Microbiological Quality of Drinking Water At Arid Zones In Adrar South Algeria

M. KIHAL[*], Z. BOUTIBA[**], DE. HENNI * and A.K.Al-ABOUDI*
*Laboratoire de Microbiologie Appliquée
**Laboratoire de Biologie et Pollution Marines,.
Département de Biologie, Faculté des Sciences. Université d'Oran .Bp 16 Es-senia. .

Summary

From ancient times the arid zones of Sahara, south Algeria, stay in a good state without signified contamination with biological and chemical matters. At the last five decades, the zones show large movement of population, therefore that became a new source of microbial and chemical contamination. The microbiological quality of drinking water has been evaluated in 28 samples from underground wells and foggara water which were analyzed. The essential microflora : aerobic bacteria (29,33 ± 0,44) cfu per100 ml, total coliforms (6,6 ± 0,15) cfu per 100 ml, fecal coliforms (2,33 ± 0,42) cfu per 100 ml and fecal streptococci (1,51 ± 0,66) cfu per 100 ml. The pH ranged from 6,22 to 7,34. Likewise, in 100 % of drinking water more than 71,42 % was non drinking water.

Keys word : Drinking water, coliforms bacteria, foggara,Adrar, Algeria, arid zones.

RESUME

Les régions arides au Sahara étaient considérées longtemps comme des zones non polluées par des éléments biologiques et chimiques. Mais, durant ces cinq dernières décennies, ces régions ont subit une augmentation démographique assez importante, ce qui a entraîné une pollution des eaux souterraines par ces éléments. Notre étude consiste à évaluer la qualité sanitaire microbiologique des eaux de consommation. 28 échantillons provenant de puits et de foggara ont été analysés. La microflore présente est constituée de bactérie aérobie (29,33 ± 0,44) ufc/100 ml, de coliformes totaux (6,6±0,15) ufc/100 ml de coliformes fécaux (2,33 ± 0,42) ufc/100 ml, de streptocoques fécaux (1,5 ± 0,66) ufc/ 100 ml. Les valeurs du pH enregistré varient de 6,22 et 7,34. Cependant, 71,42 % des échantillons analysés représentent une eau non potable.

Mots clés : *Eau de consommation, coliformes, bactérie, foggara, Adrar, Algérie, zones arides*

INTRODUCTION

Drinking water, may be not pure water in the same means, may it means different thins for other different peoples, but for the population of Sahara the water have one meaning, that is life for them. Of course they treat wells and foggara water as domestic water and they look for many characters as color odor, taste and safety to health, but they have not opinion about the risk and the level of contamination which happened in the last fifty years

Many parameters can measured to show a wide view of future these regions. This part of study fixed about the microbiological quality of drinking water, when the next part will be continued to test the other sides of study, especially about chemical contamination to measure the solid and ions concentrations of drinking and irrigation waters.

The darkness, little light in the depth wells of foggara has some effects on viability and activity of microorganisms and so long canals also have some effects about many characters of water in deferent seasons of year.

Many observations in view of microbiological activities can be observed, because of variation in thermal degree of water and become parameters to study the survival bacteria in these regions, which related with falling water.

Drinking and irrigation water are based on the underground water sources in south Algeria, especially in Adrar region. This water is extracted from wells and foggara. The later system is a parallel wells which are related horizontally by canals connected between wells in different longs (Kobori *et al*., 1982; Reynolds *et al*., 1980). From thousands years ancient population discovered this systems to avoided the vaporization large quantity of water because of high thermal arid zones weather, they are classical systems. During the pass decade, some scientists had focused their studies about the salinity of water and they neglected the contamination of water which is the major cause of outbreaks of diseases such as cholera, thyphoides, amibiases and viral gastroenteritis. Recently, the development of these regions, the increase of the population, the non renewal of water canalization the maintenance of wells and foggara and the important number of septic holes lead to water pollution (Hagedorn *et al*., 1981 and Liniger *et al*, 1998) in difference depths underground.

The aim of our study was to carry out on the pollution of underground and the foggara water in which total coliforms, fecal coliforms, fecal streptococci and aerobic bacteria had been evaluated.

MATERIALS AND METHODS.

***Samples of water* :**

28 samples of water were used in this study. 12 from foggara, 2 from individual wells, one from collective well, 10 from treated water and 3 from untreated water.

Physical and chemical analysis : temperature, turbidity and pH of water were carried out by direct method. The chlorine residual and solid matter of water samples were determined by the method of Rodier (1981) and Tarras *et al.,* (1971).

Bacteriological analysis : total coliforms and fecal coliforms were determined by two methods : the membrane filter method and by serial dilution method (Anon, 1989). Fecal streptococci were isolated in Roth broth and confirmed by Litsky broth. Aerobic bacteria were isolated in trypticase soy agar (TSA). To detect *Salmonella* and

Vibrio cholera two media were used Hektoen and MacConkey. *Staphylococcus aureus* was examinated in Chapman agar medium. All isolated bacteria were characterized morphologically and biochemically (Larpent et Larpent, 1975; Leclerc *et al*., 1995). All experiments were performed in duplicates samples for each test.

