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PROTABILITY OF GROUND WATER IN WADY EL-HYAT, LIBYA

By

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SUMMARY

Eighty (80) samples of ground water in Wady EL-Hyat, Libya have be studied to evaluate its Potability for human and animal consumption. The chemical analysis of the collected samples revealed that the mean values of nitrite, nitrate, chloride, sodium, potassium, calcium, magnesium and total hardness were 0.15, 22.5, 160.75, 97.5, 6.7, 55.6, 22.6 and 341.2 mg/l, respectively. The results also showed that the mean values of iron, copper and lead were 0.47 mg/l, 0.31 mg/l and 32.5 µg/l, respectively. The obtained data of bacteriological examination showed that the mean values of total colony count/ml, coliform count /100 ml and E. *coli* count /100 ml, were 82.2 , 40.2 and zero, respectively. High percentages of samples lay within the permissible limit recommended by WHO except for iron, and total colony count where the number of samples lay within the permissible limit were 66.5% and 60%, respectively. The hygienic significance as well as the sanitary measures suggested for prevention of chemical and bacterial pollution of ground water were discussed.

INTRODUCTION

Although artificial pollution of natural water resources in tropical Africa is still comparatively low, and limited to the vicinity of large urban centers and mining areas, the potable quality of water can not be taken for granted, particularly since only a small percentage of the population has access to treated water.

One of the primary conditions for maintaining livestock and human health is the hygienic suitability of water in use. Ground water is (normally) clean and has a good taste and is generally free from suspended solids and objectionable odour, but it contains higher concentration of dissolved solids than surface water in the same locality , In addition to a large number of elements can be traced in ground water some of them were found in concentrations of significance for human health **(Bjorvatn et al., 1997).**

Ground water has been considered safe sources for drinking water that protected against surface contamination. However, a number of reports about chemical and microbiological contamination have disproved this assumption **(Dott et al., 1986; Okun, 1992, Raja et al., 2001, Muhammetoglu et al., 2002 and Zhu et al., 2006).**

The ground water represented by means of wells is often of better quality than surface water. This is true only if the soil or rock is fine-grained and does not have cracks, crevices and bedding plants, which permit free passage of polluted water. However in passing water through soil that is rich in decomposing organic matter, the water take up a rather large amount of carbon dioxide. Thus the water become acidulated and has a great solvent action for lime and other mineral constituents **(Gorden et al., 1974).**

Ground water sources of raw water used for drinking may be subjected to contamination from different sources with several types of micro-organisms which impair water utility and usually render it unsuitable for drinking **(W.HO., 1970 and 1998).** Such pollution of underground waters occurred either through the storage on the surface ground or into soil of water products containing these substances or through their discharge into the water stream **(Zamfir and Nastase, 1975 and Onwuka et al., 2004).**

Heavy metals and other trace elements have been considered as a dangerous substances causing serious health hazards to human and other living organisms, through progressive irreversible accumulation in their bodies as a result of a repeated consumption of small amount of theses element **(Wheaton and Lawson, 1985 Raja et al., 2001, and Hill et al., 2005)**.

The major interest of public health authorities in issuing standards for drinking water was focused on the identification, quantification and evaluation of microorganisms connected with water borne disease. Routine microbiological monitoring of water supplies is primarily based on test for coliforms. These organisms have been used successfully for indicating contamination and treatment failures, but may need supplementing with other organisms to further improve confidence in water supply hygiene **(Lee, 1991)**. The aim of this work is the evaluation of ground water Potability for animal consumption in Wady EL-Hyat, in Libya.

MATERIALS AND METHODS

Work was started in October 2005 up to May 2006 with field programs constituting a major part of the workload (Wady EL-Hyat, Libya). In total, 40 private wells throughout Wady EL- Hyat area, were physically inspected and sampled. From these visits a total of 80 samples were collected and analyzed for a variety of determinants including bacteria, major ions and metals. All tested wells were pumped for 5-10 minutes to obtain a representative water sample.

