INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 1, p. 112-117, 2014

RESEARCH PAPER OPEN ACCESS

Assessment of the bacteriological contamination of the wastewaters in Annaba's main discharges in North-Eastern Algeria

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Key words: Wastewaters, Annaba, bacteria, fecal contamination indicators, pollution.

doi: http://dx.doi.org/10.12692/ijb/4.1.112-117 Article published on January 01, 2014

Abstract

In order to study the spatiotemporal evolution of the bacteriological quality of the wastewaters from the city of Annaba (Eastern Algeria), samples were taken on a fortnight basis from March 2012 to February 2013 at the three main sites of discharge. The Results show that the concentrations of fecal indicators contamination during low flow periods are higher than those recorded in the rainy season at the three sites. Total coliforms are higher ($1000x\ 10^3$ germ/100ml) in the dry season than during the rainy season ($2x10^3$germ/100 ml) in the first site, the number of fecal coliforms is higher in the dry season ($40x10^2$ germ/100ml) than during the rainy period ($6x10^2$ germ/100ml) in the second site and the number of fecal streptococci in the dry season is higher ($30x10^2$ germ/100ml), than in the rainy season (10^2 germ /100ml) in the third site. Hence, we can notice a phenomenon of dilution. Results display the presence of pathogen bacteria, such as salmonella and shigella.

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Introduction

Environment is viewed as the life milieu of man, animals and plants; it is an elaborated system of several compartments (air, soil, water), naturally balanced. Unfortunately it happens that man, by his actions, disturbs the harmony. This is what we call pollution, pollution is defined as a particular negative externality, since it involves the relationship between the economic sphere and the environment (Guétondé, 2006). We can distinguish three types of pollution: Space, air and water pollution, the last one may be due to the massive discharge of untreated wastewater and also the development of the industry, intensive agriculture and household activities have introduced in the water cycle of chemical and biological substance, more and more a significant part reaches the shallow groundwater, rivers and water bodies. Urban concentration of population increases this pollution (Gerard, 1999). Is not easy to account for the pollution in the world but we can locally monitor the quality of water by an analysis that allows us to appreciate the importance of microbiological pollution at physicochemical daily discharged into the natural environment, the bacteriological analysis of the wastewaters can be considered as a simple means of epidemiological monitoring of enteric infections. Indeed when this analysis is performed periodically it can help to make a list of enteric pathogens circulating in the population, because the pathogen portion of wastewater reflects the health of the population of the region (Payment, 2003). The region of Annaba like all Algerian regions cannot escape these problems .This study consists of a bacteriological analysis of the portion of the wastewaters generated by the urban population of the city of Annaba and contributes to the establishment of a useful technical reference in the management of sanitation sector in the city. Through this work, we evaluate the bacteriological characteristics of the wastewaters three urban sites (Forcha Oued, El Bouni and Boukhadra). The study will also try out the bi-monthly variations in the sites and make a comparison between these discharges that are studied for the first time. The purpose of this study is to draw the attention of those responsible for conveying wastewater to the treatment plant Annaba to treat before discharge into the aquatic environment.

Materials and methods

Description of the site

The wilaya of Annaba is located in eastern Algeria, between latitudes 36 ° 30 N and 37 ° 30 N and longitude 7 ° 20 E and 8 ° 40 E. Its area is 1411.98 km2, its population has increased in recent years to 650 000 inhabitants. It is bounded to the south by the wilaya of Guelma, to the west by the wilaya of Skikda, in the east by the wilaya of El Tarf (Tunisian border) and to the north by the Mediterranean Sea (Semadi, 2010) , our work was carried out at three sites in the center of this city site 1 (Boukhadra), site 2 (El Bouni) and Site 3 (Oued Forcha) (Figure 1).

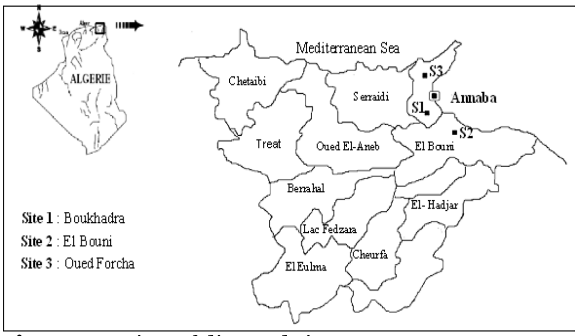

Fig. 1. Location of disposal sites.

