**Bacteriological and physico-chemical evaluation of certain sources of drinking water in Qalubia and pretreatment by NR-CB nanocomposite**

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The present study is conducted to assess physico-chemical and bacteriological analysis of Nile river water and well water as a source of drinking purposes in Qalubia, Egypt. The results obtained were compared with WHO and EPA standards for drinking water. Determination of temperature, turbidity, electrical conductivity, total alkalinity, total hardness, total dissolved solids, chlorides, calcium hardness, magnesium hardness, pH, Ca, Mg, Fe and Mn of water samples were carried out to evaluate the nature and quality of water. With exception of turbidity, calcium hardness and magnesium hardness of well water and Nile river water, also total dissolved solids, total alkalinity, calcium, iron and manganese of well water, the other physico chemical parameters were within the standard levels. The pretreatment with NR-CB nanocomposite; turbidity, iron, magnesium, calcium and manganese of well water and Nile river water were within standard levels after 2 h and 3 h of treatment. Non of the well water and Nile river water complied with bacteriological standards as total bacterial count, total coliform and fecal coliform. Pretreatment with NR-CB nanocomposite reduced total bacterial count, total coliform and fecal coliform to permissible limits according to EPA guide standards. Bacterial species (*Aeromonas sobria, Escherichia coli, Staphylococcus aureus, Pseudomonas putida* and *Leclercia adecarboxylata*) that isolated from Nile river water and bacterial species (*Staphylococcus aureus, Aeromonas sobria* and *Staphylococcus hominis*) isolated from well water were completely removed from water after pretreatment with NR-CB nanocomposite.

**Keywords:** Drinking water**,** bacterial analysis, physic-chemical analysis, water pretreatment

 Quality of drinking water is a powerful environmental determinant of health (Singla *et al.,* 2014). Although it is plentiful in nature, occupying 71% of the earth's surface, only 1% is accessible for human consumption. Thus, the quality of this 1% drinking water is a powerful environmental determinant of health, as it has an important impact on health of people. Water of poor quality can cause diseases like diarrhea, typhoid, paratyphoid fever, bacillary and amoebic dysentery and it can contribute to varying rates of diseases which manifest themselves on different time scales (Taiwo *et al*., 2010 and Miranzadeh *et al*., 2011). According to World Health Organization (WHO), mortality caused by water associated diseases is more than 5 million per year (WHO, 2013). Access to potable drinking water had improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation (Cabral, 2010). Although the access to potable drinking water is increasing, the quality of drinking water has deteriorated, due to the presence of toxic elements, which even in trace quantities, can pose serious health issues. Besides the geochemical strata of ground water sources, this problem is mostly caused by the indiscriminate discharge of industrial effluents in the natural water bodies (Ikem *et al*., 2002 and Nickson *et al*., 2005). World Health Organization (WHO, 2003) showed essential parameters of drinking water quality, total coliforms, fecal coliforms, chlorine residual, turbidity, pH, electric conductivity and temperature. The rapid growth in nanotechnology has significant interest in the environmental application of nanomatrials. One of the latent applications of antimicrobial nanomaterials is their use in water treatment (Rajendran *et al*., 2015).They also added; Nanoscaled chitosan has latent drinking water disinfection application as an antimicrobial agent in membranes, sponges or outside coating of water storage tanks. The aim of this study was to evaluate the general physico chemical and bacteriological analysis of two sources of water (well water and Nile river water) used for drinking in Qalubia governorate. Also the present work focused on the reduction of high level of physic chemical parameters and the removal of bacteria from drinking water samples by pretreatment with NR-CB nanocomposite.

**MATERIALS AND METHODS**

*Sample collection*

The present study was extended from winter 2013 to autumn 2014 during four successive seasons. Water samples were collected from two sources used for drinking purpose. The first source is a well water in Sheblanga village, Qalubia governorate. The second source is Nile river water at Benha city, Qalubia governorate. Water samples were collected in triplicates into sterile bottles and transported to the laboratory in ice box and kept at 4 ºC and analyzed within 24 h. Sampling was carried out according to Standard Methods for Examination of water and wastewater (APHA, 2005).

*Physico-chemical analysis*

Physico-chemical parameters included temperature, turbidity, pH, electric conductivity, total dissolved solids, chlorides, total alkalinity, total hardness, calcium hardness, magnesium hardness, calcium, magnesium, iron and manganese contents were determined according to the methods described in APHA (2005).

