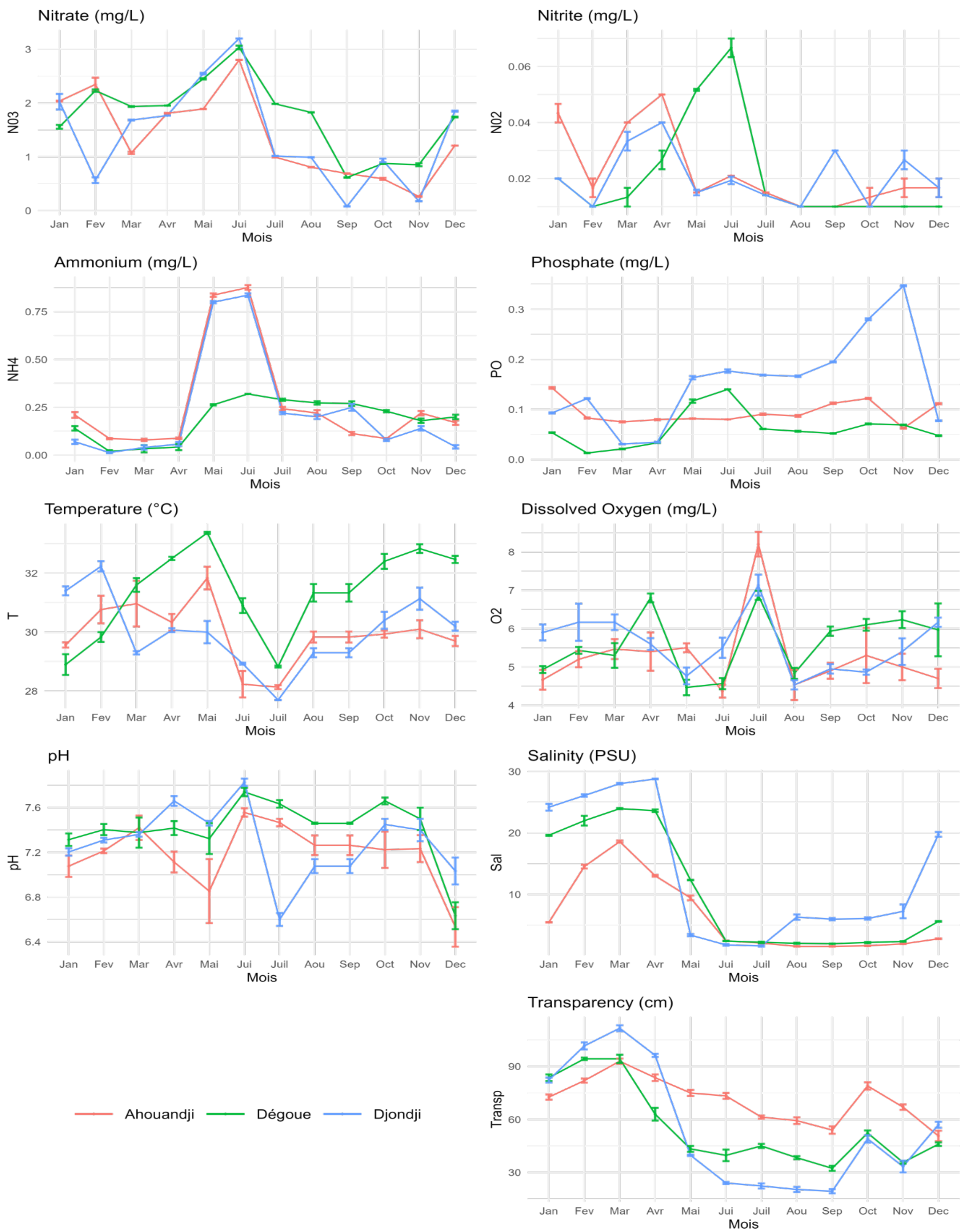

Figure 3: Temporal variation of physico-chemical parameters in the waters of the coastal lagoon.

