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# Chemical Parameters and Microbial Analysis of Potable Water of Various Tehsils in North Waziristan Agency

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**Abstract:** Water samples were collected especially into sterile containers at three tehsilsi.eMiranshah, Shawaa and Mir aliin North Waziristan Agency. The water samples were immediately subjected to both chemical and microbiological analysis in order to evaluate the quality of potable water in circulation within the agency and identify its sources of contamination. Levels of iron, calcium and magnesium detectable in the circulating drinking water were far below the WHO recommended limits. Meanwhile, other microorganismslike *E. coli, Coli form,* were found absent. The pH of potable water in circulation falls within recommended limits (6.0-8.0). However, there were some parameters likeCa, Mg, Cl and ions like sulphate and bicarbonateions, which far exceed WHO standards. There is the need for adequate changes to be made at points where water distribution systems integrity appeared compromised. The people of the various tehsils are advised to boil water before drinking in order to avoid consumption of unwholesome biological agents in the water distribution networks.

**Key words:** Chemical and microbial analysis · Potable water samples · North waziristan agency

## INTRODUCTION

Water, the universal solvent, is one of the most important of all natural resources known to human on earth. It is imperative to all living organisms, human health, most ecological systems, economic development and food production [1]. The safety of drinking water is anongoing concern within the global village. Usually, the safety of potable water supplies has been controlled by disinfection, generally by chlorination and coliform population estimates.

However, it has been reported that coliform-free potable water may not necessarily be free of pathogens [2]. Many congenital diseases such as goiter and cancer have been associated with presence of high concentration of a chemical or its inadequate supply in water. Opinya *et al*. [3] reported that low or high level of fluoride ions concentration in water as the major cause of dental fluorosis while low concentration of iodine in Homo sapiens results in goiter. Infants have been considered as a potential high risk group to the toxic effects of sodium from drinking water [4]. Currently, about 20% of the world's population lacks access to safe drinking water and more than 5 million people die annually from illness associated with safe drinking water or inadequate sanitation. If everyone had safe drinking water and adequate sanitation services, there would be 200 million fewer cases of diarrhea and 2.1 million fewer deaths caused by diarrheal illness each year [5].

The aim of this study was to evaluate the sanctity of potable water in circulation within the North Waziristan Agency and suggest safety measures to reduce the incidence of water-borne diseases.

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## MATERIALS AND METHODS

The experiments were carried out at Geological and Reservoir Labe of Oil and Gas Development Company of Pakistan Islamabad.

The source of water was three water sources in three different tehsils of North Waziristan Agency. Generally, water was collected in the morning into sterile 4-litre plastic container in the morning. The 4-litre container were immediately covered tightly after collection of water samples and transported tothe laboratory for chemical and microbiological analysis. This process was done separately on eachoccasion for the four selected sampling points in the three areas.

**Isolation of *Escherichia Coli:*** Water sample (100ml) was drawn and filtered with sterile membrane filter 0.45um. The filter membrane was then placed on McConkey agar aseptically. Then the plate was incubated at $45^0$C for22 hrs[6].

### Chemical Analysis

**Alkalinity:** Water sample (100ml) was placed in a conical flask and a drop of methylorange on it, This served as an indicator. The magnetic stirrer was then put in the conical flask with its content. This was stirred magnetically while a burette was filled with N/50 HCL and this was titrated against the water sample (100ml) in the conical flask [6].

**Acidity:** Water Sample (100ml) was placed in a conical flask and a drop of phenolphthalein on it. This served as an indicator. The magnetic stirrer was then put in the conical flask with its content. This was stirred magnetically while a burette filled with N/50 NaOH was titrated against the water sample (100ml) in the conical flask [6].

### Hardness

**Total Hardness:** Water sample (100ml) was placed in a conical flask, two drops of erichrome-T which is anindicator was dropped into the water sample and a drop of buffer-9 (i.e amino chloride and amino sulphate) on the contents of the conical flask. A burette was also filled with N/50 Ethylditetraamine (EDTA) and titrated against the water sample (100ml) in the conical flask.

**Calcium Hardeness:** Water sample (100ml) was placed in a conical flask and two drops of murexide which is anindicator was dropped on the contents of the conical flask. Buffer–12 (NaOH) was added to the contents of the conical flask. A burette filled with N/50 EDTA was titrated against the water (100ml) in the conical flask [6].