Sample collection

The wastewaters sampling was performed bimonthly from March 2012 to February 2013 in sterile glass bottles with a capacity of 250 ml. The wastewater was sent to the laboratory in a cooler where the temperature is maintained at 4 ° C (Rodier, 2009).

Results and discussion

The results of the count are shown in Figures (2) to (7). Figure (2) represents the spatio-temporal distribution of total coliforms in the three discharges sites. The distribution of total coliforms respectively varies from 2 to 1000 $x10^3$ germs/100 ml in Site 1, from 0.9 to 250 $x10^3$ germs/100ml in site 2 and from 1 to 90 $x10^3$ germs/100 ml in site 3. These values are higher than those found by Ait Hamou *et al.* (2000). The seasonal evolution of total coliforms is marked by the decrease values in winter and increase in summer due to the dilution Servais *et al.* (2009), we record a very marked July rise in the site1, similar results were recorded by Larif *et al.* (2013).

Figure (3) shows the number of fecal coliforms in the three sites, concentrations of fecal coliforms are between 8 and 800 x10^2 germs/100ml in Site1, between 6 and 40 x10^2 germs/100ml in site 2 and between 3 and 40 x10^2 germs/100ml in site 3. These values are in agreement with the values previously determined by Khalaf *et al.* (2009) and are lower than those found by (Eddabra, 2011, El Haite, 2010, Salama *et al,* 2012.) and higher than those found by Ait Hamou *et al.* (2000). At Site 1, the seasonal evolution of the germ is characterized by maximum growth in July.

Table 1. The bacteriological indicators are shown in the following table.

Germs sought	Description of the method	References
Total Coliforms	*Milieu PCA (standard agar with glucose) / incubation at 37 ° C.*	Rodier, 2009
Fecal Coliforms	*Milieu présomptif : Lactose Broth proupre of bromocrésole double concentration with bell Durhan / Incubation at 37 ° C for 24 hours.* *Milieu confirmatif : (test Mackenzie) Shubert-peptone water free of indole - Incubation at 44 ° C*	Rodier, 2009
Fecal streptococci	*Milieu présomptif : Rothe (D / C) - Rothe (S / C)*	Rejsek,2002
Sulphite-reducing clostridia	*Milieu* : Liver Meat Additive: Sodium Sulfite-ferric ammonium citrate	Rodier, 2009
Salmonella typhi and Shigella	*Milieu d'enrichissement* : sodium selenite broth *Milieu d'isolement : S-S agar, Mac conkey,* Agar hectoen - Description of bacteria with Gram Stain- oxidase test-identification through classical biochemical gallery	Rejsek, 2002

Figure (4) shows the results of the counting of fecal streptococci in the three sites, the counting of fecal streptococci varies between 1 and 40 x10² germs/100ml in Site 1, between 3 and 250 x10² germs/100ml in site 2 and between 1 and 30 x10² germs/100ml in site 3. These results are consistent with those obtained by Khalaf *et al.* (2009) and are lower than those found by (Eddabra, 2011, Salama *et al*, 2012.). The counting of fecal streptococci revealed during the track, an increase in the number of germs in March and May in site 2 that bacterial growth can be explained by the rise in temperature which is a factor proliferation of indicator bacteria pollution (Souiki, 2008).

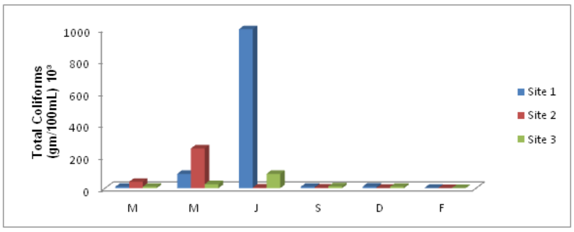

Fig. 2. The spatio-temporal distribution of total coliforms.

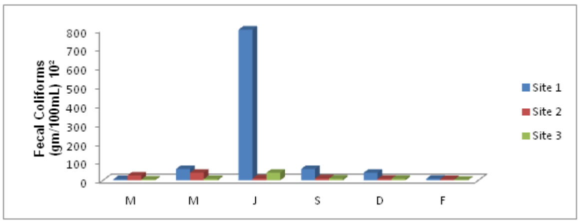

Fig. 3. The spatio-temporal distribution of fecal coliforms.

Fig. (5) highlights the counting of Clostridium in the three discharges sites. The results vary between 1 and 1000 x10² germs /ml for site1, between 2 and 30,000 x10² germs /ml for site 2 and between 2 and 35 x10² germs /ml for site 3. These results show a seasonal evolution in site 2 by the growth of the germ from spring to summer with higher concentrations in summer and falls in winter Bou Saab *et al.* (2007). The presence of sulphite-reducing clostridia in waswater indicates a terrestrial contamination (Rejesk, 2002).

