قسم : صحــة الحيــوان٠

كلية : الطب البيطري ـ جامعة أسيوط٠

رئيس القسم : أ٠د٠ عبدالمعز أحمد اسماعيل٠

التقييم الكيمائي والبكتريولوجي لمياه الشرب الجوفية في مدينة أسيوط

محمد صبيح ، ريم الدسوقي ، يوسف كامل ، جلال الغرابلي*

لقد تم فحص عدد ٢٥ بئرا جوفيا تقع داخل مدينة أسيوط فحصا كيمائيــــا وبكتريولوجيا وقد أوضح الفحص البكتريولوجي عزل الميكروبات التاليــة :

الميكروب المكور العنقودي الذهبي(٢٦٪) وكذلك الميكروبات المعوية (ايشيرشياكولاى ١٢٪) البروتيوس (٩٪) ، ستروبكتر(٢٠٪) وكذلك الكلوستردي‍وم بيرفرنجنز (١٦٪) ،

كما أوضح التحليل الكيمائي لهذه المياة وجود العناصر التالية بالمتوسطات الآتية : الامونيا (٤ مجم /لتر)، النيريت (٤ر١٩ مجم /لتر)، الكلوريد (٥٧ر٧٣ مجم /لتر) البوتاسيوم (٥٣٣ر١٣ مجم /لتر) ، المنجنيز (٤٦٦ر مجم /لتر)، النحاس(١مجم /لتر) الحديدوز (٠٠٨ر٤مجم/لتر)، الزنك(١٣٧رمجم /لتر)، الصوديوم (٣١٨ر٣٨ مجم /لتر) وكذلك الاملاح الذائبة (١٦٨ر٣٢٣ مجم /لتر)٠

وكذلك ناقش البحث الأهمية الصحيةللمكروبات المرضية المعزولة وكذلك‌العناصر الكيمائية المتواجدة في هذه المياة الجوفية والطرق الصحية المستخدمة لمنع تلـوث هذه الميـــاه٠

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* : استاذ بقسم الاراضي بكلية الزراعة ـ جامعة أسيوط٠

Dept. of Animal Hygiene,
Fac. of Vet. Med., Assiut University,
Head of Dept. Prof. Dr. Abdel-Moaz A. Ismail.

CHEMICAL AND BACTERIOLOGICAL EVALUATION OF DRINKING GROUND WATER SUPPLIES IN ASSIUT CITY

(With 4 Tables)

By

M.A. SOBIH; REEM DOSOKY; Y.Y. KAMEL and G.A. EL-GHARABLY*

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SUMMARY

Twenty five well water supplies located at Assiut city were chemically and bacteriologically evaluated. The bacteriological examination revealed the isolation of staphylococcus aureus (26%), E.coli (12%), Proteus spp. (9%), Citrobacter spp. (20%) and Cl. perfringens (16%). The chemical analysis indicated the detection of Ammonia, Nitrite, Nitrate, Chloride, Potassium, Manganese, Copper, Ferrous, Zinc, with a mean value of 4.00, 0.4, 19.9, 73.57, 13.533, 0.466, 0.1, 0.4408, 0.137 sodium 38.318 and total soluble salts (323.168) mg/Lit respectively. The hygeinic significance and measures suggested for prevention of chemical and bacterial pollution of ground water supplies were discussed.

INTRODUCTION

Sanitation of the ground water supplies are still stimulated with considerable interest by many authers all over the world.

Water taken from the ground water by means of wells is often of better quality than surface water. This is true only if the soil or rock is finegrained and does not have cracks, crevies 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 takes up a rather large amount of carbon dioxide. The water, thus acidulated has a great solvent action for lime and other mineral constituent. The major proportion of these soluble constituents furnished by the ground to such water are sodium, calcium, bicarbonate, carbonate and sulfate (GORDEN, et al., 1974; ATTIA and ABD-EL KRIM 1978; and National Academy of Sciences, 1977).

Chloride and nitrate occur to only a limited extent under normal condition in ground water away from sewages, connate water and introduced sea water (HENLEY, 1966; BAIER; 1969; CRABTREE, 1970; ATTIA and ABD EL-KRIM, 1978 and National Academy of Sciences; 1977).

Besides, pollution of the ground water with large number of adventitious microorganisms may occur. Such pollution is mostly derived from water shed crosion as well as drainge from sewage, swamps or soil of high humus content, such hazard is particularly in limestone areas where underground chambers or fissures may permit water to flow in free moving streams without appreciable filttration (HOPKINS and BEAN, 1966).