Sampling for chemical analysis

Eighty water samples were collected in a clean, white two liter polythene container. Place the inner cap and label the container with all of the required source data and the samples should be send to the laboratory within 24 hours after collection.

Sampling for bacteriological examination:

Eighty water samples were collected from the same wells. The water samples were collected in presterilized 250ml, glass bottles. The collected water samples should be placed in an ice box , delivered to the laboratory as soon as possible and labeled properly before they were despatched .

Chemical analysis:

Chemical analysis included the following:

1- Nitrate: Estimated by Bruccine method recommended by **APHA (1965).**

2- Chloride: Estimated by agrenometric method according to **APHA, (1985).**

3- Sodium and potassium were determined by flame photometry method.

4- Heavy metals (lead, iron and copper) were determined by using atomic absorption spectrophotometer (Perkin Elmer) with alteration of burner head, hollow cathode lamp, wave length and slit in relation to the examined metal.

5- Calcium and magnesium were determined by using titrimetric method **(APHA 1985).**

Bacteriological examination:

1- Total colony count/ml, using standard plate count **(Cruckshank, et al., 1980).**

2- Coliform count /100ml using M.P.N method **(W.H.O, 1985).**

3- Typical E.*coli* count /100ml using M.P.N method **(APHA, 1976).**

RESULTS

The results displayed in Table (1) showed that the mean values of nitrite and nitrate were 0.15 ± 0.5 and 22.5 ± 7.2 mg/l, respectively. On comparing the obtained results of nitrite and nitrate with the guideline values stated by WHO (1984), 91.25% and 81.29% of the examined water samples lay within the permissible limit and can be accepted for drinking use. Chloride was recovered from examined ground water with a mean value of 160.75 ±23.5. The obtained results demonstrated that 85% of water samples contain chlorides within the permissible limit.

The mean values of sodium, potassium, calcium and magnesium were 97.5 ± 31.5, 6.7 ± 2.7, 55.6±17.2 and 22.6 ±6.15 mg/l, respectively. Theses results revealed that 95%, 100%, 85% and 92.5%of the examined water samples of sodium, potassium, calcium and magnesium, respectively, lay within the standard permissible limits recommended by **WHO(1984)**.

Regarding the total hardness, the results given in the aforementioned table (1), revealed that the mean value was 341.2 ± 41.5. On comparing these results with the standard permissible limit of WHO (1984), it was found that the total hardness in 87.5% of the investigated water samples, laid within the permissible limits and are acceptable for drinking use.

Concerning heavy metals (Table 2) the mean values of iron, capper and lead were 0.47 ± 0.12 mg/l, 0.31± 0.02 mg/l and 32.5 ± 5.12μg/l , respectively. Regarding the guideline values mentioned by **WHO (1984)**, the obtained results showed that 66.25%, 100% and 97.5% of the samples laid within the permissible limits of iron, copper and lead, respectively.

The results of bacteriological examination presented in Table (3) pointed out that the mean values were 82.2 ± 19.5, 40.2 18.6 and zero for total colony count/ml, coliform count /100ml and E.*col.* count /100ml,, respectively. Comparing theses results with the guideline values stated by **WHO (1985)**, we found that, 60%, 86.25% and 100% of the results within the permissible limit concerning total colony count, coliform count and E. *coli* count, respectively

Table (1): Concentrations of chemical elements in examined ground water samples

Parameter	Minimum	Maximum	Mean S.E	%of the samples within P.L.	W.H.O. Guideline value (1984)
Nitrite	**0.0**	**0.52**	**0.15± 0.05**	**91.25**	**0.0**
Nitrate	**7.0**	**63**	**22.5 ± 7.2**	**81.25**	**45mg/l**
Chloride	**17**	**281**	**160.75 ± 23.5**	**85.0**	**250mg/l**
Sodium	**18**	**217**	**97.5± 31.5**	**95.0**	**200mg/l**
Potassium	**2**	**18**	**6.7± 2.7**	**100**	**20mg/l**
Calcium	**25**	**256**	**55.6± 17.2**	**85.0**	**200mg/l**
Magnesium	**12**	**67**	**22.6± 6.15**	**92.5**	**50mg/l**
Total hardness	**215**	**650**	**341.2 ± 41.5**	**87.5**	**500mg/l**

