

**BACTERIOLOGICAL AND PHYSICOCHEMICAL QUALITY OF HAND-DUG
WELL WATER USED FOR DRINKING AND DOMESTIC PURPOSES IN DARETA
VILLAGE, ANKA, NIGERIA.**

ABSTRACT

Water of good drinking quality is important to human health. In developing nations especially in rural and sub-urban communities, water for drinking and other domestic uses is mostly obtain from wells dug by the inhabitants. Poor construction and inadequate protection of wells predispose them to contamination. Ten(10) different well water samples were collected from Dareta village and cultured into bacteriological peptone water enrichment. The culture in the bacteriological peptone water was diluted in distilled water using serial dilution. The physicochemical properties of the water indicated that the temperature was 26-29°C, pH ranged from 5.82-6.65 and TDS ranged from 60-380mg/ml. The result of heterotrophic plate count showed bacterial count range from 23×10^2 - 110×10^4 cfu/ml. The most probable number result was from 23-1600MPN/ml. The pathogens isolated were *Salmonella spp*(40%), *Escherichia coli*(80%) and *Pseudomonas aeruginosa*(50%). The presence of *Salmonella spp* and *Escherichia coli* water indicate that the water may have been contaminated by faecal source either from humans or animals. All the water from the wells were unfit for human consumption, since they could not meet the WHO standard for drinking water, which states that there should be no coliforms in drinking water.

KEY WORDS: Well water, total coliforms count, total bacteria count and physicochemical properties.

INTRODUCTION

Water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability. Safety and quality of drinking water is always an important public health concern[1],[2] and[3]. The provision of portable water to the rural and urban population is necessary to prevent health hazards[4] and[5]. Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards, which are designed to ensure that the water is palatable and safe for drinking[6]. Potable water is defined as water that is free from diseases producing microorganisms and chemical substances deleterious to health[7]. Water borne diseases continue to be one of the major health problems especially in developing nations.

In developing countries like Nigeria, especially in the rural and sub-urban communities, water for drinking and other domestic uses is mostly obtained from wells dug by inhabitants [8]. In addition to the well water other available sources of water in rural communities are streams and rivers. The reliance on untreated ground water (wells) and streams is due to the lack of piped water. Such wells and streams are subject to contamination with pathogenic bacteria because of their proximity to latrines through seepage and human activities more especially children[9] and[3]. Also poor wastewater and solid waste management, poor construction and inadequate protection of the wells and presence of latrines closer to the wells predispose them to contamination[10]. Natural groundwater is usually of good quality, but this can deteriorate due to inadequate source protection and poor resource management. Mechanisms of groundwater recharge and the natural attenuation capacity also depend on soil type and geomorphologic characteristics[11] and [12].

The prevalence of diseases such as diarrhoea, typhoid fever, cholera and bacillary dysentery among the populace has been traced to the consumption of unsafe water and unhygienic drinking water[13]. The consumption of drinking water contaminated with pathogenic microbes of faecal origin is a significant risk to human health in the developing world, especially in remote rural areas and peri-urban 'shanty' communities. Over 3 million deaths per year are attributed to water-borne diarrhoeal diseases, especially among infants and young children in poor communities in Africa, Asia and South 14]. The most dangerous form of water pollution occurs when faecal contaminants enter the water supply. Pathogens such as *Salmonella* species, *Shigella* species, *Vibrio cholerae* and *E. coli* being shed in human and animal faeces ultimately find their way into water supply through direct and indirect deposition of contaminants from faecal source into the wells either by humans,

62 animals[15] and probably wind blow which carry some soil pathogens to the wells since most
63 of the Nigerian wells are not covered.

64 Enteric pathogens are typically responsible for several waterborne sicknesses[16]
65 and[17]. Contamination of water is a serious environmental problem as it adversely affects
66 the human health and the bio-diversity in the aquatic ecosystem. The use of indicator bacteria
67 such as faecal coliforms (FC) in water quality determination on fresh water source is widely
68 used[18]. Currently, coliforms and *Escherichia coli* are of great importance among bacterial
69 indicators used in water quality definition and health risk[19]. The aim of this research was to
70 determine the bacteriological quality of well water in the heart of Dareta village Zamfara
71 State, Nigeria.

