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Bacteriological quality of Sea water bathing water for two stations of Eastern Oran (Dahliss, Sidi-Moussa) from Western Northern Algeria

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ABSTRACT

The bathing water beaches of the coast of East Oran of Western Algeria are threatened by waste water discharges untreated or insufficiently purified bacteriological and deteriorating quality. This study is to evaluate bacterial contamination of two stations is Oran: Dahliss and Sidi-Moussa. Three biweekly samples were taken at different distances: 1m, 5m and 10m from June 1 to September 30 of 2012. For each of the two stations, the analysis focused on the estimation of the following parameters: fecal and total coliforms, fecal streptococci, *Salmonella*, *Staphylococcus*, sulfite-reducing *Clostridium* spores and the *Vibrio cholerea*. The statistical analysis of samples confirmed that they are in favour of a very significant correlation. The results showed that the Dahliss station is free from bacterial contamination; however the Sidi-Moussa station showed a level of pollution and subsequently it is unsuitable for swimming. Pathogens (*Salmonella*, *Staphylococcus* and *Vibrio*) are absent in all the samples taken. The East Oran is free from pathogen contamination.

Keywords: Bathing water, Fecal and Total coliforms, Fecal streptococcis, *Salmonella*, *Staphylococcus aureus*, *Vibrio cholerea*.

I. INTRODUCTION

Demography, technology development and all anthropogenic factors constitute a danger to public health. Marine and coastal environments in particular are subject to constant changes of physical, chemical and bacteriological (**Kerfouf** and ***al.***, **2010**).

Water is an essential and irreplaceable element to ensure the continuity of life. However, it can be a source of disease (**El Haissoufi** and ***al.***, **2011**), playing role of vector of potentially dangerous agents, including pathogenic microorganisms (**Hassoun** and ***al.***, **2010**). The deterioration of water quality is a threat as great as that related to quantitative imbalance (**El Addouli** and ***al.***, **2009**).

Monitoring quality of sea water along Algerian west coast has been the subject of much research (**Hebbar**, **2005**; **Mouffok**, **2005**; **Djad** and ***al.***, **2015**).

During the summer, swimming is a much practiced recreational activity. On this occasion, the Algerian population wants to find a welcoming environment, protected from various forms of nuisance. This quality is a health factor but has also become an important part of tourism development. Improving the quality of bathing water may reduce health problems and improve recreation of the local population, making it as a more attractive region for tourism.

The choice of sampling sites was motivated by certain factors:
-proximity of beaches to the city;
-importance of attendance by beaches vacationers;
-presence of the discharge of domestic sewage;
-few researches at site (**Hebbar, 2005**).

This work reflects the overall results collected during bacteriological analysis of bathing water of east of Oran, targeting both sites Sidi-Moussa and Dahliss, and conducted during the summer of 2012.

II. METHODS AND MATERIAL

Study Area

Kristal is located in North West Gdyel on Western slopes of Jebel Bouhaichem an altitude of 426m and 497m at the Kristal. This isolation allows it to maintain very close relations with Oran. It is a tourism expansion zone defined by Decree n°88-232 of 05/11/1988. Its suburbs cover an area of 45,6 hectares, with a total population of 5498. The predominance of employment is in the agricultural and fisheries sector with 35,5% of total employment; this is explained by the presence of farmland that by pass central Kristal one hand and the existence of an artisanal fishing activity on the other (**POS**, **1998**). The best sand beaches very attended are located at the East of Oran (Kristel) "Fig. 1".

