

Evaluation of bacteriological and parasitological quality of wastewater of the city of Oujda (Morocco)

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ABSTRACT

The urban wastewater contains and can convey a wide variety of pathogens (bacteria and parasites) to humans and can contaminate its sanitation.

The city of Oujda rejects daily 40.000 m³ of wastewater concentrated in different pollution loads. The microbial concentration of Total Coli forms, Fecal Coli forms and Fecal Streptococci are very high, its average concentration is respectively 2,9 10⁸, 3,0 10⁷ and 4,3 10⁵ bacteria per 100 ml. Analysis with Bailenger technique of helminthe eggs showed the presence of two kinds of parasites: nematodes and cestodes. The concentration of the two groups of parasites is respectively 32,59 eggs/L (88,24%) et 4,34 eggs/L (11,75%).

These concentrations are very high and exceed largely the WHO norms concerning not restrictive irrigation waters.

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KEYWORDS

Oujda;
Waste water;
Sample;
Bacteria;
Parasite;
Treatment.

INTRODUCTION

For several decades, as a result of rapid urbanization, large economic concentration and increased volumes of wastewater discharged, agriculture has developed in urban and suburban areas of Morocco. The use of wastewater in irrigation on a large scale is presented as an alternative solution to overcome the problem of water.

Wastewater is a valuable resource for irrigation mainly in areas where water resources are scarce and mobilized agricultural demand is intense. They also have a fertilizer value for crops because they contain nutrients and can lead to improved yields.

Urban wastewaters contain many germs (fungi, amoeba, protozoa, bacteria, viruses) some are pathogenic. Coli forms and streptococci evidence of fecal contamination of these waters that is imperative to purify in order to preserve the natural environment^[1].

The microorganisms in wastewater consist mainly of bacteria and helminthes. The use of untreated wastewater for irrigation may raise different issues mainly about health. One of the main sources of helminthes infections around the world is the use of no treated wastewater or partially treated sewage for irrigation of food crops^[2,3].

The aim of this study is to evaluate the quality of microbiological and parasitological load of wastewater

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of the city of Oujda (Morocco) to show the necessity of treatment before its reuse in agriculture.

MATERIAL AND METHODS

During the period of study, which takes one year (January 2011 to December 2011), was adopted composite sampling with weekly measurements for bacteria and parasites from wastewater. The points of sampling are located at the entrance of the Wastewater Treatment Plant of the city of Oujda (seven kilometers north of the city).

Technique for preparing dilutions

We made dilutions during the study phase to calculate the number of microorganisms. We had proceeded as follows^[4]:

1. With a sterile pipette 1 ml aseptically transferring 1 ml sample of wastewater in a test tube or a sterile vial containing 9 ml of diluents. Shake vigorously. We obtain the dilution of 1:10.
2. With a new sterile pipette 1 ml, transfer 1 ml of the 1:10 dilution in a second test tube or vial containing 9 ml sterile diluents. Shake vigorously. We obtain the dilution 1:100.

3. Repeat step 2 as required, by transferring 1 ml each time of the last dilution in another test tube or vial containing 9 ml of diluents. Thus, a series of dilutions Further, 1:1000 and 1:10000, etc. (For the use of highly diluted samples, do not forget that untreated wastewater usually contain 10^7 - 10^9 fecal coli forms per 100 ml).

Bacteriological analysis

Bacteriological analysis focused on the quantification of fecal bacteria: fecal coli forms (FC), total coli form (TC) and fecal streptococci (FS). The samples were taken monthly. Counting of CF and SF was performed according to the indirect method of multiple tube fermentation in lactose broth; the number was then subtracted statistically using the method of the most probable number^[5]. On pathogens, only Salmonella and Staphylococcus were determined, given the epidemiological risk associated with their presence in the water to be reused. Enumeration of staphylococci was performed on Chapman medium. The detection of Salmonella was performed according to the simple method of nutrient broth pre-enrichment followed by enrichment in selenite broth. The isolation was then performed on agar deoxycholate citrate lactose. Typical colonies were

