GREENING THE DESERT

Report on
Water Sample Analysis of Sekem Farm, El-Wahat, Egypt.

Prepared by
Assistant Prof. Dr. Ahmad Abdelhalim

July 2020
Cairo, Egypt

Contents

1. Introduction

Since greening the desert is one of the most important issues at all, Sekem have started to reclaimed 63 hectares of desert land through sustainable agriculture in El-Wahat, Egypt in order to create a sustainable community aming to decrease undesirable climate change, produce organic food, create jobs and provide suitable level of education. It is well known that greening the desert depends on water availability and quality. Therefore Sekem has provided pivot irrigation systems which required a regular check to ensure its suitability for drinking and irrigation. Believing that water quality verification is the responsibility of Sekem partners in Heliopolis univeristy, faculty of pharmacy collected water samples from various locations in the farm to be under bacteriological and chemical investigation.

1.1 Bacteriological Examination[1,2]

All water has some form of bacteria in it. The presence of bacteria does not mean the water is unsafe to drink. Only disease-causing bacteria known as pathogens lead to disease. Your test results should include total coliform bacteria. Total coliform bacteria are a group of several kinds of bacteria commonly found in the environment, including soil, vegetation and untreated surface water. They also are found in the intestinal tract of warm-blooded animals, including humans. A positive total coliform test would indicate unsanitary conditions and the possible presence of disease-causing organisms that may pose a special health risk. Shock chlorination should be performed on a source that reports a positive result.

1.2 Alkalinity[1,2]

Alkalinity is a measure of the capacity of water to neutralize acids. The predominant chemicals present in natural waters are carbonates, bicarbonates and hydroxides. The bicarbonate ion is usually prevalent. However, the ratio of these ions is a function of pH, mineral composition, temperature and ionic strength. Water may have a low alkalinity rating but a relatively high pH or vice versa, so alkalinity alone is not of major importance as a measure of water quality. Alkalinity is not considered detrimental to humans but generally is associated with high pH values, hardness and excessive dissolved solids. High-alkalinity waters also may have a distinctly flat, unpleasant taste. Treatment is an ion exchange via the addition of a tank media or reverse osmosis.

1.3 Calcium and Magnesium[1,2]

Calcium and magnesium are the main contributors to water hardness. When water is heated, calcium breaks down and precipitates out of the solution, forming scale. Maximum limits have not been established for calcium. Magnesium concentrations greater than 125 mg/l may have a laxative effect on some people. Treatment for calcium is softening (tank media) and reverse osmosis. Magnesium levels can be controlled through distillation.

1.4 Chloride[1,2]

High concentrations of chloride ions can cause water to have an objectionable salty taste and corrode hot-water plumbing systems. High-chloride waters have a laxative effect for some people. An upper limit of 250 mg/l has been set for chloride ions, although noticing the taste at this level is difficult, and even higher concentrations do not appear to cause adverse health effects. An increase in the normal chloride content of water may indicate possible pollution from human sewage, animal manure or industrial wastes.

1.5 Color[1,2]

Color may indicate dissolved organic material, inadequate treatment and high disinfectant demand, and may indicate the potential for the production of excessive amounts of disinfectant byproducts. Inorganic contaminants, such as metals, are also common causes of color. In general, the point of consumer complaint is variable, ranging from 5 to 30 color units, although most people find color objectionable in excess of 10 color units. Other contaminants that may be related to change in water color include aluminum, copper, foaming agents, iron, manganese and total dissolved solids. Treatment is reverse osmosis.

1.6 Conductivity[1,2]

Conductivity is a measure of the conductance of an electric current in water. This is an easy measurement to make and relates closely to the total dissolved solids (mineral) content of water. The maximum contaminant level (MCL) is less than 2.1 dS/m. Treatment with reverse osmosis is effective for drinking water purposes.