In terms of temporal variation, all physico-chemical parameters assessed in the coastal lagoon waters showed significant monthly variations throughout the study period ($p < 0.05$). Nitrate (NO_3^-) concentrations in lagoon waters ranged from 0.42 to 3.01 mg/L. The highest concentration (3.01 ± 0.17 mg/L) was recorded in June, corresponding to the main rainy season, while the lowest (0.42 ± 0.16 mg/L) was observed in November, marking the beginning of the minor dry season. As for nitrite (NO_2^-) levels, the highest value (0.04 ± 0.01 mg/L) was recorded in April, also during the main rainy season. The lowest concentrations (0.01 ± 0.00 mg/L) were observed in February, August, October, and December, mostly corresponding to dry seasons, except October which marks the beginning of the minor rainy season. Regarding ammonium (NH_4^+) levels, the minimum value (0.04 ± 0.03 mg/L) was recorded in February (main dry season), while the maximum (0.67 ± 0.03 mg/L) was observed in June. During the study period, the highest orthophosphate (PO_4^{3-}) concentration (0.15 ± 0.14 mg/L) was recorded in November, at the end of the minor rainy season, while the lowest value (0.04 ± 0.02 mg/L) was noted in March and April, corresponding to the main dry season and the onset of the rainy season. Lagoon water temperature ranged from 28.22 to 31.73 °C. The highest value (31.73 ± 1.53 °C) and the lowest (28.22 ± 0.49 °C) were both recorded during the main rainy season, in May and July, respectively. Dissolved oxygen peaked in July (7.40 ± 0.71 mg/L), at the start of the main rainy season, while the lowest value (4.63 ± 0.40 mg/L) was observed in August (minor season). Measured pH values ranged from 6.73 to 7.70. The highest pH (7.70 ± 0.13) was recorded in June (main rainy season), while the lowest (6.73 ± 0.31) occurred in December, during the main dry season. Salinity in the coastal lagoon waters exhibited strong fluctuations throughout the study period. The highest value (23.53 ± 4.10 g/L) was recorded in March, during the main dry season, and the lowest (1.95 ± 0.30 g/L) in July, in the main rainy season. Regarding water transparency, the highest value (99.66 ± 9.44 cm) was observed in March (main dry season), while the lowest (35.22 ± 15.36 cm) occurred in September, during the minor dry season.

Correlation Among Physico-Chemical Parameters in the Coastal Lagoon Waters: Table 2 presents a Spearman correlation matrix showing the linear correlation coefficients between the various physico-chemical parameters measured in the lagoon waters, using a significance level of 5%. Analysis of this table reveals a strong positive correlation between salinity and transparency ($r = 0.72$), as well as a weaker positive correlation with temperature ($r = 0.22$). In addition, ammonium (NH_4^+) showed a moderate positive correlation with nitrate (NO_3^-) concentrations ($r = 0.43$). A similar positive correlation was observed between nitrite (NO_2^-) and nitrate ($r = 0.36$).

In contrast, orthophosphate ions (PO_4^{3-}) were strongly and negatively correlated with both water transparency ($r = -0.52$) and salinity ($r = -0.37$). Dissolved oxygen also showed negative correlations with ammonium ($r = -0.19$), nitrites ($r = -0.21$), and orthophosphates ($r = -0.20$). Finally, salinity was negatively correlated with ammonium ($r = -0.48$).

Table 2: Correlation matrix of the physico-chemical parameters measured in the coastal lagoon waters.

	NH_4^+	NO_2^-	NO_3^-	O_2	pH	PO_4^{3-}	Sal	Temp	Transp
NH_4^+	1.000	-0.043	0.431***	-0.186	0.149	0.154	-0.477***	-0.193*	-0.346***
NO_2^-		1.000	0.355***	-0.208*	0.153	0.071	0.207*	0.068	0.141
NO_3^-			1.000	-0.145	0.238*	-0.256**	0.178	-0.018	0.127
O_2				1.000	0.009	-0.201*	0.134	-0.014	0.049
pH					1.000	-0.038	0.045	0.077	0.060
PO_4^{3-}						1.000	-0.367***	-0.148	-0.515***
Sal							1.000	0.219*	0.721***
Temp								1.000	0.060
Transp									1.000

Legend: Temp = temperature; Transp = transparency; O_2 = dissolved oxygen concentration; Sal = salinity; NO_3^- = nitrate ions; NO_2^- = nitrite ions; NH_4^+ = ammonium ions; PO_4^{3-} = orthophosphate ions.

Organic pollution: The Organic Pollution Index (OPI) values calculated for the three oyster production zones ranged from 3.33 to 3.67, indicating moderate levels of organic pollution (see Figure 4). The lowest value (3.33) was recorded at Ahouandji and Djondji, while the highest value (3.67) was observed at Dégouè. Overall, these levels of pollution reflect a significant organic load in the coastal lagoon waters, which could endanger the ecological sustainability of the *C. tulipa* oyster farming areas.

