



International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

<http://gssrr.org/index.php?journal=JournalOfBasicAndApplied>



Bacteriological Quality of Seawater Bathing Areas along the Oran Coast (West northern Algeria)

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Abstract

Marine water of Oran's Bight in the Algerian west coast, is threatened by the rejections of worn water which deteriorates the microbiological quality of coastal water. The objective of the present study was to evaluate the quality of the seawater in Bay of Oran. In total, 60 Samples were collected in 6 different stations: Andalouses beach, Cap Falcon, Bouisseville, Ain Franine, Kristel and Pointe de l'Aiguille Kristel. All samples were studied from 2010 until 2014 during May and April. For each point, the analysis included estimation of the following parameters: fecal coliform and total coliform. Our statistical outputs of the data obtained showed that hygienic quality in bacteria coliformes, is distributed in a homogeneous way on the level of the sites of the eastern coasts and western coasts in Oran's Bight. Variance analysis (ANOVA) discriminate Bouisseville and Ain Franine like station with higher contamination significantly, but no periodic difference is appreciated. The various studied stations do not have a similar profile of vulnerability.

Keywords: Bacteriological quality; bathing areas; Bay of Oran; Algerian west coast; seawater; fecal coliform; total coliform.

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1. Introduction

The contamination of the coastal and marine ecosystem became one of the major problems posed by the environment. Demography, the technological development and all anthropic factors constitutes a danger to the public health [1].

Worn water remains the principal source of contamination of the marine and coastal environment. The water discharges used on the coasts strongly increased during 30 last years and is often poured directly in the natural environment without any preliminary treatment [2]. Many work has the object of research are for the follow-up of the quality of seawater along the Algerian western coast [3,4,5]. The bacteriological contaminations in Oran's Bight constitute a true medical risk [6]. To prevent this threat, the spatio-temporal monitoring of bacteriological quality of seawater of Oran Bight, discriminate the practicable area for the bathe.

2. Study area

Oran's Bight, on the Algerian Mediterranean coast is located between the industrial gulf of Arzew in the East, and Andalouses tourist complex in the west. It is delimited, in the East by the Aiguille cape and in the West by the Falcon cape, in almost 30 miles wide. This bay is constituted in the western part, from the Oran's harbour to the Mers El Kebir end, by high and escarped cliffs, going from 10 to almost 30 m big. In the east part, the coast presents cliffs more or less high, interrupted by small and narrow beaches [7]. Marine hydrology is characterized by very turbulent circulation along the coast of Oran who supports the dispersion of possible sources of pollution and enriched the entire chain food surface [8]. The best sand beaches very attended are located at the West of the Mers El Kébir (Figure 1).



Figure 1: Cap Falcon (on the right) and tourist beach of Andalouses (on the left) [9].

3. Material and Methods

The sites of sampling retained in this study are located at the bay of Oran. West towards the East: Andalouses, Cap Falcon and Bouisseville in the West of the Oran. Pointe de l'Aiguille, Kristel, Ain Franine in the East of the city (Figure 2).