1.7 Iron and Manganese[1,2]

Iron in concentrations greater than 0.3 mg/l and manganese in concentrations greater than 0.05 mg/l may cause brown and black stains on laundry, plumbing fixtures and sinks. A metallic taste also may be present, and it may affect the

taste of beverages made from the water. High concentrations of iron and manganese do not appear to present a health hazard. Treatment includes a water softener or iron filter for iron and reverse osmosis for manganese.

1.8 Nitrates[1,2]

The results reported for nitrates can be confusing because they may be reported as nitrogen (N) or nitrate-nitrogen or as nitrate (NO3). The following are the maximum levels for each:

1- Nitrogen (N) or nitrate-nitrogen (NO3-N) should not be higher than 10mg/L.

2- Nitrate (NO3) should not be higher than 45mg/L.

High nitrate levels may cause methemoglobanemia (infant cyanosis or "blue baby disease") in infants who drink water or formula made from water containing nitrate levels higher than recommended. Adults can drink water with considerably higher concentrations than infants without adverse effects. Treatment of such water includes anionic ion exchange, reverse osmosis, distillation and/or deionization.

1.9 pH[1,2]

The pH of water is a measure of acidity or alkalinity. Because pH can be affected by dissolved minerals and chemicals, it is an important indicator of the change in water chemistry.

According to the U.S. Environmental Protection Agency, drinking water with a pH between 6.0 and 9.5 generally is considered satisfactory. Water with a pH below 6 or above 9.5 can be corrosive to metal plumbing pipes and fixtures. The pH of water can affect the performance of pesticides, particularly herbicides.

1.10 Sodium[1,2]

Sodium is a very active metal that does not occur naturally in a free state. It always is combined with other substances. In the human body, sodium helps maintain the water balance. Human intake of sodium is mainly influenced by the consumption of sodium as sodium chloride or table salt. The contribution of drinking water is normally small, compared with other sources. The treatment for certain heart conditions, circulatory or kidney diseases, or cirrhosis of the liver may include sodium restriction. Diets for these people should be designed with the sodium content of their drinking water taken into account. The National Academy of Sciences has suggested a standard for public water allowing no more than 100 mg/l of sodium. This would ensure

that the water supply adds no more than 10 percent of the average person's total sodium intake. The American Health Association recommends a more conservative standard of 20 mg/l to protect heart and kidney patients. Softening by ion exchange or limesoda ash increases the sodium content approximately 8 mg/l for each gr/gal (grain per gallon) of hardness removed. Treatment includes the use of potassium chloride instead of sodium chloride softener pellets (softener salt) or, alternatively, restricting drinking water from this source.

1.11 Sulfates[1,2]

Water containing high levels of sulfates, particularly magnesium sulfate (Epson salts) and sodium sulfates (Glauber's salt) may have a laxative effect on people unaccustomed to the water. These effects vary among individuals and appear to last only until they become accustomed to using the water. High sulfate content also affects the taste of water and forms a hard scale in boilers and heat exchangers. The upper limit recommended for sulfates is 250 mg/l. Treatment includes reverse osmosis.

1.12 Total Dissolved Solids (TDS) [1,2]

High concentrations of TDS may affect taste adversely and deteriorate plumbing and appliances. The EPA recommends that water containing more than 500 mg/l of dissolved solids not be used if other less mineralized supplies are available. However, water containing more than 500 mg/l of TDS is not dangerous to drink.

1.13 Total Hardness[1,2]

Hardness is the property that makes water form an insoluble curd with soap and primarily is due to the presence of calcium and magnesium. Very hard waters have no known adverse health effects and may be more palatable than soft waters. Hard water is primarily of concern because it requires more soap for effective cleaning; forms scum and curd; causes yellowing of fabrics; toughens vegetables cooked in the water; and forms scale in boilers, water heaters, pipes and cooking utensils. The hardness of high-quality water should not exceed 270 mg/l (15.5 grains per gallon) measured as calcium carbonate. Water softer than 30 to 50 mg/l may be corrosive to piping, depending on pH, alkalinity and dissolved oxygen. Water softeners will correct hard water of more than 270 mg/l.