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73 MATERIALS AND METHODS

74 **Sample Collection and Laboratory Analysis of Samples:**

75 The samples of water were collected in labelled sterile sample bottles. The samples were
76 transported to the laboratory in a portable sample thermocool containing ice for the microbial.
77 In the laboratory, samples of the water collected were culture into tubes containing
78 bacteriological peptone water for enrichment.

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80 **Physicochemical properties**

81 Temperature was measured at the site of the sample using HACH conductivity/TDS Meter
82 (model 44600.00). PH was conducted electronically using Lutron pH 201. TDS was also
83 determined using HACH conductivity/TDS meter (model 44600.00).

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85 **Heterotrophic plate count**

86 For enumeration of total heterotrophic bacteria in each of the samples, the water samples
87 inoculated into bacteriological peptone water for enrichment were serially diluted with sterile
88 distilled water following ten-fold dilution procedure in ten test tubes[20]. That is 1ml of the
89 sample was collected using a sterile pipette and dispensed for dilution into 9ml of distilled
90 water and then different dilutions were obtained in 9ml of distilled water. 1ml of the last three
91 dilutions of each sample was spread on plates containing nutrient agar and were incubated for
92 24 hours at 37°C. The colonies of bacteria on the nutrient agar plates were counted and each
93 number was recorded.

94 **Identification of specific bacteria**

95 Different dilutions were spread on different selective media; Salmonella-shigella agar,
96 Pseudomonas CN agar and Eosin methylene blue agar. All the plates were incubated for 24
97 hours at 37°C. The 24hours cultures of the organism were subjected were to biochemical tests
98 such as; indole, catalase, oxidase, urease and H₂S test[21]. The bacterial isolates were
99 subjected to Gram staining as described by [22].

100 **The Most Probable Number(MPN)**

101 The microbial quality of the drinking water samples was assessed by making use of the
102 multiple tube fermentation test. Total coliforms were estimated by using the 5-tube most
103 probable number (MPN) method. Sterile lactose broth of single strength and double strength
104 was used for the presumptive test and the combinations of the positive tubes were 10ml,
105 1.0ml and 0.1ml. Then, the inoculated tubes of lactose broth were incubated at 44°C for 24
106 hours. The MPN was estimated by determining the number of tubes in each group that
107 showed gas and acid production following the incubation period following the method of
108 [14]. Positive presumptive tests were confirmed using eosin methylene blue agar. Colonies
109 with characteristic growth were reinoculated into tubes of lactose broth. Growth
110 characteristics in lactose broth(production of gas and acid) as well as reactions to indole and
111 glucose[23].

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124 RESULTS

125 **Table 1:** Some Physicochemical Parameters and Heterotrophic plate count

SAMPLE	TEMPERATURE(°C)	p ^H	BACTERIAL COUNT (CFU/ML)
W ₁	27.2		110×10^4
		5.82	
W ₂	26.0		98×10^3
		6.13	
W ₃	28.4		56×10^3
		6.53	
W ₄	27.1		76×10^4
		6.56	
W ₅	29.0		102×10^4
		6.43	
W ₆	26.5		108×10^4
		6.50	
W ₇	27.3		46×10^3
		6.41	
W ₈	28.6		64×10^4
		6.34	
W ₉	26.0		64×10^3
		6.55	
W ₁₀	28.6		33×10^2
		6.50	

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127 KEY: W= Well1, 2,3,4,5,6,7,8,9,10,