* : Prof. Dr. Soil Sci. Department Fac. of Agriculture, Assiut University.

The most common pathogenic and potentially pathogenic bacteria recovered from ground water were; Staphylococcus aureus, E. coli, klepsiella pnemoniae, citrobacter freundii, pseudomonas aeroginosa and clostridium perfringens (KARLA et al., 1980; MARK et al., 1980; ATTIA, 1978; SAMAHA, 1985; and ESSA, 1985).

Salmonellae and some other species of pathogenic bacteria have frequently been detected from wells by ESSA, 1985. Salmonella typhimurium may at times cause trouble, as in the big outbreaks in the city of Reverside, California, 1965, where over 16000 persons drinking unchlorinated well water were reported to have been affected with this organism in the space of 5 weeks (ESSA, 1985).

This study was conducted to evaluate the ground water supplies at Assiut city by examination for bacteriological and chemical pollution.

MATERIAL and METHODS

Fifty well water samples were collected from 25 wells distributed at different areas at Assiut Governarate Every well was pumped for sometimes inorder to obtain a representative water sample away from stagnant or contaminated water. Each sample was obtained in a sterile standard glass bottles of one litre capacity, after rinsing the bottle with the water being sampled, the sample was collected and the bottle was securely corked. The samples were iced and transferred as soon as possible to the laboratory for chemical and bacteriological analysis.

I- Chemical analysis :

Estimation of chloride and soluble ions including calcium, sodium and potasium and total soluble salts were determined according to JACKSON (1958). Iron, Zinc, Manganese and copper were determined using atomic absorption spectrophotometer. Ammonia content, nitrite and nitrate were detected by using kits*.

2- Bacteriological examination :

The bacteriological examination of the water sample was carried out according to Baily and scott, 1978, CRUICKSHANK, 1980, and BEERENS, et al., 1980).

2.1. Haemolytic streptococci:

Nutrient broth was used as enrichment medium, crystativolet blood ager as well as blood agar were subcultured from the incubated 24 hrs. broth and incubated at 37°C for 24 hrs. Identification of the pure culture was based on growth character and biochemical activities.

2.2. Enterococci group:

Streptococcus faecalis (S.F) broth was inoculated with the water samples and incubated at 37°C for 18-24 hrs. Macconkey's agar plates subculture from the inoculated broth were similarly incubated for 24 hrs. Representitive colonies were identified according to their cultures characters and biochemical activities.

2.3. Staphylococcus aureus:

NaCl broth was used as enrichment medium. Mannitol salt agar and staph 110 were subcultured from the inoculated broth and incubated at 37°C for 24 hrs. The mannitol fermenting pure cultures were examined for haemlysis on blood agar and for coagulase activity.

*** : Merckoquant 10024 (E. Merk-Darmstadt. F.R. Germany).**

2.4. Enterobacteria:

Membrane filter technique was applied. Water samples were filterated through sartorious mambrane filters with pore size 0.2 Um. Each fitter was divided into two parts, one of them was immersed in selenite F broth, and the other was introduced into MacConkey broth. The inoculated tubes were incubated at 37°C for 18-24 hrs. A loopful from enrichment tubes was carried on MocConkey's and S.S. agar plates and incubated at 37°C for 24 hrs. Identification of the pure cultures was based on growth characteristics and biochemical reactions.

2.5. Clostridium perfringens:

Lactose sulphite broth was prepared and dispensed in about 8 ml in test tubes. 0.5 ml of 1.2% metabisulphite and 0.5 ml of 1.0% aqueous solution of ferric ammonium citrate were aseptically added to each before the use. Each tube was inoculated with one ml of the original sample. The inoculated tubes were incubated at 46°C for 18-24 hrs. Tubes showed black precipitation and gas formation were recorded as positive for clostridium perfringens.

RESULTS and DISCUSSION

The bacteriological examination of water revealed the isolation of different species of bacteria including staph. aureus, E.coli, proteus species, citrobacter species and Cl. perfringens (Table 4).

Staph. aureus were recouered from 29 samples with an over all incidence of 26%. Of these 8% were of haemolytic type and the other 18% were of non haemolytic type. Because of the unexpected isolation of pathogens in drinking water, staphylococcus was investigated more thoroughly and its presence in water may be attributed to contaminated faucet aerator screens (LeCHEVALLIER, 1980). However, S. aureus is one of the most important agents of food poisoning. It is also considered as an eteiologically significant agent in a variety of clinical syndromes including skin obscesses. Pustules, less frequently septicemia, enterocolitis, oestamylitis, and pnemonitis (IVLER, 1974).