1.14 Sodium adsorption ratio(2) (SAR)

SAR is an irrigation water quality parameter used in the management of sodium-affected soils. It is an indicator of the suitability of water for use in agricultural irrigation, as determined from the concentrations of the main alkaline and earth alkaline cations present in the water. It is also a standard diagnostic parameter for the sodicity hazard of a soil, as determined from analysis of pore water extracted from the soil. in general, the higher the sodium adsorption ratio, the less suitable the water is for irrigation.

2. Sampling

Samples were collected on 28/06/2020 from the following locations

1- Main house (Sekem farm, El-Wahat)
2- Pivot 2 (Sekem farm, El-Wahat)
4- Pivot 23 (Sekem farm, El-Wahat)
5- Before Filter (Sekem farm, El-Wahat)
6- After Filter (Sekem farm, El-Wahat)
7- Tap water 1 (faculty of pharmacy, Heliopolis University, Cairo)
8- Tap water 2 (faculty of pharmacy, Heliopolis University, Cairo)

3. Results of Analysis

Bacteriological examination and chemical analysis of water Samples collected from Sekem farm, El-Wahat and tap water of the faculty of pharmacy, Heliopolis University are listed in **Table 1, 2**. Samples were analyzed in microbiology lab and water lab in Heliopolis University.

4. Drinking water Limits[1,2]

Limits of some substances and characteristics of drinking water accordion to EPA and WHO are listed in **Table 3**

5. Conclusion

A total coliform bacteria and Salmonella results indicates that none of these bacteria were detected in the sample. Therefore, the water may be considered safe for human consumption. On the other hand, the chemical analysis test results indicate this water samples meet EPA and WHO drinking water standards.

6. Remarks

1- Samples of Sekem farm, El-Wahate did not underdo bacteriological examination, only one sample of tape water 1 from the faculty of pharmacy was examined.
2- Sample taken before and after filtration show nearly the same results meaning that filtration step is not for removal of ions.
3- Samples, Tap water 1 and Tap water 2, that was taken from the same place one after another showed different results for some parameters.
4- Some important ions like Iron has not been measure because of the lab decision.
5- Samples that was collected from Sekem farm, El-wahat and from tap water of the faculty of pharmacy, Heliopolis University, Cairo, were found to be of the same quality as they shown nearly the same results.
6- One extra sample of unknown source has been found in the analysis results under the name W_9.

7. Recommendations

1- All samples should have undergone bacteriological examination.
2- Samples should be analyzed in another lab for matching the results.
3- Several parameters should be included in sample analysis like toxic chemical substances, chemical substances that may affect health, and Substances and characteristics that may affect the acceptability of water **(Table 4)**[1,2].