*Bacteriological analysis*

Spread plate method was used to enumerate total bacterial count. 0.1ml of a suitable dilution of sample was distributed over surface of nutrient agar medium by glass spreader. Inoculated plates were divided into two sets; one was incubated at 22 ºC to enumerate saprophytic bacteria and the other was incubated at 37 ºC to enumerate parasitic bacteria (Clark, 1971). Some bacterial colonies were isolated on agar slant and identified by VITEK 2 compact system. Total coliforms (TC) and faecal coliforms (FC) were enumerated using the most probable number (MPN) technique**.** MacConkey broth medium was used for determination of TC and FC, acid and gas indicated positive reaction. Positive tubes in total coliforms were subcultured on fresh single MacConkey broth tubes and incubated in 44.5 ºC for 24 h for fecal coliform bacteria (APHA, 2005).

*Pretreatment of water by NR-CB nanocomposite*

Natural rubber-carbon black (NR-CB) nanocomposite was added to the tested water sample by 20 g/l for 3h with aeration using air supply. An appropriate sample was taken after 1 h, 2 h and 3 h for physico-chemical and bacterial analysis**.** In NR-CB nanocomposite, natural rubber (NR) had been used as the base to prepare nano polymer composite which has been mixed with a high level of carbon black (CB), Fast Extrusion Furnace Black (FEF). An open mill had been used to mix NR and FEF and other chemical ingredient necessary for rubber matrix vulcanization, ZnO as activator, processing oil, Stearic acid, sulphur for matrix cross linking and CBS (N-cyclohexyl-2-benzothiozolyl sulfonamide)as accelerator. The obtained composite had been subjected to vaulcanization in an autoclave under pressure 1.5 atm and temperature 121 ºC for about 2 hrs. The vulcanized nano polymer composites was grinded using special mill to obtain small grains ranged between 0.5 to 2 mm in size

**RESULTS**

 Physical and chemical characteristics of well water and Nile river water are shown in table 1. Temperature of Nile river water and well water during winter, spring, summer and autumn was (20-27-28-25 ºC) and (20-26-27.5-24 ºC), respectively. The highest value was in summer and the lowest was in winter. Turbidity (NTU) of river water and well water

Table 1.Physico-chemical parameters of Sheblanga well water and Nile river water in Qalubia with respect to seasons during 2013 – 2014

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EPA standard** | **WHO****standard** | **Nile river water** | **Sheblanga well water** | **Tested parameters** |
| Autumn | Summer | Spring | Winter | Autumn | Summer | Spring | Winter |
| - | - | 25 | 28 | 27 | 20 | 24 | 27.5 | 26 | 20 | Temperature ºC |
| 1 | 1 | 5.2 | 5.9 | 9.6 | 3.4 | 1.39 | 6.1 | 23 | 4 | Turbidity (NTU) |
| 6.5-8.5 | 6.5-8.5 | 8 | 7.8 | 8.6 | 8 | 7.5 | 8 | 7.7 | 7.7 | pH |
| 1500 | 1500 | 492 | 448 | 409 | 415 | 1555 | 1484 | 1507 | 917 | Conductivity(US/Cm) |
| 500 | 1000 | 324.7 | 295.6 | 269 | 273.9 | 1026 | 913.44 | 994.6 | 605 | TDS (mg/l) |
| 250 | 250 | 27 | 26 | 30 | 21.5 | 145 | 160 | 260 | 178.5 | Chlorides (mg/) |
| 250 | 250 | 198 | 180 | 200 | 210 | 430 | 380 | 300 | 474 | Total alkalinity(mg/l)  |
| 350 | 350 | 160 | 144 | 148 | 185 | 390 | 440 | 448 | 490 | Total hardness(mg/l) |
| 200 | 200 | 85 | 73 | 80 | 95 | 240 | 300 | 320 | 322 | Ca2+hardness(mg/l) |
| 150 | 150 | 75 | 71 | 68 | 90 | 150 | 140 | 44 | 168 | Mg2+hardness(mg/l) |
| 80 | 80 | 34 | 29.2 | 32 | 38 | 96 | 120 | 128 | 128.8 | Calcium (mg/l) |
| 30 | 30 | 15 | 71 | 16.32 | 18 | 30 | 33.6 | 10.56 | 40.32 | Magnesium (mg/l) |
| 0.3 | 0.3 | 0.12 | 2.94 | 0.4 | 0.34 | 0.83 | 0.758 | 0.571 | 0.38 | Iron (mg/l) |
| 0.4 | 0.4 | 0.2 | 0.0 | 0.0 | 0.25 | 0.84 | 0.690 | 0.35 | 1.56 | Manganese (mg/l) |