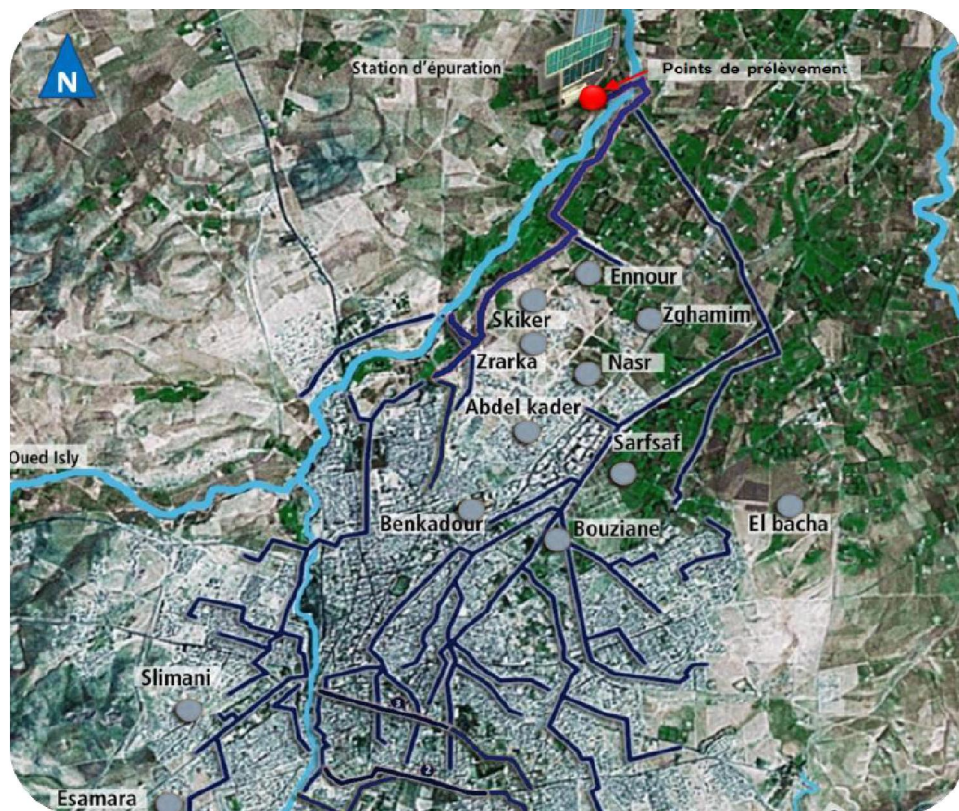


Figure 1 : Wastewater sampling points of the city of Oujda

identified or suspected by biochemical tests.

Counting methods used for their specificity and speed calculations are similar to MPN (Most Probable Number). Like all bacteriological analyzes, they have a confidence interval. In our case this confidence interval is $\pm 95\%$ [- / 2: 2] or ± 0.3 log.

Parasitological analysis

Parasite load of wastewater of the city of Oujda was determined monthly according to Technique of Bailenger recommended by WHO^[6]. Eggs were counted using a blade Mac Master 0.3 ml. The total number of helminthes eggs (N) per liter of wastewater is calculated from the following formula:

$$N = A \cdot X / P \cdot V$$

N = number of parasites per liter wastewater sampled.

A = counted number of parasites on the blade Mac Master

X = final volume of product (ml).

P = capacity blade Mac Master (0,3 ml).

V = initial sample volume of wastewater to be analyzed (2 liters).

RESULTS AND DISCUSSION

Bacteriological characterization

The average load of total coli form (TC), fecal coli forms (FC) and fecal staphylococci (SF) received by the wastewater treatment plant Oujda was evaluated and the results are presented in the TABLE 1 below.