**Magnesium Hardness:** Deduced by obtaining the difference between the values of total hardness and calciumhardness of each water sample [6].

**Spectrometric Analysis of Water Samples:** The concentration of chloride, iron, sulplate, copper, fluoride ions were detected usingspectro-meteric analytic system. The TDS meter detected total dissolved solids. Turbidity was determined using the turbidimeter[6].

## RESULTS AND DISCUSSION

Chemical analysis of water supplies was necessary to guarantee the quality, compliance with established quality criteria and efficiency of operation of water treatment plants and distribution systems. The pH of the water in circulation falls within WHO limits (Table 1).

The concentration of chloride ions detected in the water distributed was not similar in all the three sampling points. Chlorine is an effective antimicrobial agent with the capacity to react destructively with the protein components of all types of organisms and even protecting the water from contamination during distribution.

However,in Mir Ali Tehsil water distribution system, the chlorination was ineffective and this might be responsible for high coliform counts, high counts of *Escherichia coli*and high population of general bacteria in the water samples.

Excessive concentration of $Fe^{3+}$ in circulation is objectionable for a number of reasons which includes; its precipitation as insoluble ferric hydroxide, which stains laundry and plumbing fixtures, $Fe^{3+}$ also promotes growth of “Iron Bacteria” which deposits slimy coating in the pipes [6].

Presently, public health standards consider water to be safe for human consumption when it contains a maximum of 500 colony forming units per milliliter (cfu/ml), when it is free of *E. coli* (lessthan 5cfu/100ml) and when its nephelomertic turbidity is less than [7,8,9]. However, the water in circulation in all the tehsils does not contain *E. coli* colony and thus are free from such microbial (Table 1). The water supply can be increased, if all tehsils water distribution networks are properly replaced and maintained in order to reduce health hazards to local community.

Table 1: Analysis Data of Drinking Water Samples of Three Tehsils of North Waziristan Agency

| Field | North Waziristan Agency | Date Sample Collected | 14-01-2014 |
|---|---|---|---|
| Well | --- | Date Sample Received | 16-01-2014 |
| Formation | --- | Date Sample Analyzed | 18-02-2014 |
| Sampling Point | Tehsil Miranshah | Type of Water | Drinking Water |
| W.H. F.T. (°F) | --- | Choke Size | --- |
| Sep. Temp.(°F) | --- | W.H.F.P. (Psig) | --- |
| Depth (Meters) | --- | Sep. Pres. (Psig) | --- |
| A - Physical Properties: | | | |
| Appearance | Clear | Density | 1.002 @ 18°C |
| Color Unfiltered | Colorless | RW (ohm-meter) | 10.0 @62 °F |
| Color Filtered | Colorless | Hydrogen Sulphide | Absent |
| Odor | Odorless | Genetic Type | SO4-Na |
| pH | 7.39 | | |
| B - Dissolved Solids: | | | |
| i -Cations: | mg/L | ii – Anions: | mg/L |
| Sodium, Na (calculated) | 43 | Chloride, Cl | 43 |
| Calcium, Ca | 63 | Sulfate, SO4 | 142 |
| Magnesium, Mg | 88 | Carbonate, CO3 | Absent |
| Barium, Ba | 4.1 | Bicarbonate, HCO3 | 506 |
| Manganese, Mn | 0.3 | Nitrate, NO3 | 0.6 |
| Aluminum, Al | Absent | Phosphate, PO4 | 0.21 |
| Iron, Fe (Dissolved) | 4.43 | Silica, SiO2 | 24.3 |
| Total Dissolved Solids | 700 | Total Suspended Solids | --- |
| Dissolve Oxygen | 6.2 | Biological Oxygen Demand | --- |
| Chemical Oxygen Demand | 8 | | |
| C - Bacteriological Examination: | | | |
| Coli-form | Absent | E. Coli/B. Coli | Absent |
| (Drinking water sample # 1 form Tehsil Miranshah) | | | |
| Field | North Waziristan Agency | Date Sample Collected | 14-01-2014 |
| Well | --- | Date Sample Received | 16-01-2014 |
| Formation | --- | Date Sample Analyzed | 18-02-2014 |
| Sampling Point | Tehsil Shawa | Type of Water | Drinking Water |
| W.H. F.T. (°F) | --- | Choke Size | --- |
| Sep. Temp.(°F) | --- | W.H.F.P. (Psig) | --- |
| Depth (Meters) | --- | Sep. Pres. (Psig) | --- |
| A - Physical Properties: | | | |
| Appearance | Clear | Density | 1.001 @ 18 °C |
| Color Unfiltered | Colorless | RW (ohm-meter) | >10 @62 °F |
| Color Filtered | Colorless | Hydrogen Sulphide | Absent |
| Odor | Stagnant | Genetic Type | SO4-Na |
| pH | 7.37 | | |
| B - Dissolved Solids: | | | |
| i -Cations: | mg/L | ii – Anions: | mg/L |
| Sodium, Na (calculated) | 33 | Chloride, Cl | 36 |
| Calcium, Ca | 78 | Sulfate, SO4 | 73 |
| Magnesium, Mg | 41 | Carbonate, CO3 | Absent |
| Barium, Ba | 4.1 | Bicarbonate, HCO3 | 385 |
| Manganese, Mn | 0.2 | Nitrate, NO3 | 0.1 |
| Aluminum, Al | Absent | Phosphate, PO4 | 0.16 |
| Iron, Fe (Dissolved) | 2.16 | Silica, SiO2 | 15.8 |
| Total Dissolved Solids | 460 | Total Suspended Solids | --- |
| Dissolve Oxygen | 7.8 | Biological Oxygen Demand | --- |
| Chemical Oxygen Demand | 10 | | |
| C - Bacteriological Examination: | | | |
| Coli-form | Absent | E. Coli/B. Coli | Absent |
| (Drinking water sample # 2 form Tehsil Shaawa) | | | |