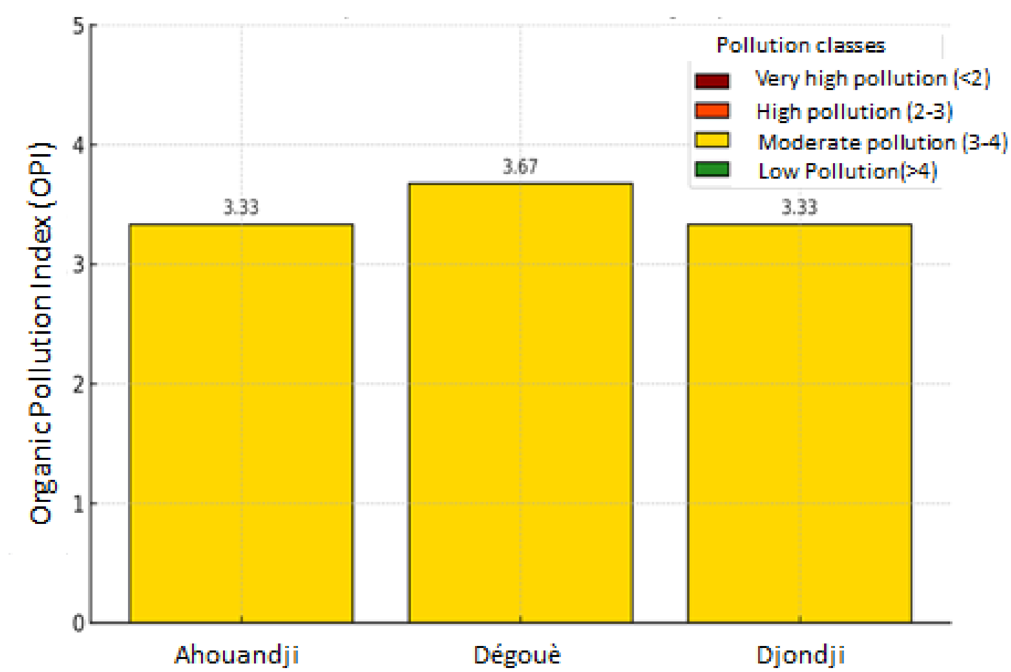

Figure 4: Spatial variation of the Organic Pollution Index (OPI).

Comparison of Results with the Physico-Chemical Requirements of *C. tulipa:* The comparison of the obtained results with the physico-chemical requirements of *C. tulipa* is presented in Table 3.

Table 3: Comparison of the results with the physico-chemical requirements of *C. tulipa.*

Parameters	Requirements (Mahu *et al.*, 2022)	Values Obtained in the Coastal Lagoon of Benin	
Temperature	Develops within a temperature range of 18 to 33 °C. Temperatures below 10 °C and above 35 °C can be lethal.	29.93±1.12 °C	Ahouandji
		31.35±1.49 °C	Dégouè
		29.99±1.21 °C	Djondji
Salinity	Develops within a salinity range of 4 to 50 ppt. Salinities below 4 ppt and above 50 ppt may impair growth and survival. Prolonged exposure to 0 ppt salinity leads to mortality.	6.24± 5.90 ‰	Ahouandji
		10.02±9.30 ‰	Dégouè
		13.26±10.74 ‰	Djondji
pH	Develops within a pH range of 6 to 8.5. Extremely low or high pH values have significant adverse effects on shell development.	7.18±0.32	Ahouandji
		7.41±0.29	Dégouè
		7.28±0.32	Djondji
Dissolved Oxygen	Develops in environments with low dissolved oxygen concentrations, down to approximately 1 mg/L.	5.26±1.09 mg/L	Ahouandji
		5.61±0.87 mg/L	Dégouè
		5.60±0.80 mg/L	Djondji
Turbidity / Transparency	Excess silt clogs the gills, impedes food flow during filter feeding, and leads to mortality.	70.91±12.69 Cm	Ahouandji
		55.66±22.27 Cm	Dégouè
		54.75±33.58 Cm	Djondji

DISCUSSION

The results of this study show that most of the physicochemical parameters measured in the coastal lagoon waters varied both spatially and temporally. The temperatures recorded in the lagoon waters during this study were generally high, reflecting the tropical climate of the study area (Boko, 1992; Okpeitcha *et al.*, 2022). The highest (31.73 ± 1.53 °C) and lowest (28.22 ± 0.49 °C) temperatures were observed during the main rainy season, in May and July respectively. This can be attributed to the impact of climate change, as documented by various authors in the region (Boko *et al.*, 2012; Chouti *et al.*, 2017). The salinity of the coastal lagoon waters showed considerable fluctuations throughout the year and across the different production zones. Overall, salinity decreased from the area near the estuary mouth at Djondji towards the production area of Ahouandji, which is further inland. This observation has previously been reported by several authors throughout the Beninese estuarine system and is explained by the intrusion of marine waters through contact with the Atlantic Ocean in the coastal lagoon (Adandédjan *et al.*, 2012) as well as in the Cotonou lagoon (Okpeitcha *et al.,*2022; Sintondji *et al.,* 2022). The same authors also highlighted spatial and seasonal variations in physicochemical parameters, particularly salinity, in Benin's coastal waters, which supports our findings. This spatiotemporal variation strongly influences the distribution of benthic macroinvertebrates in these lagoons, contributing to their diversity (Sinsin *et al.*, 2018; Odoutan *et al.*, 2019). Several studies have documented the effects of temperature and salinity on oyster reproduction and growth (Bernard, 2011; Sutton *et al.*, 2012; Lagarde *et al.*, 2017). Throughout the study period, the lagoon waters were relatively well oxygenated, with dissolved oxygen concentrations of 5.26