P.L : Permissible limit

Table (2): Heavy metals concentrations in the examined water samples:

Parameter	Minimum	Maximum	Mean±S.E	%of the samples within P.L.	W.H.O. Guideline value (1984)
Iron (mg/l)	**0.12**	**1.03**	**0.47± 0.12**	**66.25**	**0.3mg/l**
Copper (mg/l)	**0.09**	**0.81**	**0.31± 0.02**	**100**	**1mg/l**
Lead (μg/l)	**15.0**	**53.0**	**32.5± 5.12**	**97.5**	**50 μg/l**

Table (3): Mean values of bacteriological examination of the ground water samples

Parameter	Bacterial count				
	Minimum	Maximum	Mean±S.E	%of the samples within P.L.	W.H.O. Guideline value (1984)
Total colony count/mL	37	**196**	**82.2± 19.5**	**60**	**Very low**
Coliform count /100ml	**0.0**	**91**	**40.2± 18.6**	**86.25**	**0.0**
E.coli. count /100m	**0.0**	**0.0**	**0.0**	**100**	**0.0**

DISCUSSION

Contamination of ground water sources can occur naturally over very long periods of time, particularly in response to climatic change. But the major cause of contamination by far is man's activity and in this case, contamination can occur rapidly and dramatically.

The significance of nitrate in drinking water has received considerable attention in recent years since the discovery that high concentrations of nitrate in water used in preparing baby formulas may cause blue babies' disease (**Environmental protection Agency, 1991; Okun, 1992 and Haime et al., 1992).** In addition nitrate is toxic for animals and poultry and causes serious troubles on the account of its reaction with haemoglobin to form methahemoglobinaemia **(Clarke and Myra, 1975 and Faust and Aly, 1983).** Our findings agreed with those reported by **Teraoka (1993), Mclay et al., (2001) and Onwuk et al., (2004).**

On other hand, our findings were much lower than those recorded by **Hollander and Sander (1987) and Halwani et al. (1999)** who found that nitrate concentration was above 50 mg/l, with a maximum of 163 mg/l. Nitrates seep slowly into the soil at a rate of about 0.5-1 meter per year until they reach the water table. However, tons of nitrogen are carried into the ground water each year by runoff and infiltration.

High nitrate levels (taken as those > 20 mg/l) can indicate contamination of ground water by sewage effluent, either from sewage treatment plants or from septic tank leakage, from agricultural fertilizer or from the release of nitrates held in the soil profile.

Chloride, the simplest chemical indication of water contamination with sewage effluents, was recovered from ground water with a mean value of 160.75mg/l. The variation in chloride content may be contributed to the difference in the nature of the ground strata and the geological structure of the different localities. The obtained results of chloride in this study were coincided almost with those recorded by **Soltan (1998)**.

The concentration of potassium in most natural water is very low and its presence in water indicate its pollution with sewage. The data obtained for potassium in this study was nearly agreed with those recorded by **Sobih et al.(1988) and Raja et al. (2001)**) who found that the mean value of postassium in ground water were 4.6 and 13.53 mg/l, respectively. On the other hand, the obtained data for potassium were lower than, those obtained by **Ismail and Ramadan (1995)**. The results of sodium were nearly agreed with those reported by **Raja et al., (2001)** and higher than those recorded by **Sobih et al., (1988)**.

Calcium and magnesium are constituents that cause practically all the hardness of water and are the active agents in the formation of the greater part of the scale formed in stean boilers and in other vessels in which water is heated or evaporated. The obtained results of calcium and magnesium were coincided with that reported by **Raja et al., (2001).**

The variation in the hardness content of water affects the efficacy of the drinking water vaccines of poultry , besides the danger of excessive scale formation and dissolving heavy metals **(WHO, 1970 & 1998).** The obtained results in this present study, almost agreed with those recorded by **Sobih et al., (1988) and Soltan (1998)**, but not coincided with that reported by **Ahmed et al., (1996) and Raja et al., (2001).**

Water having a hardness of less than 50 ppm (50 mg/L), generally is rated as Soft, and its treatment for the removal of hardness under ordinary circumstances is not necessary. Hardness between 50 and 150 ppm does not seriously interfere with the use of water for most purposes: however it does apprecially increase the consumption of soap.