TABLE 1 : Average load of total coli forms, fecal coli forms and staphylococci of wastewater in the entrance of WWTP of Oujda

Pathogens/100ml	Load in wastewater
CT	2,9 10 ⁸
CF	3 10 ⁷
SF	4,3 10 ⁶
CF/SF	6,9

The microbial concentration of CT, CF and SF of wastewater of Oujda is very high. The average charges for different bacterial populations studied are respectively 2.9 10⁸, 3.0 10⁷ and 4.3 10⁵ bacteria per 100 ml. These values are in the same order of concentration as those typically encountered in urban effluents^[7-11]. Also, this bacterial load exceeds largely that recommended by WHO for irrigation water which is of the

order of 1000 CFU/100 ml^[12]. Moreover, the ratio CF/SF is greater than 1, which suggests a fecal contamination of wastewater Oujda is of human origin^[13-15].

Parasitological characterization

The parasitological study of wastewater of Oujda was assessed by a technique of Bailenger, this method detect mainly helminthes eggs. Microscopic examination of the samples studied yielded the results summarized in TABLE 2 below.

TABLE 2 : Mean concentration of helminthes of wastewater of Oujda

Helminthes species	Average concentration (eggs/liter)
Ascaris sp	17,11
Strongyloides sp	11,57
Toxocara sp	1,55
Nematodes Trichuris sp	1,31
Enterobius sp	0,62
Ankylostoma sp	0,43
Total	32,59
Teania sp	2,03
Cestodes Hymenolepis sp	1,74
Moniezia expansa	0,57
Total	4,34

Nine species of helminthes belonging to two classes (nematodes and cestodes) were identified. The class of nematodes, most diverse is represented by eggs of Ascaris sp, Strongyloides sp, Toxocara sp, Trichuris sp, Enterobius sp and Ankylostoma sp, the cestodes are represented by the species of Teania sp, Hymenolepis sp and Moniezia expansa. Concentrations of the two groups of parasites are respectively: 32.59 eggs / L (88.24%) and 4.34 eggs / L (11.75%). The predominance of nematode eggs could be explained by their high resistance to different factors in wastewater and their mode of transmission characterized by a direct cycle^[16-18]. According to several authors^[19-21], the concentration of helminthes eggs is strongly related to demographic factors. This parasitological analysis shows that these waters exceed strongly the standards set by WHO and the Norms and Standards Committee of the Ministry of Environment of Morocco (1egg helminthes per liter), this water cannot be used in agriculture without treatment and can pose a potential major hazard to the health of farmers and consumers.

This study also highlighted the qualitative and quan-

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titative variations of helminthes eggs of wastewater of Oujda depending on the season (TABLE 3).

TABLE 3 : Seasonal variation of helminthes of wastewater of Oujda

Helminthe species	Saison				
	Autumn	Winter	Spring	Summer	
Nematodes	Ascaris sp	14,52	10,05	19,23	24,61
	Strongyloides sp	13,41	14,13	10,67	8,07
	Toxocara sp	1,06	0,67	1,34	3,11
	Trichuris sp	0,88	0,22	1,76	2,37
	Enterobius sp	0,23	0,11	0,95	1,14
	Ankylostoma sp	0,31	0,15	0,53	0,74
	Teania sp	1,78	1,15	1,98	3,20
Cestodes	Hymenolepis sp	1,53	0,52	1,90	3,01
	Moniezia expansa	0,17	0,07	0,46	1,61
Total	33,89	27,07	38,82	47,86	

Seasonal variation of parasite load of two classes of helminthes shows high concentrations during the seasons of summer and spring, respectively, 47.86 and 38.82 eggs/L and lower concentrations during autumn and winter and are respectively 33.89 eggs/L and 27.07 eggs/L. WHO studies indicate that the abundance of helminthes eggs in spring and summer is due to the conditions of temperature, moisture, oxygen and solar radiation favor the maturation of helminthes^[22,24].

CONCLUSION

The bacteriological and parasitological load analysis of wastewater of the city of Oujda has showed that the concentrations of total coli forms, fecal coli forms and staphylococci and helminthes eggs are far exceed the standards recommended by the World Health Organization and the Moroccan standards of water used for irrigation, that hence the need for good treatment before use in order to avoid population to contamination and disease.

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