was (3.4-9.6-5.9-5.2 NTU) and (4-23-6.1-1.39 NTU), respectively during four seasons and exceed the reference values for chemical parameters. pH values ranged from 7.5 to 8.6 for well water and from 7.8 to 8.6 for Nile river water and were within the permissible limits. The highest values of conductivity (µs/cm) of Nile river water and well water were 492 µs/cm and 1555 µs/cm, respectively and recorded in autumn. The lowest conductivity values of Nile river water and well water were 917 µs/cm and 409 µs/cm and were in winter and spring respectively. Total dissolved solids of well water were ; 605-994.6-913.44-1026 mg/l during winter, spring, summer and autumn, respectively and exceed the reference values for chemical parameters. Maximum value (324.7 mg/l) of Nile river water was recorded in autumn and it was within standard level. All chlorides values of Nile river water and well water were in acceptable level in all seasons. Total alkalinity (CaCo3) values of well water exceeded the standard levels where highest value (474 mg/l) was in winter and lowest value (300 mg/l) in spring. All total alkalinity values of Nile river water did not exceed permissible limits. Total hardness of well water and Nile river water were within the standard levels during four seasons. The data of calcium hardness of well water revealed that the highest value (322 mg/l) was in winter and the lowest value (240 mg/l) was in autumn. The value of calcium hardness (73 mg/l) of Nile riverwater was within the permissible limit and recorded in summer. Magnesium hardness values of studied water sources were higher than that given by the permissible values. Calcium concentrations of well water during four seasons exceeded the reference values for chemical parameters. Calcium , magnesium and iron values of Nile river water during four seasons were within the acceptable levels. Magnesium, iron and manganese contents of well water were higher than permissible values for chemical parameters. Manganese values of Nile river water in spring and summer did not recorded while in winter and autumn exceeded the permissible value.

Table 2.Physico-chemical parameters of well water and Nile river water before and after pretreatment with NR-CB nanocomposite during 3 hours

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nile river water after treatment | Nile river water | Well water after treatment | Well water | Tested parameters |
| After3h | After2h | After1h | After3h | After2h | After1h |
| 20 | 20 | 20 | 28 | 22 | 22 | 22 | 27.5 | Temperature ºC |
| 1 | 1 | 1.2 | 5.9 | 1.2 | 1.2 | 1.6 | 6.1 | Turbidity (NTU) |
| 7.5 | 7.7 | 7.7 | 7.8 | 7.5 | 7.7 | 7.7 | 8 | pH |
| 388 | 392 | 420 | 448 | 1445 | 1453 | 1456 | 1484 | Conductivity (US/Cm) |
| 256.08 | 258.7 | 277.2 | 295.6 | 953.7 | 958.98 | 960.9 | 913.44 | TDS (mg/l) |
| 18 | 19 | 22 | 26 | 128 | 136 | 140 | 160 | Chlorides (mg/) |
| 144 | 160 | 175 | 180 | 320 | 338 | 340 | 380 | Total alkalinity (mg/l) |
| 98 | 112 | 122 | 144 | 320 | 352 | 360 | 440 | Total hardness (mg/l) |
| 67 | 68 | 70 | 73 | 200 | 216 | 220 | 300 | Ca2+hardaness (mg/l) |
| 31 | 44 | 52 | 71 | 120 | 139 | 140 | 140 | Mg2+hardaness(mg/l)  |
| 26.8 | 27.2 | 28 | 29.2 | 80 | 86.4 | 88 | 120 | Calcium (mg/l) |
| 6.2 | 8.8 | 10.4 | 71 | 24 | 27.8 | 33.6 | 33.6 | Magnesium (mg/l) |
| 0.025 | 0.031 | 0.2 | 2.94 | 0.023 | 0.023 | 0.028 | 0.758 | Iron (mg/l) |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.032 | 0.1 | 0.3 | 0.690 | Manganese (mg/l) |