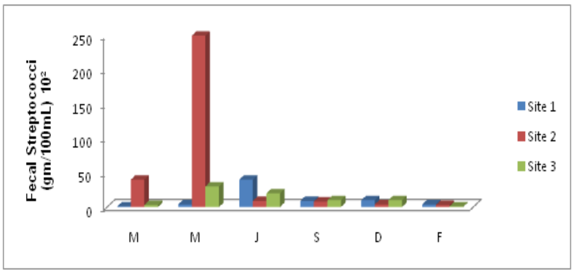

Fig. 4. The spatio-temporal distribution of fecal streptococci.

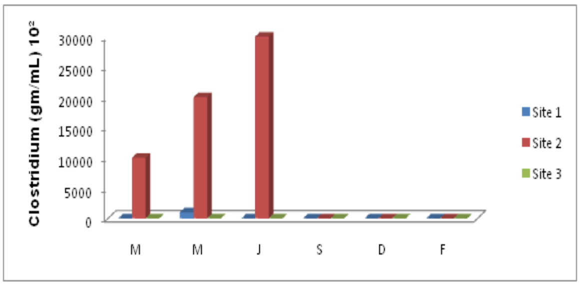

Fig. 5. The spatio-temporal distribution of sulphite-reducing clostridia.

Figure (6) represents the spatio-temporal distribution of Salmonella in the three discharges sites. The distribution ranges from 0.9 to 7 x10² germs /ml in Site 1, from 1 to 4 x10² germs /ml in site 2 and between 1 to 3 x10² germs /ml in site 3. These values are higher than those found by Ait Hamou *et al.* (2000). We record an increase in the number of germ at sites 1 and 2 during the period of our experiment, and a disturbance between decrease and increase between seasons for site 3.

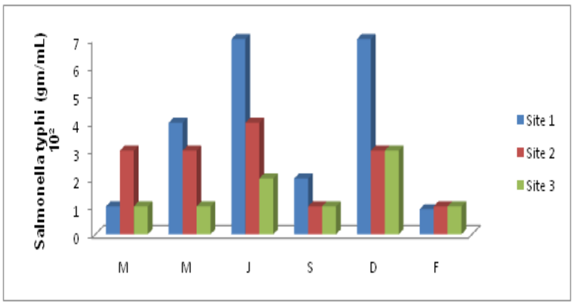

Fig. 6. The spatio-temporal distribution of salmonella typhi.

Figure (7) represents the counting of Shigella in the three discharges sites. The counting is between 0.7 and 1 x10² germs /ml in Site 1, between 0.8 and 3 x10² germs /ml in site 2 and a constant value of 1 x10² germs /ml during the period of experimentation in our site 3. The results of counting Shigella show constant values during the period of parallel work in sites 1 and 3 that there is no space-time evolution which can be explained by the lack of correlation between environmental parameters and the bacteria Kim *et al.* (2005), Except Site 2 the counting of the germ is characterized by a remarkable growth during the summer, however, a reduction in the number of Shigella in winter due to the dilution Servais *et al.* (2009).

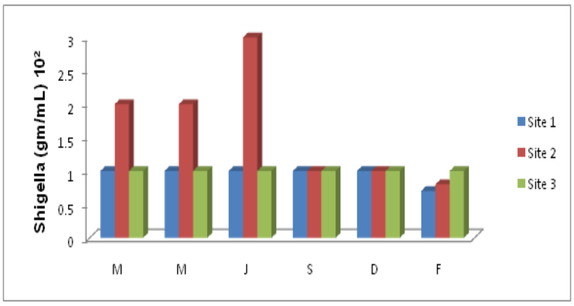

Fig. 7. The spatio-temporal distribution of shigella.

Conclusion

Wastewater from the city of Annaba has high concentrations of fecal indicators, the wastewater had their bacterial charge must not be discharged directly into the marine ecosystems they may have a considerable environmental impact especially, when they are vectors of water-borne germs. In our study the bacteriological water monitoring confirmed fecal contamination due to the presence of total coliforms, fecal coliforms, fecal streptococci and sulphite-reducing clostridia and also a pathogenic contamination due to the presence of Salmonella and shégella this sewage can cause severe nuisance to the public so it requires treatment to improve their quality and to avoid degradation of the receiving Milieu.

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