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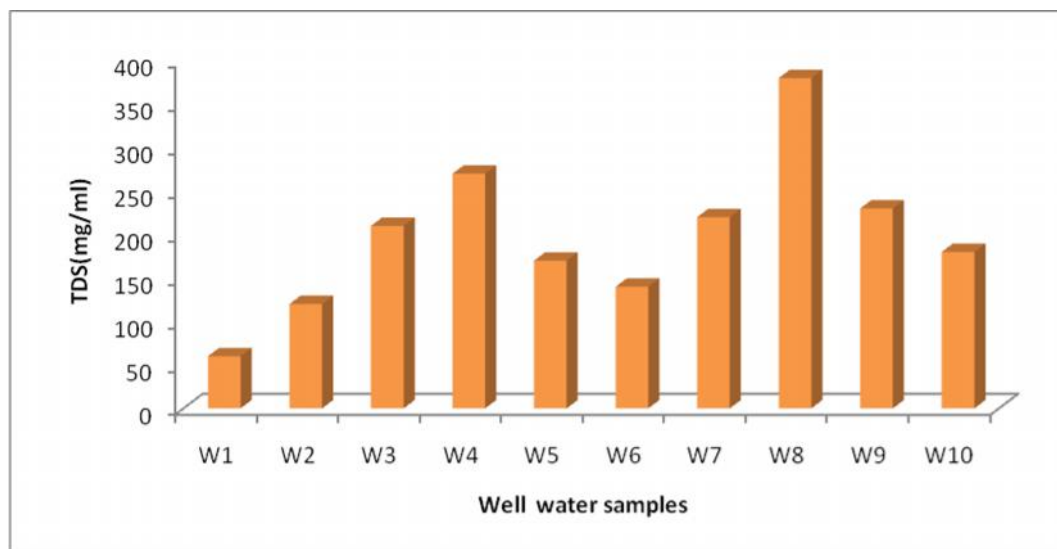
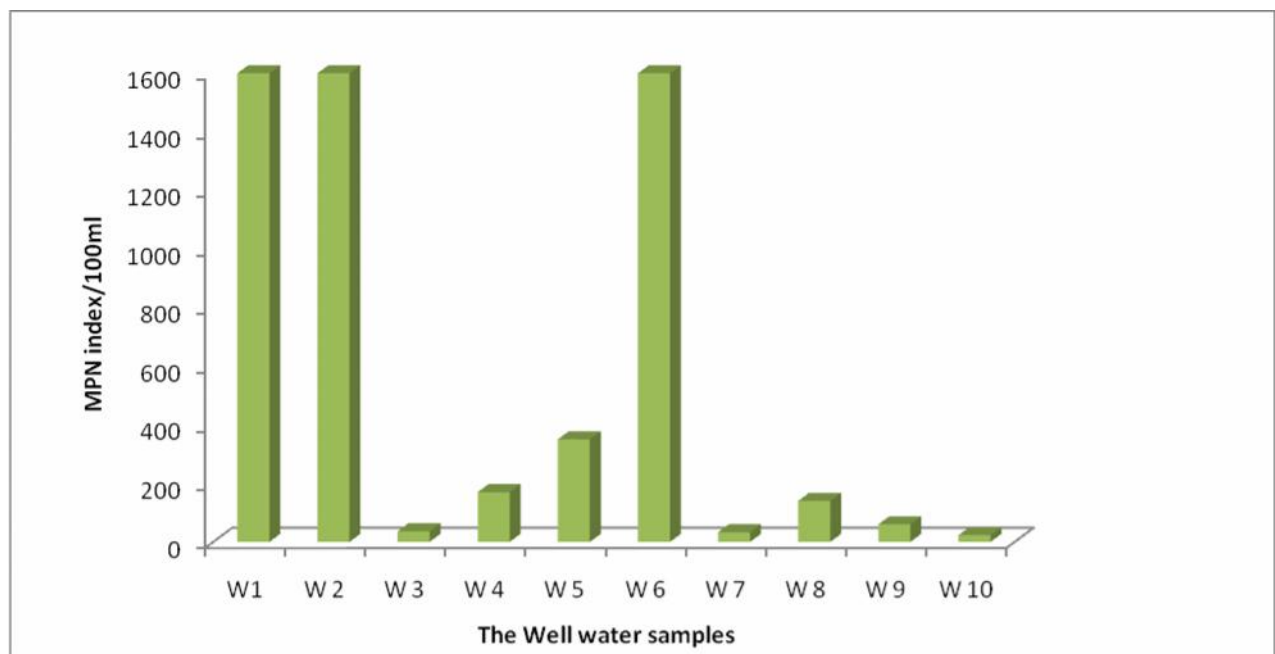


Figure 1: The Total dissolved solutes in the well water



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151 Figure 2: Completed test of MPN showing gas production in fresh lactose broth, staining
 152 character of the indicator bacteria and indication of portability for each water sample.