The effect of pretreatment of well water and Nile river water by natural rubber-carbon black (NR-CB) nanocompositeat different times, after 1 h, 2 h and 3 h, resulted in reduction of some physical and chemical parameters of water often to safe levels (Table 2). Pretreatment of well Water with NR-CB nanocomposite reduced total hardness from 440 mg/l to 320 mg/l after 3 h. Calcium, magnesium, iron and manganese content of well water reduced to safe level after pretreatment with NR-CB nanocomposite. Calcium reduced from 120 mg/l to 80 mg/l, magnesium from 33.6 mg/l to 24 mg/l, iron from 0.758 mg/l to 0.023 mg/l and manganese from 0.690 mg/l to 0.032 mg/l after 3 h. Pretreatment of Nile river water reduced calcium hardness from 73 mg/l to 67 mg/l, magnesium from 71 mg/l to 6.2 mg/l and iron from 2.94 mg/l to 0.025 mg/l after 3 h to permissible limits. Turbidity reduced from 6.1 NTU to 1.2 NTU for well water and from 5.9 NTU to 1UNT for Nile river water.

Data in table 3 showed that NR-CB nanocomposite are able to reduce biological pollutants in water such as certain indicator bacteria. Pretreatment of well water with NR-CB nanocomposite reduced total bacterial count (CFU/ml) from 2.85 X 102 to 0. 2 X 102, total coliform (MPN/100 ml) from 5.1 to <1.1, fecal coliform from 2.2 to < 1.1.

Table 3. Bacterial analysis of Sheblanga well water and Nile river water before and after pretreatment with NR-CB nanocomposite

|  |  |  |  |
| --- | --- | --- | --- |
| WHO standard | Nile river water | Sheblanga well water | Bacterial count |
| After treatment | Before treatment | After treatment | Before treatment |
| <0.05 x 103 | 0. 53 x 102 | 1.3 x 103 | 0. 11 x 102 | 0. 73 x 102 | Total bacterial count at 22 ºC (CFU/ml) |
| <0.05 x 103 | 0.69 x 103 | 2.75 x 103 | 0. 20 x 102 | 2.85 x 102 | Total bacterial count at 37 ºC (CFU/ml) |
| <1.1 | <1.1 | 35 x 103 | <1.1 | 5.1 | Total coliform (MPN/100ml) |
| <1.1 | <1.1 | 23 | <1.1 | 2.2 | Fecal coliform (MPN/100ml) |

The isolation and identification of bacteria from Sheblanga well water and Nile river water showed that the bacterial species isolated from Nile river water were higher than that isolated from well water. The bacterial isolates, obtained from collected samples of Nile river water and well water, were identified by VITEK 2 compact system into six species. Bacterial species isolated from well water were *Aeromonas sobria, Staphylococcus aureus, and Staphylococcus hominis* while bacterial species isolated from Nile river water were *Escherichia coli, Aeromonas sobria, Staphylococcus aureus, Leclercia adecaboxylata* and *Pseudomonas putida.* Pretreatment of water samples by NR-CB nanocomposite completely removed all these bacterial species.

Table 4: Incidence of the isolated bacterial species in water sources before and after pretreatment with NR-CB nanocomposite

|  |  |  |
| --- | --- | --- |
| Nile river water  | Sheblanga well water  | Bacterial species |
| After treatment  | Before treatment | After treatment  | Before treatment  |
| - | + | - | + | *Aeromonas sobria* |
| - | + | - | - | *Pseudomonas putida* |
| - | + | - | - | *Leclercia adecarboxylata* |
| - | + | - | - | *Escherichia coli* |
| - | + | - | + | *Staphylococcus aureus* |
| - | - | - | + | *Staphylococcus hominis* |