E.coli was more frequently recovered from the different water supplies representing 12%. This results are coinside with what were reported by KARLA et al., 1980; MORK et al. 1980; ATTIA and ABD EL-KRIM, 1978 and SAMAHA, 1985). However, the presence of E.coli in ground water is of hygienic importance. It is commonly taken as the most delicate of pllution and its presence indicates runoff contamination and recent faecal pollution (BAGLEY and SIEDLER, 1978; GELDREICH et al., 1964). Moreover, it recovered from a wide variety of diseases in demostic animals including joint ill and white scours in calves, bovinee mastitis in cattle, colibacillosis in poultry (BUXTON and FRAZER, 1977). Also, it has been implicated in cases of gastroentritis, epidemic diarrhea, summer diarrhea as well as other cases of food poisoning in man especially infants and children (ROGERS and KOEGLER, 1961, TULLOCH et al., 1973).

Protus species was detected in water samples with an overall incidence of 9%. They cimprised of Pr. morganii 5% Pr. mirabilis 2%, and Pr. vulgaris 2%. Proteus species is considered as a potentially pathogen and secondary invador in cases of wound infections and diseases in animals and man. It is also recovered from cases of cystitis and pyelitis in man (FRAZIER, 1967, MERCHANT and PARKER, 1967). Moreover, it was encountered in cases of summer diarrhea of infants and food-borne outbreaks as well as sever diarrhea and dysentry in young animals, sheep, goats and dogs (MOUSTAFA et al., 1948; BUXTON and FRAZER, 1977).

Citrobacter spp. were detected from water samples with an incidence of 20%. These organisms are considered as oppartunistic pathogens. They have been associated with cases of enteritis in man (FINEGOLD and MARTIN, 1982).

Cl. perfringens was recovered from 16% of the water samples. Similar results were obtained by ESSA, 1985 who recovered such organisms from wells. The survival of this organism in water is longer than coliform group and its presence in water indicate faecal pollution (W.H.O., 1970) Cl. perfringens is the most common pathogens of sheep causing Braxy like enterotoxaemia, pulpy kidney, gangrenous mastitis and haemorrhagic enterotoxaemia. It may also be responsible for wound infections and food-poisoning outbreaks in man and gas gangrene in animals (DOLL et al., 1970 and DOILY et al., 1981). Streptococcus faecalis as well as the different types of Enterobacteria failed detection in any of the samples examined. A result which is disagree with what has been recorded by SAMAHA, 1985 and ESSA, 1985, who recovered strept. faecalis from ground water. The chemical analysis of water revealed the detection of collection of elements namely Ammonia, nitrite, nitrate, chloride, Manganese, copper, Ferrous, Zinc. sodium, potassium and total soluble salts with a mean value of 4, 04, 19, 73.57, 0.466, 0.1, 0.4008, 0.137, 38.318, 13.533 and 323.168 mg/Litre respectively (Table 1).

Ammonia and their final stages of oxidation including mitrite and nitrate were recovered from water samples with a mean value of 4, 0.4, and 19.4 mg/L respectively. The W.H.O. state that in some circumstances nitrate have been shown to present a health hazard to infants and possibly older children at concentrations greater than 45 mg/L. Water having 10 to 13 mg/Lit N are in use without apparent harmful effect. The acceptable range suggested by W.H.O. for nitrate is 50 to 100 mg/L (11.3 to 22.6 as N). However, water with high nitrate nitrogen content, are known to cause methaemoglobinaemia in young infants.

Chloride, the simplest chemical indication of the amount of sewage effluents, was recovered from ground water with a minimum, maximum and mean value of 34.5, 189.5 and 73.57 mg/L respectively. Such values are more or less lower than the highest desirable level of chloride (200 mg/Lit) recommended by W.H.O.

Potassium was estimated in water with a mean value of 13.533. The concentration of potassium in most natural water is very low and its presence indicate its pollution with sewage. Manganese, the troublesome element in water even when present in small quantities, was recovered from water samples with a mean value of 0.466. Manganese when present in water is offten associated with iron and has a behaviour which is similar, except that the deposits are commulative. High quantities of manganese are toxic and 0.05 mg/Lit is considered as the highest desirable level of such elements (W.H.O.).