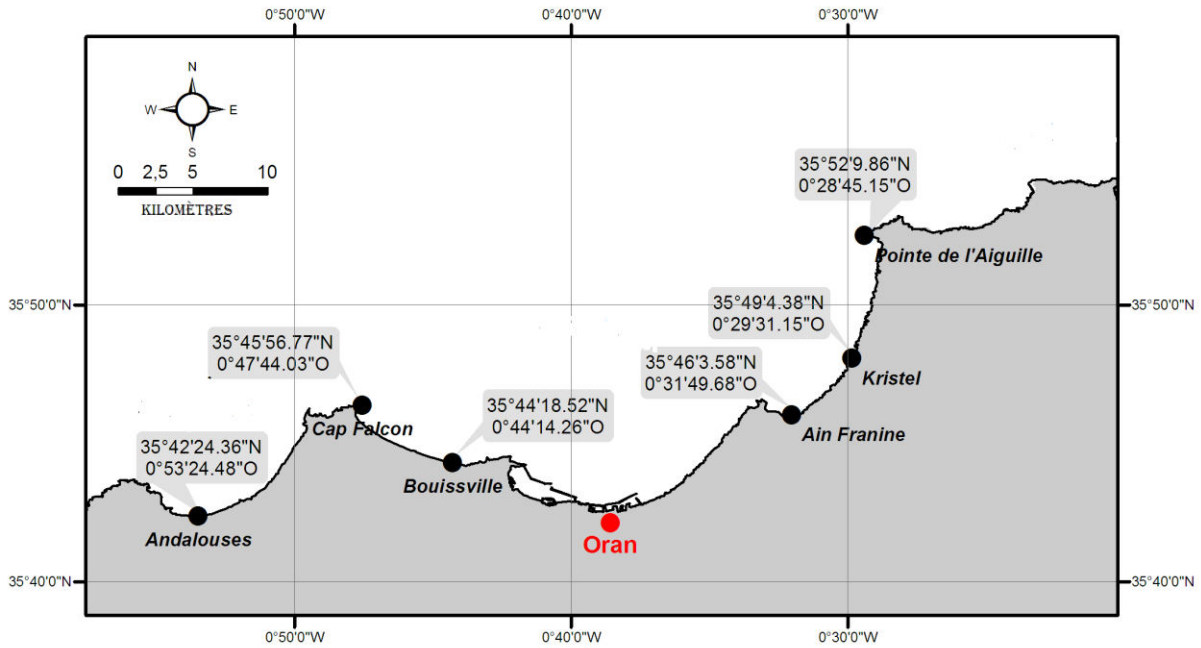


Figure 2: Location of the sampling sites distributed in the bay of Oran

Sixty (60) samples were carried out, every May and April over five years successive (2010-2014). Taking away, the transport and analysis of the sea water samples were realized in accordance with the directives applicable to the medical seawater monitoring [1]. The method used for research and the enumeration of the germs tests of fecal contamination is carried out by colimetry in liquid solution [11]. The bacteriological profile of Oran's coast is established by the analysis of the results treated and compared in inter-site (total Coliform vs total Coliform and fecal Coliform vs fecal Coliform) and in intra-site (total Coliform vs fecal Coliform). This comparison is based on the analysis of the variance (ANOVA) for the multiple comparison of averages, the test T of Student identifies the sites with the extreme values. The variance analysis of the level of contamination according to the years is carried out by ANOVA.

4. Results and discussion

Analysis of the variance (ANOVA) shows that there is at least an average which differs significantly for the total coliform (Ct) and fecal (Cf) (Figure 3), (Figure 4). Cap Falcon and Andalouses, Kristel and Pointe de l'Aiguille present the averages of Ct statistically equal. It is thus respectively the average (Ct) of Bouisseville and Ain Franine who exceeds the two other sites (Tab. 1). Whereas the ANOVA prove that there is not average significantly different for the fecal coliform (Cf). In fact, the average of (Cf) of Cape Falcon connects that of Andalouses to that of Bouisseville and they is the same for the average of (Cf) Kristel who connects the Pointe de l'Aiguille to Ain Franine.

Two to two, the test of Student affirms that the average of (Cf) of Bouisseville exceed the average statistically of

(Cf) of Andalouses and that the average of (Cf) of Ain Franine exceed the average statistically of (Cf) of Pointe de l'Aiguille. Cap Falcon and Andalouses or Kristel and Pointe de l'Aiguille receive a load in (Ct) or in (Cf) similar, but no periodic difference is appreciated. khi 2 (Tab. 2) show a highly significant connection ($p < 0,001$) between the total and fecal coliform of all study station, except that Ain Franine ($p > 0,05$).