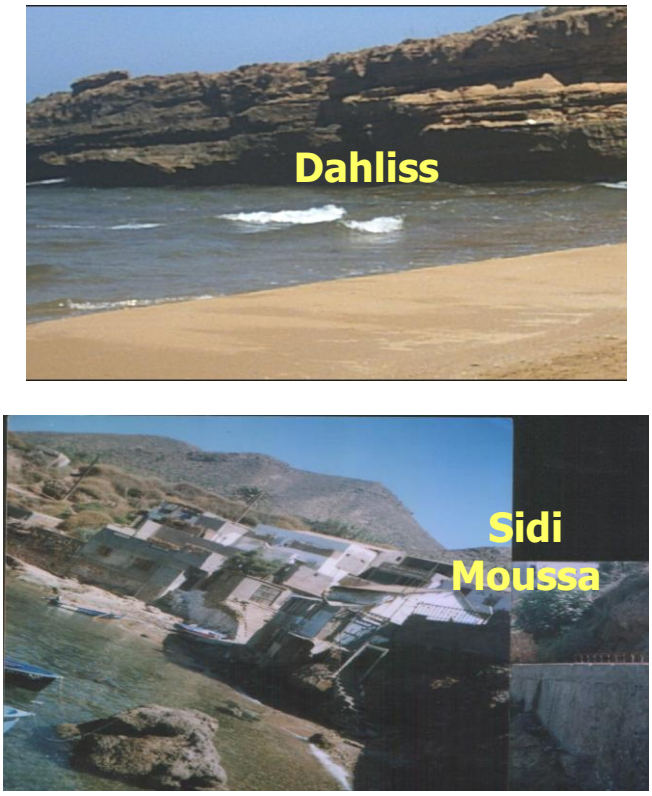

Figure1: Dahliss (on the left) and Sidi-Moussa (on the right) (Hebbar, 2005)

The coastal strip of Kristal site is formed by:

-Of shores accessible: Sidi-Moussa beach, Tamda beach, Dahliss beach and Ain-defla beach.
-Of inaccessible shores, generally corresponding to the slopes with slopes exceeding 25%: cliffs and headlands.

Sampling

Method used for the detection of total and fecal coliforms and fecal streptococci is the series of dilutions in liquid medium (NPP), described by **WHO** in **1995**.

Bacteriological analyzes of this work consisted in search of following tests and pathogens germs: Total coliforms including fecal coliforms , streptococci fecal (or Intestinal Enterococci), *Escherichia coli*, *Vibrio cholerea* (**Pilet**, **1996**), *Staphylococcus aureus*, *Salmonella* (**Guiraud**, **1998**) and spores of sulphite-reducing *Clostridium* (**Rejsek**, **2002**) under aseptic conditions, hours and days or population of bathers is stronger and at a distance of 30cm below water surface at article 3 of Interministerial decree n° 8 of 17.01.1994 .

Total coliforms on BPCL environment, thermotolerant fecal coliforms in the middle Schubert at 44°C for 48 hours and fecal streptococci Rothe medium based on sodium azide at 37°C for 48 hours. Search spores of sulfite-reducing *Clostridium* fits on liver meat medium agar supplemented with iron alum and 5% solutions of sodium sulfite 10% crystallized.

Salmonella by two enrichment on SFB medium with SFB additives, isolated on two agars (Hektoen and SS) and biochemically identified on all suspect colonies.
Vibrio cholera on two enrichments middle EPA 10 times concentrated , followed by two isolations on two separate agar (TCBS and GNAB) and biochemical identification of any suspicious colony.

Staphylococcus enrichment broth by Giolitti and Cantoni followed by isolation on agar Baird Parker and confirmation of pathogenicity test by looking for staphylocoagulase.

Note: All samples must be accompanied by an information sheet on which we note: the source of the sample, date and time of collection, the temperature of the water, the sea state and speed and the wind direction.

To contribute to the study of evolution of bacteriological quality of seawater of East Oran, we chose three sampling points (1, 5 and 10m), which are located in two stations: Sidi-Moussa and Dahliss "Fig. 2". The closest

beaches to cities were controlled at the same time sensitive to water pollution.

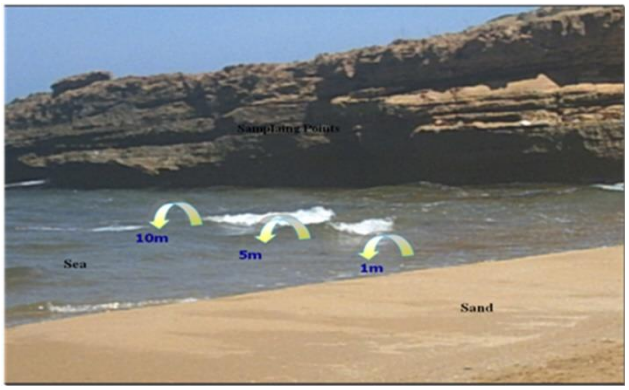

Figure 2: Sample points at the study area

III. RESULT AND DISCUSSION

It is interesting to note the continued presence of fecal contamination indicators (total and fecal coliforms and fecal streptococci) and spores of sulphite- reducing bacteria and total absence in the bathing water beaches of bacterial genera: *Salmonella*, *Staphylococcus aureus*, *Vibrio cholerea*, although sea water is their natural habitat seen its high salt concentration and thus spreading the standards that specify their absence in the bathing water (cf. Executive decree n°: 93-164).

