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S. Conine
Henderson State University

D. Cox
Henderson State University

K. Mitchell
Henderson State University

Clark Kuyper
Ouachita Baptist University

Jimmy D. Bragg
Henderson State University

BACTERIOLOGICAL QUALITY OF PRIVATE WATER WELLS IN CLARK COUNTY, ARKANSAS

S. CONINE, D. COX, K. MITCHELL,
C. KUYPER*, and J. BRAGG
Biology Department
Henderson State University
Arkadelphia, AR 71923

*Chemistry Department
Ouachita Baptist University
Arkadelphia, AR 71923

ABSTRACT

Most private water wells in Clark County appeared to be contaminated by bacteria, apparently entering the wells from surface water seepage. Eighteen to 24% of the wells investigated were positive for fecal contamination. Deeper wells were less often contaminated. More than one-half of the wells sampled exceeded recommended limits of inorganic chemicals for safe potable water. High concentrations of iron and manganese were most common, exceeding recommended limits in more than 40% of the wells.

INTRODUCTION

This study was initiated because of interest expressed by the three student authors regarding the quality of water available from private wells. Wells throughout Clark County were analyzed for three bacterial parameters and fourteen chemical/physical parameters.

METHODS AND MATERIALS

Fifty wells were sampled during 1987-88. Bacterial analyses were by membrane filtration (Millipore HA 045) according to standard methods (APHA, 1985). Both typical and atypical colonies were counted for total coliform. The other two parameters measured were fecal coliform and fecal streptococcus. Culture media were m-Endo broth (Millipore), m-FC broth and m-Enterococcus agar (Difco). Quality control was maintained according to EPA guidelines (Bordner and Winter, 1978). Chemical analyses were according to standard methods (APHA, 1985). Only the chemical data from wells exceeding recommended concentrations are reported in this paper.

RESULTS AND DISCUSSION

Sampling was throughout the county and an attempt was made to sample wells in each of the approximately seventeen geological formations appearing at the surface within the boundaries of the county (USGS, 1976). The study was biased in regard to finding the property owner at home so that permission could be obtained before sampling the well.

Coliform bacteria were isolated from 78% of the wells tested. Since both typical and atypical colonies were enumerated, this parameter was considered to indicate surface water seepage into the well without consideration of fecal contamination.

Eighteen percent of the wells tested positive for fecal coliforms and 24% for fecal streptococci. These parameters are indicative of fecal contamination, and the data suggest 18-24% of the wells have seepage from septic tanks, barnyards, or other sources of animal wastes.

An inverse correlation between well depth and degree of bacterial contamination seemed to exist (Table 1). Deeper wells were less often contaminated by surface seepage.

A continuation of the study is planned to attempt to correlate variation in water chemistry with geologic strata, but data reported here relate only to those wells with inorganic chemical concentrations exceeding Environmental Protection Agency (EPA, 1976) and/or American Society for Testing and Materials (ASTM, 1979) recommendations (Table 2).

Table 1. Correlation of well depth with bacterial contamination.

Bacterial Parameter	Wells Tested Positive (%) Depth (m) less than 10	10-30	more than 30
Total coliforms	54	32	12
Fecal coliforms	16	8	0
Fecal streptococcus	24	8	0

Table 2. Wells exceeding inorganic chemical limitations

Chemical Parameter	Limit (mg/l)	Wells above limit (%)
Ammonium nitrogen	0.5*	10.2
Chloride	250.0*	2.0
Iron	0.3**	49.0
Manganese	0.05**	44.9
Nitrate nitrogen	10.0**	8.2
Sulfate	250.0*	6.1

*ASTM (1979).

**EPA (1976).

More than 40% of the wells sampled exceeded limitations of iron and manganese, 10% exceeded the limit for ammonia, 8% for nitrate nitrogen, and 6% for sulfate. No correlation between well depth and chemical contaminants was observed, and data are inadequate at this time to relate to particular geologic formations through which the wells pass.

Data from the study indicated that most private water wells within Clark County are contaminated with bacteria from surface water. Deeper wells (100 ft or more) are more often free of contamination. Details of construction were not known for most of the wells but deeper wells are usually cased to a greater depth which would prevent surface water seepage into the well. Any amount of contamination may constitute a health hazard, and if a source of animal wastes in the vicinity of the well results in fecal contamination, the health hazard is compounded. Anyone considering the construction of a well might be properly advised to invest in a deep well and adequate casement to prevent surface water seepage. Home owners using an existing shallow well should consider installation of a chlorination system.

Inorganic chemicals considered in this study, particularly iron and manganese, may originate from soluble components of the geologic strata through which the well is drilled. Others such as ammonia and nitrate may be of surface origin from fertilizers or from bacterial degradation of contaminating organic compounds.

From a public health viewpoint, this study suggests greater care needs to be exercised in using private wells for potable water, and more effort should be directed toward the expansion of water districts so that treated water can be delivered to every household.

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AMERICAN PUBLIC HEALTH ASSOCIATION. 1985. Standard methods for the examination of water and wastewater, 15th ed. APHA, Inc. N.Y. 1193 p.

AMERICAN SOCIETY FOR TESTING MATERIALS. 1979. Annual book of ASTM standards: water. Easton, Md. 1280 p.

BORDNER, R. and J. WINTER. 1978. Microbiological methods for monitoring the environment: water and waste. Environmental Monitoring and Support Laboratory. U.S. Environmental Protection Agency. Cincinnati, Ohio. EPA 600/8-78-017.

ENVIRONMENTAL PROTECTION AGENCY. 1976. Quality criteria for water. U.S.E.P.A., Washington, DC. 256 p.

UNITED STATES GEOLOGIC SURVEY. 1976. Geologic map of Arkansas. USGS, Dept. of Interior, Washington, DC.