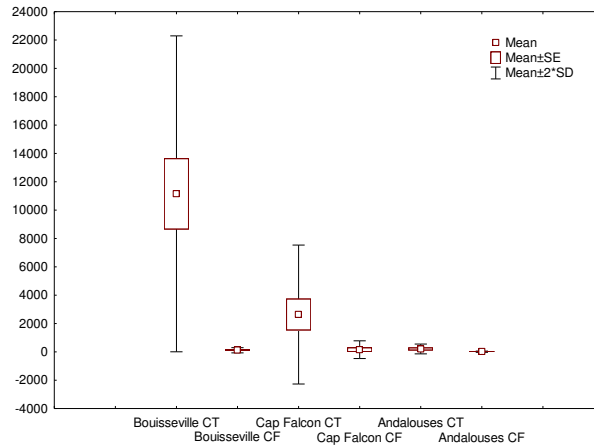


Figure 3: Analyze variance of the concentration of the total coliform (Ct) and fecal coliform (Cf) in eastern coast of Oran's Bight

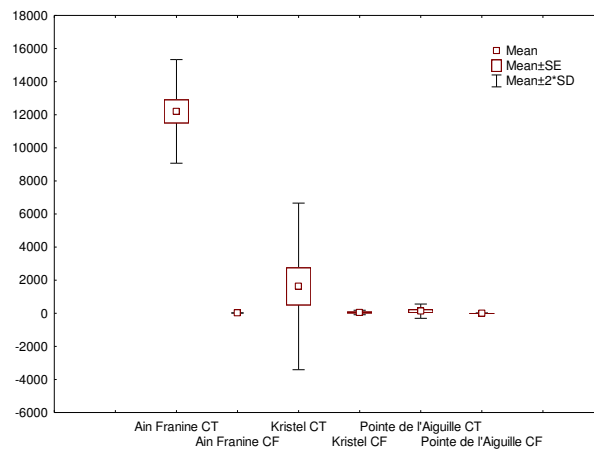


Figure 4: Analyze variance of the concentration of the total coliform (Ct) and fecal coliform (Cf) in eastern coast of Oran's Bight

The average charge in (Ct) at Bousseville and at Ain Franine exceed the averages statistically of (Cf) respectively Western and East sites.

From Cap Falcon or Kristel, there does not exist more significant differences between the concentrations (Ct)

andet (Cf). Although with Andalouses the average charge in (Ct) exceed the average charge statistically in (Cf).

Variance analysis (ANOVA) discriminate Bouisseville and Ain Franine like station with higher contamination significantly, but no periodic difference is appreciated.

The projection of the results of the load of the coliformes translated several levels of contamination which referent to different authorizations of bathe with an offset decreasing graduation.

Table 1: Comparison intersites of average of total and fecal coliform.

	West coast		East coast	
	Total Coliform /100ml	Fecal Coliform /100ml	Toatl Coliform /100ml	Fecal Coliform /100ml
Similar average	C vs. A (t = 1,93)	C vs. B (t = -0,28)	K vs. P (t = 1,2914)	K vs. AF (t = -1,343)
		C vs. A (t = 1,011)		K vs. P (t = -1,866)
Average different	B vs. C (t = 4,07)	B vs. A (t = 3,31704)	AF vs. K (t = 8,3013)	AF vs. P (t = 5,11520)
	B vs. A (t = 6,52)		AF vs. P (t = 22,47)	
F spatial	22,59**	0,78	79,834**	2,765
F temporel	0,37	1,684	0,0836	0,855

p < 0,005 : *

p < 0,001 : **

t : test of Student

F : Analyze variance (ANOVA)

C : Cap Falcon ; A : Andalouses ; B : Bouisseville ; K : Kristel ; AF : Ain Franine ; P : Pointe de l'Aiguille.

The analysis of the spatial-temporal evolution of the bacteriological quality of water of bathes of bay of Oran shows during the 5 years of study, a diagonal symmetry by report/ratio to the town of Oran enters the beaches, dominated by the contamination in total coliformes (Ct) and/or fecal.