± 1.09 mg/L at Ahouandji, 5.61 ± 0.87 mg/L at Dégouè and 5.60 ± 0.80 mg/L at Djondji. These results are consistent with those reported by Adandedjan *et al*. (2017). Regarding water transparency, the annual average values obtained across the three production areas suggest that the waters of the Ahouandji lagoon were generally clearer than those of the other two lagoons. This may be explained by dredging activities carried out by the Beninese government in the Djondji area and its surroundings during the study period. Dredging causes sediment resuspension, leading to increased water turbidity (Lamptey, 2011). Concerning seasonal variation, the lowest transparency value (35.22 ± 15.36 cm) was recorded in September, which coincides with the peak flooding period in southern Benin. During this time, significant runoff containing suspended matter from the northern regions reaches the southern lagoonal waters, as this period coincides with the main rainy season in the north of the country (Okpeitcha *et al*., 2022; Sintondji *et al*., 2022). These waters are supplied to the coastal lagoon through the Couffo River and Lake Ahémé via the Ahô Channel (Viaho *et al*., 2020). The correlation between the physicochemical parameters assessed in the lagoon waters highlights the complex interactions reflecting the combined influence of marine, continental and anthropogenic inputs. A strong positive correlation was observed between salinity and water transparency (r = 0.72), suggesting that marine intrusions, which are typically clearer and saltier, improve water column clarity. These findings are consistent with those of Sintondji *et al*. (2022), who reported a strong positive correlation (r = 0.80) between these two parameters in the Nokoué Lagoon in Benin. This relationship has also been documented in other lagoon ecosystems subject to estuarine exchanges, where salinity serves as an indicator of marine inputs (Pérez-Ruzafa *et al*., 2011). A significant negative correlation was observed between ammonium (NH_4^+) and salinity (r = -0.48). This indicates that higher nutrient concentrations are likely to be introduced into the waters of the coastal lagoon through freshwater discharges carrying continental materials, or through domestic and agricultural runoff. These findings corroborate the observations of Chouti *et al*. (2017), who identified Lake Ahémé and the Mono River as potential sources of pollution in the lagoon. This phenomenon is commonly reported in lagoon systems influenced by urban development or agricultural runoff (Newton *et al*., 2003). Water transparency was inversely correlated with phosphate (r = -0.52), confirming the hypothesis that nutrient enrichment in the coastal lagoon is associated with the wet season, when nutrient-rich loads are carried by freshwater inflows originating from Lake Ahémé via the Ahô Channel or from the Mono River through the opening of the Nangbeto hydroelectric dam gates. Phosphorus enrichment typically promotes phytoplankton growth, increasing turbidity and reducing light penetration (Cloern, 2001). The moderate coupling observed between nitrate (NO_3^-) and ammonium (r = 0.43) suggests shared nitrogen pollution sources, such as the mineralisation of organic matter or nitrogen-based fertilisers (Orou *et al*., 2024). The weak to negative correlations between dissolved oxygen and nutrients (NH_4^+, NO_2^- and PO_4^{3-}) observed in this study could suggest oxygen consumption during the breakdown of nutrient-rich organic matter, or as part of the nitrification process (Diaz & Rosenberg, 2008). The Organic Pollution Index (OPI) calculated for the three *C. tulipa* oyster farming zones indicates a moderate level of organic pollution across all sites. Viaho *et al*. (2020) reported the accumulation of organic matter in the coastal lagoon, which could explain this level of pollution. When compared with the physicochemical tolerance ranges of the oyster *C. tulipa*, the average values obtained across the three production zones fall within suitable thresholds. This suggests that the lagoon waters are generally favourable for oyster reproduction and growth (Mahu *et al*., 2022).

CONCLUSION AND APPLICATION OF RESULTS

The results of this study demonstrate that the physicochemical quality of coastal lagoon waters fluctuates over time and varies across different oyster farming zones. While the measured parameters indicate that the current water quality is generally favorable for the reproduction and growth of *C. tulipa*, certain factors still pose challenges. Notably, water quality deteriorates during the flood season when freshwater runoff from northern Benin flows into southern coastal ecosystems. Another issue is the occasional opening of the Nangbeto hydroelectric dam's floodgates, which exacerbates flooding in the coastal lagoon area. Furthermore, anthropogenic pressure, particularly from agricultural activities along the lagoon's banks and the discharge of household waste, must be carefully managed to ensure the sustainable production of high-quality oysters in these waters.

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