153 Table 2: Biochemical characteristics of the isolates from each sample

SAMPLE	Oxidase	Catalase	Indole	H ₂ S	Urease	Pathogen Isolated
W ₁	+	+	+	-	+	<i>Escherichia coli</i> , <i>Pseudomonas aeruginosa</i>
W ₂	-	-	+	+	-	<i>Salmonella spp</i> , <i>Escherichia coli</i>
W ₃	+	+	+	+	+	<i>Escherichia coli</i> , <i>Pseudomonas aeruginosa</i> , <i>Salmonella spp</i> ,
W ₄	-	-	+	-	-	<i>Escherichia coli</i>
W ₅	-	-	+	+	-	<i>Salmonella spp</i> , <i>Escherichia coli</i>
W ₆	+	+	-	-	-	<i>Escherichia coli</i> , <i>Pseudomonas aeruginosa</i>
W ₇	-	-	+	-	-	<i>Escherichia coli</i>
W ₈	+	+	-	-	-	<i>Pseudomonas aeruginosa</i>
W ₉	-	-	+	+	-	<i>Salmonella spp</i> , <i>Escherichia coli</i>
W ₁₀	+	+	-	-	-	<i>Pseudomonas aeruginosa</i>

DISCUSSION

The total dissolved solids(TDS) of the water sample ranged from 60-380mg/ml which was below the allowable limit of 500mg/ml, the pH of the water samples collected from the well ranged from 5.82-6.13 which were at weak acidic pH. In drinking water the maximum allowable limit of pH is between 6.5 and 8.5. The temperature of the water samples ranged from 26-29°C. The range of total bacteria count was from 23×10^2 - 110×10^4 . The bacterial count revealed that 1ml of the water from W₁ has the highest number of bacteria with counts of 110×10^4 , which means that W₁ was more contaminated follow by W₆ with a total bacterial count of 108×10^4 . The least count of the bacteria was obtained from W₁₀ with a total count of 33×10^2 as shown in table 1. This result indicates that none of the water samples is fit for consumption.

The most probable number(MPN) for the presumptive total bacteria count of the water samples ranges from 23-1600MPN/100ml as shown in table. From the table it indicates that water from W₁, W₂ and W₆ had the highest total coliform count of 100MPN/100ml, the least total count were from W₁₀, W₃, and W₇ with count of 23MPN/100ml, 36MPN/100ml and 33MPN/100ml respectively. Other total coliform counts obtained are: 170MPN/100ml, 350MPN/100ml, 140MPN/100ml and 60MPN/100ml which were obtained from W₄, W₅, W₈ and W₉ respectively. The Nigerian maximum allowable limit of total dissolved solids in drinking water is 500mg/ml, temperature is ambient temperature and no total coliforms or *E. coli* should be detected using per 100 millilitres for most probable number[24]. *E. coli* in drinking water indicates the water has been contaminated with faecal material that may contain disease causing microorganisms, such as certain bacteria, viruses, or parasites

The presence of coliforms group in the water samples generally suggests that a certain selection of water may have been contaminated with faeces either of human or animal origin. Faecal coliforms (FC) are the most widely used indicator bacteria for faecal contamination, as their excreted load is similar or larger than that of pathogenic organisms, and their survival time in the environment longer than that of excreted bacteria and viruses[25]. Other more dangerous microorganisms could be present[26]. The pathogens isolated from these wells were *Escherichia coli*, *Pseudomonas aeruginosa*, and *Salmonella spp*, the presence of these pathogens has rendered all the well water unfit for consumption, but yet it has become sole source of water for drinking and domestic purposes by the inhabitants of this village[27].

These microbes of faecal origin could find their ways to this water source through indirect and direct deposition of contaminants from faecal source either from humans, animals, birds and wind. *Pseudomonas sp.* is a very common contaminant in water systems due to their ease of colonization and they form thick biofilms which consequently has an effect on turbidity, taste and odour of drinking water [28]. Therefore, none of the water used for drinking in this village meet the maximum acceptable value. The maximum acceptable value of total coliform in drinking water is less than 1 per 100mL and free from faecal coliform[29]. [14] and [30] reported that consumption of drinking water contaminated with pathogenic microbes of faecal origin is a significant risk to human health in the developing world, especially in remote rural communities.

Water should meet different quality specifications depending on the particular uses. Thus, potable and domestic water should contain no pathogens or other contaminants that could be harmful to health of man. Water should have proper organoleptic properties and should be suitable for domestic uses. There should be portable supply of water to rural communities for consumption. Water quality should be controlled in order to minimize acute problem of water related diseases, which are endemic to the health of man.

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