The significant accumulation of coliformes in Bouisseville and in Ain Franine, is mainly due to the direct discharge of the untreated used water emissary or insufficiently purified, with the immediate proximity of the beach of Ain Franine and on the level of the beach of Bouisseville, thus threatening the pledged marine animal-

life on the level of these sites and representing particularly a true danger to human health. On the contrary, weak contamination of the sites Andalouses and of Pointe de l’Aiguille be explained by its distance of the urban centres and also by the existence of a strong hydrodynamism characterizing this coastal sector MILLOT (1989).

Table 2: Comparison of the interspecific averages of Coliform (test t of Student).

		Total Coliform /100ml						
		B	C	A		AF	K	P
Fecal Coliform/100ml	B	6,58**	2,01	1,35	AF	22,84**	1,39	1,67
	C	6,54**	1,97	0,35	K	22,77**	1,36	1,17
	A	6,64**	2,09	3,56*	P	22,86**	1,40	1,84
F temporal		0,195	1,02	0,686		0,012	0,95	0,827
Khi2 Ct Cf		452,57**	1550,8**	248,45**		13,59	3355,42**	316,73**

* : p < 0,005

** : p < 0,001

t : test t of Student

C : Cap Falcon ; A : Andalouses ; B : Bouisseville; K : Kristel ; AF : Ain Franine ; P : Pointe de l’Aiguille

Unilateral increase in the average in (Cf), with depends on (Ct) is probably due to the terrigenous contribution of fecal matter in Ain Franine.

The weak load in fecal coliformes in Andalouses and in Pointe de l'Aiguille are due to their distance of the urban centres and the existence of a strong hydrodynamism MILLOT (1989) who amplifies the purifying capacity of sea water. The gradient of concentration indicates that the direction of the currents influences on this scale the concentration and the dispersion of the coliformes. The courantology seems respectively to control the concentration and the dispersion of the bacteriological loads of the sites far away from the outlets.

Results obtained by KERFOUF and his colleagues [1] for the station of Bouisseville, MOUFOK (2005), for the Oran western coast, SOUIDI (2009), HEBBAR (2005) for Oran east, the regularities of the reports/ratios of concentrations confirm of Ct and Cf revealed in our study.

It is to be announced the absence of highly pathogenic germs such as the Salmonellas, the choleraic Vibrio and Entérovirus for the sites and the period of sampling.

While referring to the standards of healthiness, the concentrations of the fecal germs listed seldom exceed the tolerated limits WHO (2004), but the comparisons inter-sites show different levels of contamination. Then, although to the standards relating to water of bathes OMS (2004), the sites show different bacteriological profiles. The assessment of the coliformes in this area over the period this 2011-2014 is stable because it ya no

provision of specific installation.

5. Conclusion

The real and potential impact of bacterial pollution on the level of the beaches of Oran is reflected by the study of the bacteriological quality of this water of bathe. The report on their good quality remains weakened by a chronic deterioration, since they are continuously exposed at the risks of industrial and spared wastes exacerbated by the tourist influence. This is the case for water of bathe of Bouisseville and Cape Falcon or Ain Franine and of Kristel which however present different bacteriological profiles.

This program of monitoring spread out over five years made it possible to determine the quality of water of bathe for beaches supervised as being of quality acceptable for the bathe.. The prevalence of the fecal coliform highlights the impact of the contribution complex, chronic and repeating of worn water of the town of Oran, of the commune of Bouisseville and Kristel. The essential cause of the bacterial pollution of bay of Oran was the various rejections of domestic worn water and industrialists who flow there without any preliminary treatment [12,13]. The principle of precaution and durable management of water bathe of the littoral oranais master key by a good analysis of the environmental context of studied spaces and by the intervention of the local authorities in the construction of the stations of purification in order to promote as soon as possible with nautical approvals and to protect the health from those which practises it.

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