**DISCUSSION**

 The physico-chemical parameters are the most important principles in the identification of nature, quality and type of water. Temperature varied with respect to seasons. The variation ranged from 20 to 28 ºC for well water and from 20 to 27.5 ºC for Nile river water. The obtained results were in agreement with that reported by Abdo (2005). Al-Bayatti *et al*. (2012) found a high significant temperature difference with respect to seasons and months, air and raw water temperature. Temperature was a factor of great important for aquatic ecosystem, as it affects the organisms, as well as the chemical and physical characteristics of water (Declince, 1992). Seasonal variations of turbidity of well water and Nile river water ranged from 1.39 to 6.1 NTU and from 3.4 to 9.6 NTU, respectively. Turbidity of the two water sources exceeded 1 NTU which was recommended by EPA (2012). High turbidity was often associated with higher levels of disease causing microorganisms such as bacteria and other parasites (Shittu, 2008). Rivers may get contamination from soil runoff, which thereby increased its turbidity, which is a measure of cloudiness of water (EPA, 2002; Schwartz *et al*., 2000). The pH of well water and Nile river water were in agreement with pH assigned by EPA as the standard pH of water which ranges from 6.5-8.5 (EPA, 2012). The pH of well water, stream water and river water were within standard pH assigned by EPA (Shittu *et al*., 2008). There was no significant difference for pH which recorded between seasons, months and sites (Al-Bayatti *et al*., 2012). Electrical conductivity of well water and Nile river water were within permissible limit (1500 microsiemens/cm) except well water in autumn exceeded 1500µs/cm. Electrical conductivity in the aquatic ecosystem is considered to be a good indicator for evaluating total dissolved solid materials in water and nature of the purity of water (APHA, 1998). Total dissolved solids of Nile river water were in agreement with EPA (2012) standard of 500 mg/l, while TDS of well water exceeded standard level. Total dissolved solid in drinking water had been associated with natural sources, sewage urban runoff, industrial waste water and chemical used in the water treatment process (Ballester and sunyer, 2000). Total hardness and chlorides of all water were in agreement with the standard limit. Total hardness of water was caused mainly by dissolved calcium salt and magnesium salt from the surrounding ores. The hardness will influence the taste of water but the taste threshold differs from person to person (Pindi *et al*., 2012). Result of chlorides content was in agreement with that recorded by Shittu *et al*. (2008). Total alkalinity of Nile river water was in acceptable level in all seasons but in well water, total alkalinity exceeded the standard level (250 mg/l). Alkalinity in natural waters is a result of dissolution of CO2 in water. Carbonates and bicarbonates thus formed are dissociated by yield hydroxyl ions. The alkalinity value is essential to evaluate the dose of disinfection in water treatment practices and defluoridation processes (Pindi *et al*., 2012). Magnesium, calcium, iron and manganese of well water exceeded the standard level but were within the acceptable level for Nile river water except manganese was higher in winter and autumn. Water bodies get polluted with trace metals from a variety of sources such as chemical weathering of rocks and soils, dead and decomposing vegetation and animal matter and humanity's activities the discharge of industrial effluents (Pindi *et al*. 2012).

 Pretreatment of well water and Nile river water by Natural rubber-carbon black (NR-CB) nanocomposite reduced some physical and chemical parameters such as total hardness, turibidity, calcium, magnesium, iron and manganese content to permissible limits. Solener *et al*. (2008) used clay-polymethoxyethylacrylamide (CPN) nanocomposite to remove pb (II) from aqueous solution with a very high adsorption capacity of 81.02 mg/g. The adsorption of Pb (II) on the CPN proceeds via physisorption and was endothermic. Polymer-clay nanocomposites are used in heavy metal adsorption because of suitable clay properties such as large specific surface area, chemical and mechanical stability, layered structure and high cation-exchange capacity (Mishra, 2015)