The quantity of iron in ground water may differ greatly, from place to place., even in water from the same formation. A level of about 0.3mg/l iron, stains laundry and plumbing fixatives and cause undesirable taste and the precipitation of excess iron give an objectionable reddish brown colour to water. The findings of the present study were consistent with those reported by **Ahmed et al., (1996)**, but were not agreed with that recorded by **Tork (1989), Botchway et al., (1996) and Raja et al., (2001).**

Copper is rarely found in ground water but it may enter a water supply from the use of copper piping or from the dosing of an impounding reservoir with copper sulphate for the reduction of algae. The levels of copper in this study were coincided with that recorded by **Botchway et al., (1996).** Our results concerning lead were partially in agreement with those recorded by **Ahmed et al., (1996) and Jirles (1997).**

Contaminated drinking water is a significant factor in the spread of infectious water- related disease, so the prevention of contamination of livestock drinking water with urine, faeces and carcasses is especially important if the presence of a water-born or water-associated livestock disease is suspected. Ground water is normally of high bacteriological quality since the soil usually affords the underlying aquifer a considerable degree of protection against contamination.

The results of bacteriological examination revealed that the colony count alone is of little value in detecting the presence of faecal pollution **(WHO 1971)**. While *E.coli* still preferable water pollution indicators than Bifido bacteria (**WHO 1970 and Okuofu, 1989**). These findings coincided with those reported by **Paull et al., (1995)** who found that water from shallow wells contained higher count of bacteria than deeper wells. On the other hand, the obtained results were much lower than those reported by **Matson et al., (1978) and Robert and Wesley (1983).**

CONCLUSSION

On the basis of our findings we can conclude that there is no sanitary control measures adopted, so that water sources constitute a variety of disease hazards to man and animals. Presence of some heavy metals in amount higher than the permissible limit in water has an important health hazard and may lead to chronic poisoning for man and animals consuming such polluted water. Wells for public water supplies must be located as for as possible from all sources of pollution including septic tanks, drainage system, barn, human dwellings and other activities that may be responsible for extra-load of biological contamination of water sources. Strict hygienic measures should be applied to improve the water quality and safeguard the water user against infection.

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صلاحية المياه الجوفية فى منطقة وادى الحياة- ليبيا

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فى هذه الدراسة تم جمع عدد ثمانون عينة مياه من أربعون بئراً أهلياً تقع فى شعبية وادى الحياة بالجماهيرية العربية الليبية وذلك لتقييم صلاحية المياه الجوفية للشرب. اظهرت نتائج الدراسة للتحليل الكيميائى أن متوسطات العناصر الكيميائية للنيتريت، النترات، الكلوريدات، الصوديوم، البوتاسيوم، الكالسيوم، الماغنسيوم والعسر الكلى كانت 0.15، 22.5، 160.75، 97.5، 6.7، 55.6، 22.6، 341.2 ملجم / لتر ماء على التوالى بينما كانت نتائج العناصر الثقيلة للحديد والنحاس والرصاص 0.47 ملجم/ لتر، 0.31 ملجم/ لتر، 32.5 ميكروجرام/ لتر على التوالى.

إما بخصوص نتائج الفحوصات البكتريولوجية فقد كان متوسط العدد الكلى للبكتريا ، والعدد الاحتمالى لبكتريا القولونية وبكتريا الاشريشيا كولاى هى 82.2 ، 40.2 ، صفر على الترتيب.

أيضا أظهرت نتائج الدراسة أن معظم العينات التى تم تحليلها كيمائياً وبكتريولوجياً كانت تقع داخل المعدلات الدولية لمنظمة الصحة العالمية فيما عدا عنصر الحديد والعدد الكلى للبكتريا.