The indicators of fecal contamination have a high concentration in sea water of Sidi-Moussa station, explained by the proximity of this beach to discharges of domestic wastewater. **Essid** et ***al.*** (**2007**) explained the increase in sedimentary bacterial loads by the richness in organic matter. The survival of these bacteria would be under the influence of temperature (**Rozen** and **Belkin**, **2001**). In terms of *E. coli*, it is observed that its presence is dominant in most of the water samples analyzed in July and August, which indicates recent occurrence pollution. Fecal coliform (E. coli) and fecal streptococci are very well correlated with the health risk (**Fewtrell** and **Bartram**, **2001**).

Research for *Salmonella* leads to knowledge of dangerous pollution areas and assesses the value of the treatment of a wastewater treatment plant for sewage effluent which must be cleared of any pathogen before its release the natural environment (**Mouffok**, **2004**).

Microbial contamination levels have been the subject of several studies. A high bacterial pollution with an impact on public health was highlighted in the bay and the port of Algiers (**Delali** and ***al.***, **2000**; **Gueddah**, **2003**).

Industrial pollution of Kristal site is spread in the absence of industrial activities; by cons were domestic waste water that takes precedence. It is an agricultural village which delivers a relatively large volume of wastewater without treatment in that the village has no sewer system and is real permanent injector groundwater pollution flowing into the sea they even come out of the range used by the public during the summer season.

Evolution of seeds depending on the time and distance

Tests germs increase with the summer temperature and decrease gradually as one move away from the seaside. The germ rate is decreasing 1m =, 5m and 10m “Fig. 3”.

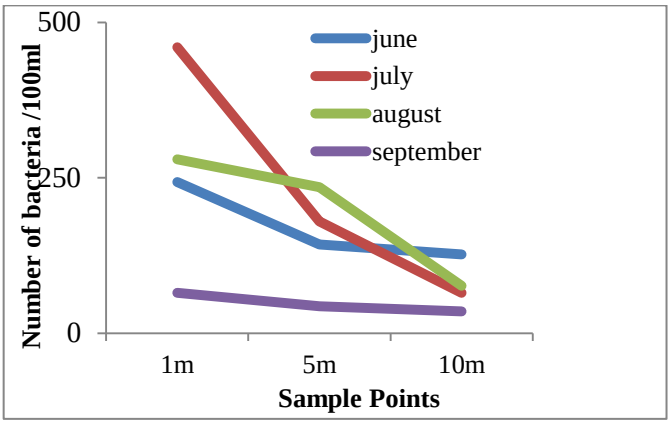

Figure 3: Sampling points of the study area

Monthly evolution of bacterial contamination

For total coliforms and fecal coliforms, it was found respectively:
- 460 cfu/100 ml and 110 cfu/100ml for Dahliss beach;
- 2700 cfu/100 ml and 1300 cfu/100ml for Sidi-Moussa beach.

Tests germs increase with the summer temperature and decrease gradually as one move away from the edge of the sea. The rate is decreasing germs 1m, 5m and 10m “Fig. 3”.

The minimum value of coliforms concentration (total and fecal) is visible at the beginning of June and by the end of September (Dahliss station); this is explained by the low existing population (only the employed staff is present). Rate of fecal coliforms in various samples of Sidi-Moussa station far beyond the standards. This massive presence reflects a strong fecal contamination and correspondingly risk of the presence of pathogens (**Bourgeois** and **Leveau**, **1991**); their origin may be either animal (intestines) or human (hand).

For fecal streptococci, their presence is visible in both beaches especially for Sidi-Moussa station where the concentration is 400 cfu/100ml during August. In contrast, normal concentrations appear to Dahliss station. Fecal streptococci are responsible for gastroenteritis and are specific indicators of ancient human fecal pollution (**WHO/UNEP**, **1995**); they are more resistant and have a long persistence in seawater (with the opposition of *E. coli*) Having regard to their resistance at a concentration of 6,5% NaCl and a temperature of 10 to 45°C (**Prescott** and ***al.***, **1995**).

The analysis of sulphite-reducing bacteria (specifically spores *Clostrdium*) revealed a maximum value of 20 (Sidi-Moussa station). Their presence indicates an old or intermittent fecal contamination and persistence in the environment (**Kunin**, **1993**). Presence of *Clostridium perfringens* in intestines of humans and many animal species is its presence in water and food due to fecal contamination (**Monteil** and ***al.***, **1992**).