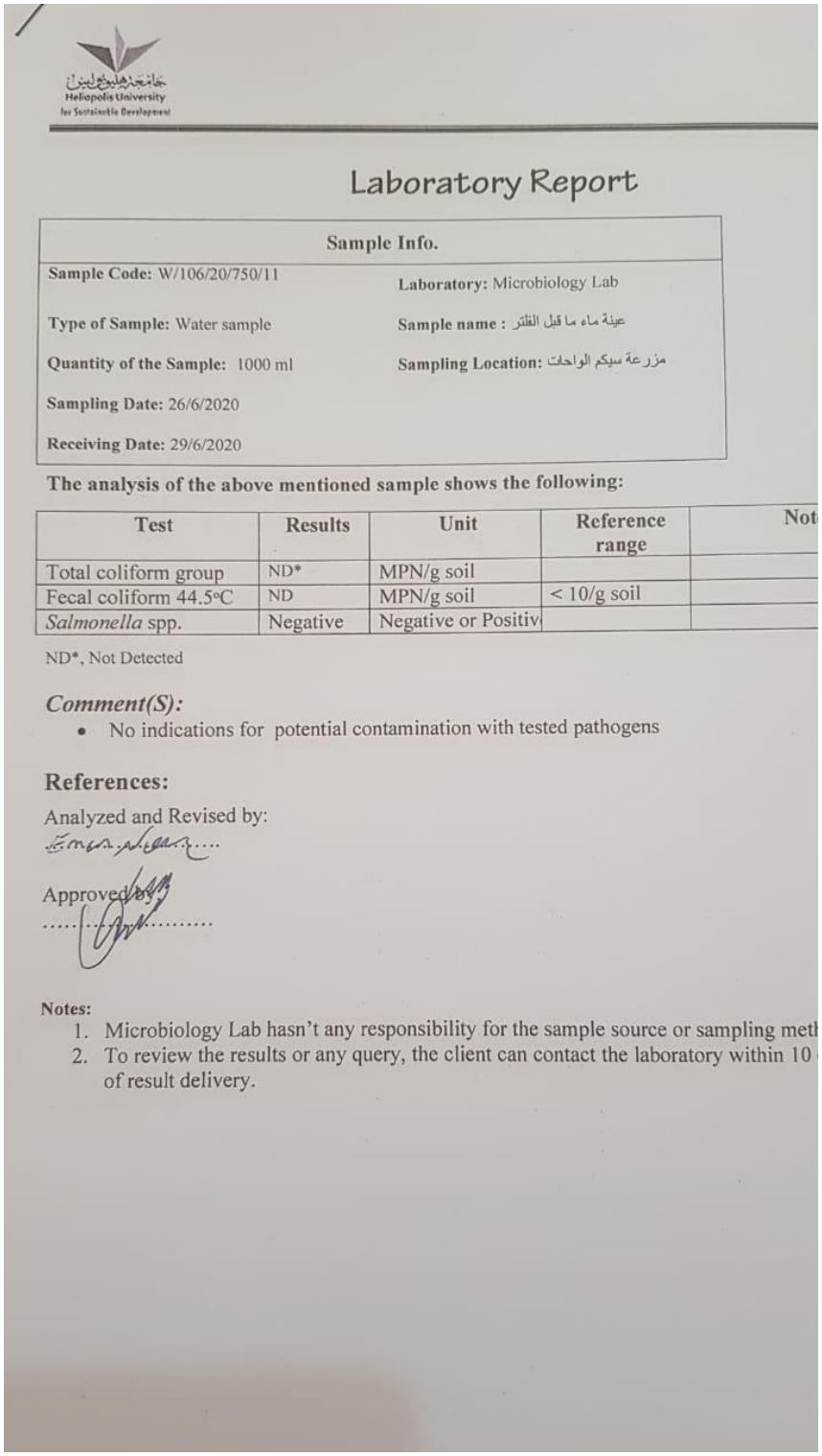
8. Acknowledgement

Special thanks to Mr. Helmy Abouleish for his financial support, logistics, and directions. Great thanks to Prof. Dr. Mohamed Youssri, Prof. Dr. Gouda Helal and Prof. Dr. Rasha El-kholy for their approval and facilities they provide.
Many thanks for Prof. Dr. Sameh fekry for collecting samples.

9. References

1- Drinking Water Standards and Health Advisories, EPA, 2018.
2- Guidelines for drinking-water quality, 4th edition, incorporating the 1st addendum, WHO, 2017.

Table 1: Bacteriological examination of tape water 1, Faculty of pharmacy, Heliopolis Universiy.



جامعة هليوبوليس
Heliopolis University
for Sustainable Development

Laboratory Report

Sample Info.	
Sample Code: W/106/20/750/11	**Laboratory:** Microbiology Lab
Type of Sample: Water sample	**Sample name :** عينة ماء ما قبل الفلتر
Quantity of the Sample: 1000 ml	**Sampling Location:** مزرعة سيكم الواحات
Sampling Date: 26/6/2020	
Receiving Date: 29/6/2020	

The analysis of the above mentioned sample shows the following:

Test	Results	Unit	Reference range	Not
Total coliform group	ND*	MPN/g soil		
Fecal coliform 44.5°C	ND	MPN/g soil	< 10/g soil	
Salmonella spp.	Negative	Negative or Positiv		

ND*, Not Detected

Comment(S):

- No indications for potential contamination with tested pathogens

References:

Analyzed and Revised by:

Approved by:

Notes:

1. Microbiology Lab hasn't any responsibility for the sample source or sampling meth
2. To review the results or any query, the client can contact the laboratory within 10 of result delivery.