Table 1: Continue

| | | | |
|---|---|---|---|
| Field | North Waziristan Agency | Date Sample Collected | 14-01-2014Well |
| | --- | Date Sample Received | 16-01-2014 |
| Formation | --- | Date Sample Analyzed | 18-02-2014 |
| Sampling Point | Tehsil Mir Ali | Type of Water | Drinking Water |
| W.H. F.T. (°F) | --- | Choke Size | --- |
| Sep. Temp.(°F) | --- | W.H.F.P. (Psig) | --- |
| Depth (Meters) | --- | Sep. Pres. (Psig) | --- |
| A - Physical Properties: | | | |
| Appearance | Clear | Density | 1.006 @ 18 °C |
| Color Unfiltered | Colorless | RW (ohm-meter) | 1.5 @62 °F |
| Color Filtered | Colorless | Hydrogen Sulphide | Absent |
| Odor | Odorless | Genetic Type | SO4-Na |
| pH | 7.68 | | |
| B - Dissolved Solids: | | | |
| i -Cations: | mg/L | ii – Anions: | mg/L |
| Sodium, Na (calculated) | 850 | Chloride, Cl | 1047 |
| Calcium, Ca | 202 | Sulfate, SO4 | 1650 |
| Magnesium, Mg | 291 | Carbonate, CO3 | Absent |
| Barium, Ba | 2.2 | Bicarbonate, HCO3 | 436 |
| Manganese, Mn | 0.1 | Nitrate, NO3 | 1.7 |
| Aluminum, Al | 0.009 | Phosphate, PO4 | 0.26 |
| Iron, Fe (Dissolved) | 0.57 | Silica, SiO2 | 16.8 |
| Total Dissolved Solids | 5900 | Total Suspended Solids | --- |
| Dissolve Oxygen | 7.9 | Biological Oxygen Demand | --- |
| Chemical Oxygen Demand | 2 | | |
| C - Bacteriological Examination: | | | |
| Coli-form | Absent | E. Coli/B. Coli | Absent |
| (Drinking water sample # 3 form Tehsil MirAli) | | | |

High microbial counts in water are undesirable because of the increased likelihood thatpathogens may be present, the possibility that these organisms will find access to foods and drink thereby causing spoilage and the adverse effects such organisms may have on pipelines andprocessing equipment. Generally, the chemical quality of all the water samples under study does not falls within the standards stipulated by World Health Organization and Federal Environmental Protection Agency.

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