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Studies on the Influence of Physico-chemical Properties on Water Quality and Antibiotic Resistant Pattern of Enteric Bacteria Isolated from Different Water Sources in Bangladesh

[1]F. Begum, [1]M. S. Islam, [2]M. A. Rahman and [2]H. Rahman
[1]Department of Physiology, Biochemistry and Pharmacology, Sylhet Govt. Veterinary College, Tilagor, Sylhet, Bangladesh; [2]Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh, Bangladesh

Abstract: A total of 90 water samples obtained from various sources (tubewell, reservoir tank, tap supply, pond, river and aqua mineral) collected in three seasons were examined for their water quality based on total bacterial count and physico-chemical properties. The combined effect of physico-chemical properties of water on the growth and propagation of bacteria was highly significant ($P<0.01$) in pond and river water and very poor and insignificant ($P<0.05$) in tubewell, reservoir tank, tap and aqua mineral water. One hundred sixty four isolates of enteric bacteria including *Escheria coli*, fecal Streptococci, Salmonella and Shigella were examined for their sensitivity to antibiotics. The study revealed that 7.0 to 32% of isolates were resistant to tetracycline followed by ampicillin and streptomycin. Resistance to Chloramphenicol was of moderate degree (3 to 14%) and that to Ampicillin, Kenamycin and Gentamycin was relatively low (0.82 to 7.02%). *E. coli* possessed the highest antibiotic resistance and was most widespread among the bacterial isolates obtained from pond water.

Key words: Influence, physico-chemical properties, water quality, antibiotic resistant, enteric bacteria

Introduction

In the recent years pollution of water and resistance to antibiotics of bacterial strains emerged as a major cause of public health hazards in Bangladesh. Most of the small and large industries have been installed on the bank of the rivers, canals and ponds.

Industrial wastes and domestic sewages are usually dumped in these waters without prior treatment (WPCP, 1975 and EPC, 1980). This is deteriorating the water quality and endangering the ecosystems. Microbial populations are selective to the amount of organic materials contributed through human and animal excretions and other domestic wastes as well as inorganic compounds added by industrial wastes. On the other hand, the emergence of bacterial strains resistant to antibiotics is of considerable medical and public health significance and thought to be due to free-sale, indiscriminate and unwise use both in man and animals.

The present study was undertaken to determine the influence of physico-chemical properties of water on its quality used for domestic, fishing and nimal farming and effect of antibiotics on water bacteria isolated from different sources having potentially of health hazards.

Materials and Methods

A total of 90 samples from various sources were collected and examined as per Standard methods (ISO, 1965; WHO, 1977 and APHA, 1982). The physioco-chemical parameters like color, transparency, temperature, pH, dissolvedoxygen and free carbondioxide were estimated (Rahman, 1993). The percentage distribution of bacterial isolates in different sources of water were also determined (Rahman, 1993).

The influence of combined effect of five physico-chemical properties as independent factors (X_1, X_2, X_3, X_4, X_5) upon the density of total bacteria as dependent factor (Y_1) of different sources of water was analysed by multiple regression analysis following the key of Gomez (1984). For the analysis of multiple regression the multi-parameter equation considered was as follows: $Y = a + B_1X_1 + B_2X_2 \ldots\ldots B_5X_5$).

The bacterial isolates namely *E. coli*, fecal streptococci, Salmonella and Shigella were examined for their drug resistance pattern as per recommendation of Thorusberry (1985). The antibiotics employed for this study were tetracycline, streptomycin, ampicillin, chloramphenicol, kenamycin, amoxicillin and gentamycin. The variations of resistance of mean of bacterial isolates to different antibiotics were tested by LSD using the programme of Gomez and Gomez (1984).

Results and Discussion

The combined effect of physico-chemical properties of water obtained from five different sources on the growth and abundance of bacterial isolates was calculated. The combined effect of tubewell and tap water was insignificant ($P>0.05$) and negligible. But

the effect was highly significant ($P<0.01$) in case of both pond and river water and in some cases of reservoir tank water.