Table 2: Chemical analysis of water samples collected from Sekem farm, El-Wahat.

Parameter	Main house		Pivot 2		Pivot 23		Before filter		After filter		Tape water1		Tape water1	
	meq / L	**mg / L**	meq / L	**mg / L**	meq / L	**mg / L**	meq / L	**mg / L**	meq / L	**mg / L**	meq / L	**mg / L**	meq / L	**mg / L**
EC (ds/m)	0.37		0.3		0.3		0.3		0.3		0.31		0.31	
pH	7.05		6.74		7.15		7.05		6.9		7.28		7.12	
Ca^{+2}	0.5	**10**	0.3	**6**	0.6	**12**	0.4	**8**	0.4	**8**	1.3	**26**	2.1	**42**
Mg^{+2}	1.5	**18**	1.4	**16.8**	1.9	**22.8**	1.8	**21.6**	1.9	**22.8**	1.4	**16.8**	0.3	**3.6**
Na^{+}	0.2	**4.6**	0.2	**4.6**	0.3	**6.9**	0.2	**4.6**	0.2	**4.6**	0.3	**6.9**	0.5	**11.5**
K^{+}	1	**39**	1	**39**	1	**39**	1	**39**	1	**39**	0.2	**7.8**	0.2	**7.8**
CO_3^{-2}	0	**0**	0.3	**9**	0.3	**9**	0.3	**9**	0.4	**12**	0.4	**12**	0.3	**9**
HCO_3^{-2}	0.9	**27.45**	1	**30.5**	1	**30.5**	1.1	**33.55**	1	**30.5**	0.6	**18.3**	1.2	**36.6**
Cl^{-}	2	**71**	1.6	**56.8**	2.2	**78.1**	1.5	**53.25**	1.5	**53.25**	2	**71**	1.5	**53.25**
SO_4^{-2}	0.1	**4.8**	0.1	**4.8**	0.2	**9.6**	0.1	**4.8**	0.1	**4.8**	0.1	**4.8**	0.1	**4.8**
SAR	0.3		0.2		0.2		0.2		0.2		0.3		0.5	
TA	1.6		1.9		1.7		1.7		1.5		1		1.6	
THW	2.5		2		2.3		2.2		2.4		2.7		2.4	
$CaCO3^{-2}$		**125**		**100**		**115**		**110**		**120**		**135**		**120**
SP %	8.1		6.7		6.7		6.7		6.7		9.7		16.1	
PSP %	20		15.4		33.3		20		18.2		15		35.7	

Table 3: Limits of some substances and characteristics of drinking water accordion to EPA and WHO.

Parameters	EPA	WHO
EC (ds/m)	2.1	----
pH	6.5 – 8.5	6.5 – 8.5
Ca^{+2} (mg/L)	----	75
Mg^{+2} (mg/L)	----	50
Na^{+} (mg/L)	100	----
K^{+}	----	----
CO_3^{-2}	----	----
HCO_3^{-2}	----	----
Cl^{-} (mg/L)	250	200
SO_4^{-2} (mg/L)	250	----
SAR	13	----
TA	----	----
THW (mg/L)	270	500
$CaCO3^{-2}$	----	----
SP %	----	----
PSP %	----	----

Table 4: Parameters that should be included in water sample analysis

Toxic Chemical Substances	Chemical Substances that may Affect Health	Substances and Characteristics Affecting the Acceptability of Water
Arsenic	Fluorides	Suspended matter
Cadmium	Nitrates	Total solids
Cyanide	Polynuclear aromatic hydrocarbons (PAR)	Anionic detergents
Lead		Mineral oil
Mercury		Phenolic compounds
Selenium		Iron
Pesticides		Zinc