Results and Discussion

The levels of biological and chemical contamination in drinking water (wells and foggara) in Sahara are seldom high enough to cause acute health effects. They are more likely to cause chronic health effects that occur after exposure water to small amount of chemical matters because of sand and wind movement in different years seasons

A summary of the results of physical and chemical analysis were given in table 1. The pH values of water varied from 6,22 to 7,34 in wells. Whereas, the pH of foggara water was 6,22. the solid matter was (3,01 ± 0,14) mg l^{-1} . The chlorine residual was 0,66 mg l^{-1} of the treated water. The water temperature varied from 20 °C to 26, 33 °C for all the year.

Table 1. Physical and chemical analysis of the water samples

Origin of samples	Number of samples	Temperature(°C)	pH	Solid matter (mg l^{-1})	Chlorine (mg l^{-1})
Untreated water	03	26,33 ± 0,07	7,34	1,38 ± 0,73	00
Treated water	10	21,55± 0,23	6,87	1,47 ± 0,15	0,66 ± 0,13
Individual wells	02	21,5 ± 0,13	6,49	1,99 ± 0,48	00
Collective wells	01	20,5	6,22	2,34 ± 0,11	00
Foggara water	12	23,62 ± 0,33	6,87	3,01 ± 1,42	00

Table 2. Gives the density of different groupes of bacteria show : The highest counts of total aerobic bacteria was obtained in collective wells (92 ± 3,3) cfu ml^{-1}. In the other sides the counts of (29,33 ± 0,44) , (23,08 ± 2) , (18,4 ± 3,26) and (7,7± 2) cfu ml^{-1} were enumerated in untreated water, foggara water, treated water and in individual wells water respectivelly.

The results show that a total coliforms increased in foggara water (10,8 ± 0,2) cfu per 100 ml, only two samples of treated water the count of total coliforms was (3,57 ± 1,4) cfu per 100 ml. Also, the fecal coliforms count was higher in foggara water (9,2 ± 3,1) cfu per 100 ml. The density of fecal streptococci was (7,25 ± 1,65) cfu per 100 ml, where the fecal coliforms and fecal streptococci lead to concluded that human sources predominantly are polluted the wells and foggara water. Similar results were obtained by Al-Sulami and Yasseen (1990) in wells water of the desert west of Basrah city, south of Iraq. Also Wiesmann, (1997) and Bolay *et al.*, (1997) were studied the hygienic of drinking water in Vietnam and Africa respectively.

Table 2. Bacteriological counts of wells and foggara water of arid zones of Algeria.

Origin of samples	Number of samples	Aerobic bacteria	Total coliforms	Fecal coliforms	*Fecal streptococci*	Number of polluted samples
Untreated water	03	29,3 ± 0,44	6,6 ± 0,15	2,33 ± 0,4	1,51 ± 0,66	03
Treated water	10	18,4 ± 3,26	3,57 ± 1,4	3,3 ± 0,6	1 ± 0,2	02
Individual wells	02	7,5 ± 2	4,5 ± 0,75	3 ± 0,66	2,5 ± 0,4	02
Collective wells	01	92 ± 3,3	7	6	4	01
Foggara water	12	23,08 ± 2	10,8 ± 0,2	9,2 ± 3,1	7,25 ± 1,65	12

The number was cfu . ml^{-1} in the aerobic bacteria and cfu per 100 ml in the other groups

Biochemical identifications have been carried out on all isolated bacteria. The predominant genera found in the arid zones, south Algeria, were : *Escherichia coli*, *Enterobacter aerogenes*, *Citrobacter freundii*, *Klebsiella pneumoniae* var. *oxytoca* and some species of *Aeromonas*. Whereas, *Salmonella*, *Clostridium*, *Vibrio* and pathogenic *staphylococci* species have not been detected in this part of study.

These results suggested that foggara water is well contaminated than other source of water in the region of Adrar. It may be due to the concentration of the solid matter which helped the micro-organisms proliferation (Yates and Yates, 1990, Angehm *et al*., 1997). Lechevalier *et al*., (1991) who had reported that waters containing greater than 50 µg l^{-1} of organic carbon always exhibited development of heterotrophic plate count bacteria. Whereas, Paul *et al.*, (1995) who also had observed and suggest that organic carbon may often be a growth-limiting nutrient in drinking water for fecal indicator bacteria. Those studies combined with our results, presented here, demonstrate that a mechanism exists for the fecal contamination of the subsurface and surface environments by wastewater disposal practices in arid zones of south Algeria. Arid zones water of south Algeria still need for more chemical and biological studies and the connected these studies with the health state of nomads.

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