 Pretreatment by NR-CB nanocomposites was effective in bacterial removal from well water and nile river water samples. Total bacterial count in well water and Nile river water were reduced from 2.85 X 102 CFU/ml to 0.2 x 102 CFU/ml and from 2.7 X 103 CFU/ml to 0.69 X 103 CFU/ml, respectively (permissible limit is < 0.05 X 103 CFU/ml). Total coliform and fecal coliform in Nile river water and well water were also reduced to less than 1.1 MPN/100 ml (permissible limit ˂ 1.1 MPN/100 ml). *Aeromonas sobria*, *Staphylococcus aureus, and Staphylococcus hominis* were completely removed from well water, also *Escherichia coli, Aeromonas sobria, Staphylococcus aureus, Leclercia adecaboxylata and Pseudomonas putida* were completely removed from Nile river water after treatment by NR-CB nanocomposite. A clay-polydimethyloxane-chitosan-sliver (Clay-PDMS-Ct-Ag) nanocomposite completely destroys a set of infectious bacteria (*E. coli*, ATCC25922; *Pseudomonas aeruginosa*, ATCC27853; *Staphylococcus aureus*, ATCC25923; *Candida albicans* ATCC14053 (Zhou *et al.*, 2007). ACPN (montmorillonite-polydimethyoxane-chlorhexidine acetate nanocoposite) film prepared by intercalation form solution had very strong antimicrobial activity against *Staphylococcus aureus* and *E coli* ( Meng *et al*., 2009). Another class of CPNs was centered a round the use of chitosan (CS) and chitosan nanocomposites which exhibit antimicrobial activity (Ignatova *et al*., 2013). Bruna *et al.* (2012) developed copper-modified montmorillonite (MtCu)-low density polyethylene (LDPE) nanocomposites with very high antimicrobial activity against *E coli* 0157 : H7n/t. They also showed that increasing the fraction of Mt Cu in the CPN to 4% increased the fraction of MtCu in the CPN to 4% increased the antibacterial activity to 94%. This antibacterial activity was attributed to the presence of Cu (II), as a known antibacterial agent. Moreover, copper reduced the growth rate of *E coli* by more than 99.99%, causing damage to cell walls and altering bacterial cell contents. Some other metals induced an electrical field on the outer membranes of the microorganisms which in turn increased changes in the permeability of microbial cells and thus caused cell death by membrane rupture (Nan *et al*., 2008)

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**تقيم بكتريولوجى و فيزيقوكيمائى لمصادر معينة لمياة الشرب بمحافظة القليوبية و معالجتها بواسط ان ار- سى بى نانوكمبوسيت**

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تهدف هذة الدراسة الى التحليل الفيزيقوكيميائى و البكتريولوجى لمياة من نهر النيل ومياة من بئر شبلنجة كمصادر لمياه الشرب ، محافظة القليوبية ، جمهورية مصر العربية و مقارنة النتائج التى حصلنا عليها مع القيم القياسية لمنظمة الـ EPA ، WHO . تم فى هذا البحث قياس درجة الحرارة ، درجة العكارة ، التوصيل الكهربى ، القلوية الكلية ، العسر الكلى ، المواد الصلبة الذائبة ، الكلوريدات ، عسر الكالسيوم ، عسر الماغنسيوم ، pH ، الكالسيوم ، الماغنسيوم ، الحديد ، المنجنينز لتحديد طبيعة و جودة المياة . بأستثناء درجة العكارة ، عسر الكالسيوم ، عسر الماغنسيوم لمياة البئر و مياة نهر النيل و ايضا المواد الصلبة الذائبة ، القلوية الكلية ، محتوى الكالسيوم ، الحديد ، المنجنيز لمياة البئر . كانت الخصائص الفيزيقو كيميائية الاخرى مطابقة للقيم القياسية . نتيجة المعالجة بواسطة ان ار- سى بى نانوكمبوسيت انخفضت درجة العكارة ، محتوى الحديد ، الماغنسيوم ، الكالسيوم ، المنجنيز لمياة البئر و مياة نهر النيل و اصبحت داخل القيم القياسية بعد ساعتين و ثلاث ساعات من اضافة النانوكمبوسيت . عدم توافق قيم التحليل البكتريولوجى (العد الكلى البكترى – العد الكلى لبكتريا القولون – بكتريا القولون البرازية) لمياة نهر النيل و مياه البئر مع المستويات القياسية . اصبحت عينات مياه نهرالنيل و مياه البئر بعد المعالجة بالنانوكمبوسيت بالنسبة الى العدد الكلى البكتري ، العد الكلى لبكتريا القولون العامة ، بكتريا القولون البرازية مطابقة للحدود المسموح بها طبقا لمنظمة EPA . الانواع البكترية (ايروموناس سوبريا ، ايشيريشيا كولاى ، استافيلوكوكاس اوريس ، سيدوموناس بيوتيدا ، ليكليريشيا ديكربوكسيلاتا) المعزولة من مياة نهر النيل و الانواع البكتيرية (استافيلوكوكس اوريس ، ايروموناس سوبريا ، استافيلوكوكس هومينيس) المعزولة من مياة البئر اختفت كلية من عينات المياة بعد المعالجة بواسطة ان ار- سي بى نانوكمبوسيت .