Copper was detected in water samples with a mean value of 0.1 mg/L. This element is rarely found in natural waters but it may entre a water supply from the use of copper piping or from the doseing of an impounding reservoir with copper sulphate for the reduction of algae. However, the W.H.O. highest desirable level in drinking water is 0.05 mg/Lit., and the maximum permissible level 1.5 mg/Lit with reference to taste and corrosion is not toxic to humanbienge.

Other elements including sodium, ferrous, and zinc with a mean value of 38.318, 0.4008 and 0.137 mg/L. respectively were recovered from water samples. The total of dissolved solids consists mainly of the common substances listed under the heading of mineral constituents was recovered from ground water with a minimum, maximum and mean value of 198.4, 889.6 and 323.168 mg/Litre respectively. Such value were more or less lower than the highest desirable level (500 mg/L) recommended by W.H.O.

An outstanding feature in our results is the variability of the mineral and bacterial load among the three different locality as shown in Tables (2 and 3). The highest level of the pollutional load was recovered from the university locality followed El-Wilidia and El-Hamera respectively. These finding may be attributed to drainage from cultivated land, concentrated farm yard manure and sewage effluents.

Wells for public water supplies must be located as far as possible from all sources of pollution including barns, privies, cesspools, septic tanks, drainage system and waste disposal. The increasing number of incidens of ground water pollution leads one to question the value of distance as a protection. Instead, it may become necessary to study direction of ground water flow before placing well field or permitting subsurface waste water disposal. However temporary contamination of wells can be overcome by adding bleaching powder or calcium hypochlorite to the water in order to provide a substantial chlorine residual. The study proved to be of value in assessing the possibility of infection with pathogenic organisms when frequently use or continously use such ground water. The chemical and bacteriological finding show that all the water samples present a hazardous risk for users.

REFERENCES

Attia, El.S. and Abdel-Karim, S. (1978): Evaluation of the hygienic condition of different water sources used in Farms in Iraq. Assiut Vet. med. J. Vol. 5 No. 1 & 10.

Bagley, S.T. and R.J. Siedler (1978): Comparative pathogenicity of environmental and clinical klebsiella. Health. Lab. Sci. 15-: 104-111.

Bailey, W.R. and Scott, E.G. (1978): Diagnostic microbiology. A text book for the isolation and identification of pathogenic microorganisms. The C.V. Mosby Comp. SAINT Lois.

Beerens, H. Ramound. ch; Lepage. C. and Criquelion, J. (1980): A direct method for the enumeration of clostridium perfringens in food and faeces. Proceeding of world congress. Foo borne infections and intoxication. Berlin (West) 29, 6, 3-7.

Buxton, A and Frazer, G. (1977): Animal microbiology Vol. (Immunology, Bacteriology, Mycology, Diseases of fish and Laboratory methods. Block well scientific Publications.

Crabtree, K.T. (1970): Nitrate variation in ground water: Technical completation report OWRR B-044 wis office of water resources research.

Cruickshank, R.; Duguid, T.P.; Marmion, B.P. and Swain, R.H. (1980): "Medical Microbiology" 12th Ed., Vol. 11, reprinted churchill livingstone and Robert stevenson Edinburgh, EHI 3HF.

Doily, S.W. and Joseph, J.D. (1981): Identification, distribution, and toxignicity of obligate anaerobes in polluted water. Appl. Enviro. Microb. Vol. 41, No. 4, 1074-77.

Doll, W.; Schuberi, B. and Seeliger, H.R.R. (1970): "An epidemic of food poisoning caused by clostridium per fringens. Altimenta, 9: 16.

Drinking water and Health (1977): The National research council, Washington. D.C.

Essa, Y.M.I. (1985): Bacteriological aspects of water sources, sea food and sewage in Arab Rapublic of Egypt. Ph. D, thesis. FAc. of Med., Cairo-University.

Finegold, S.M. and Martin, W.J. (1982): Cited after Baily and Scott Diagnostic Microbiology, 6th Ed., C.V. Masby Co. St. Louis, toronto Lindon.

Frazer, W.C. (1967): Food Microbiology 2nd Ed., New-York McCraw Hill Inc.

Geldreich, E.E.B.A. Knner and P.W. Kabler (1964): Occurrence of coliforms, faecal coliforms and faecal streptococci on vegetation and insects. Appl. Microbiol. 12: 163-96.

Gordon, A.; Gory, K.; James, J.; Carole, A. and David, G. (1974): Comparative survival of indication bacteria and enteric pathogens in well water. J. Appl. Microbiol. Vol. 27 No. 5: 823-824.

Hopkins, E.S. and E.L. Bean (1966): Water purification control. Fourth Ed. The Williams & Wilkins Comp. Baltimore, Md. 21202. U.S.A.