Oran East is free of bacteriological pollution and remained almost in line with the regulations in force in comparison with the western Oran. Ain-Turck, Bousfer and Madagh beaches have high rates of total and fecal coliforms and fecal streptococci. The analysis of these waters has detected a presence of the same genus *Salmonella* during August (**Mouffok**, **2005**). The absence of pathogenic bacteria: *Staphylococcus aureus* and Salmonella and presence of fecal bacteria (total and fecal coliforms and fecal streptococci) in seawater Ain-defla Eastern of Oran have been authenticated. The same study confirms presence of *Staphylococcus aureus* on sampling seven months (December to June) and that of *Salmonella* three months (April to June) on Genets station west of Oran (**Seddik**, **2008**; **Souidi**, **2008**; **Maatallah** and ***al.***, **2011**). The study of **Messaoui** (**2011**) showed that the dry sand contains fecal contamination germs rates much higher than the wet sand and seawater at beaches of BeauSejour, Eden, Andalusians and Maddagh of Oran west.

Spatial Evolution of bacterial pollution

For Dahliss beach (commonly called French beach), the quality of its bathing water is good. This is due to several characteristics: its location far from any urban center, the absence of industrial facilities, low population absent throughout the year except for weekends and summer season. These results are lower than the standards or guides peremptory norms; but that does not exempt subject to continuous monitoring throughout the period of attendance at the beach by the various summer visitors (resident or foreign).

Sidi-Moussa station is polluted throughout summer period when the maximum value is very high in August. This is due to the different mansions built, excessive population density, number population varying from 500 to 1000 (**POS**, **1998**), heavy rainfall recorded in April and May, values are respectively 47,4 and 68,6 mm causing uncontrollable flows inexorably spilling pollutants flow (**ONM**, **2010**) and discharge of domestic sewage directly into the sea without any treatment. All homes feature pits, lacking the sewage system without forgetting the presence of a small port at this station, frequented by many trawlers and pleasure boats.

The results of analyzes and commentaries on the state of the beaches, and interpretation of results, are regularly transmitted in the form of weekly and monthly reports to the Wilayas and agencies, to keep them informed on the quality of bathing water. Such information shall be made through the website of the agency (www.APPL.dz), to public knowledge, as stipulated in Law n°03-02 of 17.02.2003 laying down general rules for use beaches and tourist exploitation.

Statistical Analysis

Standard method ranks

The order numbers associated with these percentages are: $n_{50} = 24 * 0{,}50 = 12$ and $n_{90} = 24 * 0{,}90 = 21{,}6 \approx 22$

The concentrations of total coliforms (TC), fecal coliforms (FC) and fecal streptococci (FS) can be read as being associated with order numbers n_{50} and n_{90} = 12 = 22. Bacterial concentrations estimated in 50 and 90% are stated in Table1.

Table1. Bacterial concentration of two stations

Parameters of quality of bathing water	Microbial concentrations		
	Criteria	Sidi-Moussa	Dahliss
CT_{50}	500	950	90
CT_{90}	5000	2200	460
CF_{50}	100	93	17
CF_{90}	1000	950	70
SF_{50}	100	40	08
SF_{90}	1000	150	40

Results of table1 confirm that bacteriological quality of water of beach Dahliss is good for swimming and poses no health risk to bathers, for against that of Sidi-Moussa is polluted and requires a ban permanent bathing saw the dramatic depletion of sand and presence of a resident population on these sites and absence sewerage of domestic waste water.

The correlation coefficients between TC/FC and FC/FS recorded for sea water taken from both sites are respectively r = 0,928 and r = 0,944. These results are in favor of a very significant correlation.

IV. CONCLUSION

Good quality of bathing water is an undeniable tourist attraction for coastal communities; it is synonymous with a good management of Environment and of coastal ecosystems.

The bacteriological analysis of seawater is important for the chemist where it is interesting to know the exact chemical composition of the water and for the hygienist to know its particular quality bathing water that must obey defined criteria (**Mouffok**, **2004**).

In our study, although short (spread over four months of the summer season 2012), we deduce that the waters of Sidi-Moussa station are more contaminated than beach Dahliss. We counted fairly high levels of bacteria (total and fecal coliforms, fecal streptococci), which reflect the risks to people attending these environments but we have not isolated *Salmonella*, *Staphylococcus* and *Vibrio cholerae*. The installation of waste water treatment plant gray water is needed to avoid any risk of contamination and pollution, the consequences are often irreversible.

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