From the results , it is assumed that the effect of physico-chemical properties of water on the bacterial growth may perhaps depend upon the concentration of organic and inorganic nutrients. Ali *et al.* (1985) led the opinion that the physico-chemical properties of water significantly influence the growth of microorganism. The appearance of high organic and inorganic nutrients generally reflects the indication of water pollution which are thought to create favourable conditions and alter the required environment for the growth of bacteria. Alam *et al.,* (1989) had similar observations. The degree of resistance of bacterial isolates to different antibiotics is presented in Table 1. The bacterial isolates were resistant to tetracycline (7.79 to 32.19), streptomycin (6.62 to 26.64), ampicillin 5.44 to 30.82, chloramphenicol (3.63 to 14.43) amoxicillin (1.58 to 7.02) kenamycin and gentamycin (0.82 to 4.40). Highest proportion of bacterial isolates was resistant to tetracycline, ampicillin and streptomycin and lowest to kenamycin and gentamycin. Among the bacterial isolates *E. coli* possessed the highest and Salmonella the lowest drug resistant property. The bacterial isolates obtained from various sources showed different degrees of resistant to different antibiotics (Table 2) and the variation in response to these antbiotics were statistically significant ($P<0.01$). The antibiotic resistance was most wide spread among the pond water isolates.

Similar observations were made by Jebouri and Meshadani (1985) and Kralikova *et al.* (1986). They led the opinion that the strains acquired some selective advantages from the environment resulting the enhancement of their survival. Drug resistant Salmonella isolates ranging from 61 to 100% resistant have been detected by different workers (Alcaide and Garay, 1984; Milch *et al.,* 1985). It was reported that during certain Salmonella epidemics nearly 100% of the isolated strains could become resistant to multiple antibiotics. In Japan 75% of Shigella strains were found drug resistant (Bose *et al.,* 1984; Macaden and Bhat, 1985).

Bangladesh has been facing many health hazards of which dumping of all wastes in the water system and the indiscriminate use of antibiotics is one of the major concerns. Water likely to be contaminated from various sources may have been exposed to different antibiotics. When these resistant bacteria come in contact with other organisms in the water they may transfer the R-factor that carries this resistance to other organisms.

The remedy for overcoming this hazard could however be, to avoid dumping of all wastes in the water as well as enforcing effective drug control.

Table 1: Antibiotic resistance of bacterial isolates

Bacterial isolates	No. of isolates tested	% of bacterial isolates resistance to various antibiotics						
		Tetracy-cline	Streptomy cin	Ampici llin	Chloram phenicol	Kenamy cin	Amoxici llin	Gentamy cin
E. coli	100	32.19	26.64	30.82	14.43	4.60	7.02	4.06
Fe. Streptococci	60	21.85	19.18	12.26	8.17	4.40	5.03	4.40
Salmonella	15	7.79	6.62	5.44	3.63	0.82	1.58	0.82
Shigella	25	9.42	9.88	8.11	3.95	1.04	2.70	1.04

Table 2: Effect of different antibiotics on enteric bacteria isolated from various water

	% of resistance of mean of total bacterial isolates				
Antibiotics	Tubewell N = 24	Reservoir tank N = 30	Tap supply N = 22	Pond N = 46	River N = 42
Tetracycline	1.43a	2.05a	1.42a	2.36a	2.20a
Streptomycin	1.29a	1.71b	1.10b	2.15b	2.06b
Ampicillin	0.97b	1.45c	0.97c	1.80c	1.49c
Chloramphenicol	0.64c	0.45d	0.51d	1.39d	0.85d
Kenamycin	0.05e	0.12f	0.12f	0.62f	0.28fg
Amoxicillin	0.14a	0.25e	0.25e	0.97e	0.42e
Gentamycin	0.03e	0.06g	0.06f	0.34g	0.35eg

N = No. of bacterial isolates.

Values having similar letter are not significantly different ($P>0.01$)

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