Ivler, D. (1974): Staphylococcus, p. 91-95 in E.H. Lennette, E.H. spandling and J.P. Truant (ed), Manual of Clinical microbiology, 2nd. Ed. American society for microbiology, washinaton. D.C.

Jackson, M.L. (1958): Soil chemical analysis. the Library on the congress. Willey.

Karla, G. Lamka, Mark W. Lechevallier and Ramon J. Sieder (1980): Bacterial contamination of drinking water supplies in modern rural neighborhood. Appl. and Environ. Microbid. Vol. 39, 734-738.

Lechevallier, M.W. and R.J. Seidler (1980): Staphylococcus aureus in rural drinking water. Appl. Environ. Microb. 39, 739-742.

Merchant, I.A. and Packer, R.A. (1967): "Veterinary Bacteriology and Virology" 7th Ed. Iowa state Univ. Press.: Ames; Iowa. U.S.A.

Moustafa, M.N.E.D.; Elyan, A and Gohar, B.A. (1948): J. of Egyptian Med. Ass. 31, 556.

Rogers, K.B. and Kaegler, S.J. (1961): Intestinal cross infection with type strains of Bacterium coli. J. Hyg., 49.

Samaha, H. (1985): The hygienic quality of some well water samples in Behera and Alexandria Governorate, Fac. of Vet. Med. Alex. Univ. Press. Vol. I. Jan. 236-258.

Smith, S.O. and J.H. Baier (1969): Report in nitrate pollution of ground water, Nassau, county, long island. Bureau of water resources, Nassau country department of health, Mincola, N.Y.

Tullock, F.F., Ryan, K.J., Formal, S.S. and Franlin, F.A. (1973): Envasive enteropathogenic E.coli dysentry. An outbreaks in 28 adults. Ann. Interna. med. 79, 1, 13.

W.H.O. (1970): European standards for drinking water. Geneva Suitzerland.

Table (1): Minimmum, and mean values of estionated elements present in the examined well water samples.

Element	minimum mg/Litre	maximum mg/Litre	mg/Litre	Standard Limit* mg/Litre
Ammonia	0.00	10.0	4.00	
Nitrite	0.00	10.0	0.4	50 mg/Litre
Nitrate	0.00	60.0	19.4	
Chloride	34.5	189.5	77.57	200
Sodium	23.92	75.9	38.318	250
Potssium	5.85	35.7	18.533	Very low
Copper	0.00	0.14	0.7	0.05 mg/Litre
Ferrous	0.00	1	0.4008	0.3
Zinc	0.00	0.33	0.137	5.0
Manganese	0.00	1.35	0.466	0.05
Total soluble salts	198.4	889.6	323.168	500

* : Highest desirable level in drinking water supplies (W.H.O.).

Tale (2): Mean values of the estimated elements of groun water samples at the three different localities.

Elements	Locality		
	Assiut -University	El.Wilidia	El. Hamera
Ammonia	4.66 mg/L	4.00 mg/l	3.33 mg/L
Nitrite	2.32	2.00	0.00
Nitrate	16.00	26.00	13.3
Chloride	80.4	68.76	52.7
Sodium	52.8	39.99	24.6
Potassium	11.6	12.46	6.33
Copper	0.025	0.06	0.08
Ferrous	0.31	0.26	0.3
Zinc	0.14	0.05	0.04
Manganese	0.53	0.99	1.08
Total solids	400.93	325.76	212.2

Table (3): Pathogenic and potentially pathogenic as well saprophytic bacteria recovered from ground water.

Locality	No. of sample	Type of isolates								
		Slaphylococci		Enterobacteriacaea						Cl. perf.
		Haemdytic	Non haem.	E.coli	Proteus	Aik.fac.	Citrobact	Herella	Edw.	
University	32	8	6	6	7	9	1	5	1	7
El-Hamera	6	–	5		–	–	–	–	–	1
El-Wilidia	10	1	9		–	–	6	–	–	2

Table (4): Summarised results of the bacteria recovered from the ground water samples.

Types of isolates	Number	Percentage %
Staph. aureus (haemolytic.)	8	8
Staph. aureus (non-haemoly).	9	18
E.coli	6	12
Pr. morganii	5	10
Pr. mirabilis	1	2
Pr. vulgaris	1	2
Citrobacter. spp.	10	20
Alkalig. Faecalis	16	32
Herella	5	10
Edwardersilla	1	2
Cl. perfringens.	8	16