BACTERIOLOGICAL SAFETY OF HOT TAPWATER IN DEVELOPING COUNTRIES

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OF THE 4,804,635 Americans who went abroad in 1968, many traveled in regions with questionable sanitary standards, particulary for water supplies. The frequency of the various types of enteritides and dysenteries is high enough to make them a public health problem among traveling U.S. citizens. Whether these illnesses are euphemistically called "Montezuma's revenge" or "tourista" in some countries, or by more prosaic names elsewhere, the disability and discomfort from them should not be underestimated. Often an expensive or much-needed vacation is terminated by severe gastrointestinal disturbances, and the ailments frequently hamper the course of business transactions.

There are many possible sources of intestinal infections, often caused by specific, identifiable agents and sometimes with prolonged unpleasant sequelae, such as in amebic dysentery. Such sources include salads, milk products, ice, and often the water that may be used for drinking, diluting drinks, or brushing teeth. The unavailability of safe water can seriously inconvenience the American traveler accustomed to being well shielded from unsafe water at home.

Most hotels in which American travelers are likely to stay (unless they venture into back country) are likely to have hot and cold running tapwater in the guests' rooms or bathrooms. Considering the temperatures of the hot, piped water, these supplies should, theoretically, be pasteurized. However, before assuming this theory is practical, its validity should be tested in the field.

In order to test the theory, I traveled the coast of West Africa from Senegal to Nigeria, a region with a particularly high incidence of intestinal infections. The various dysenteries are among the more common causes of death among the residents, causing, for example, in Ghana, 6 percent of all deaths (*1*).

Tapwater was tested in the hotels of Senegal, Ivory Coast, Ghana, Togo, and Dahomey. The hotels themselves varied from excellent to poor. A total of 49 tests were made in 17 establishments. Since West Africa is not frequented by tourists, the number of hotels is relatively small, and some of the more simple resthouses had no hot water.

In getting samples of hot and cold tapwater for comparative testing, I was not limited to the hotels where I roomed. In cities such as Dakar, Abidjan, Accra, Lomé, and Cotonou, water was also drawn in the private residences of Americans and in the washrooms of hotels where I stopped for a drink or a meal.

Technique

Millipore monitors were used to analyze water under field conditions. These sterile, disposable plastic filter holders require a minimum of equipment.

M–Endo broth medium was added to incubate coliform bacteria while suppressing the growth of most noncoliform colonies. This medium is obtainable in small, easily transported ampoules. The presence of coliform bacteria is commonly used as an indication of the extent of pollution of a water supply and its suitability for drinking.

Using a small, plastic syringe, 100 ml. of water were syphoned through the filter of the monitor. After adding the medium, the plastic filter holders were closed and placed in trouser pockets which served as incubators for 1 or 2

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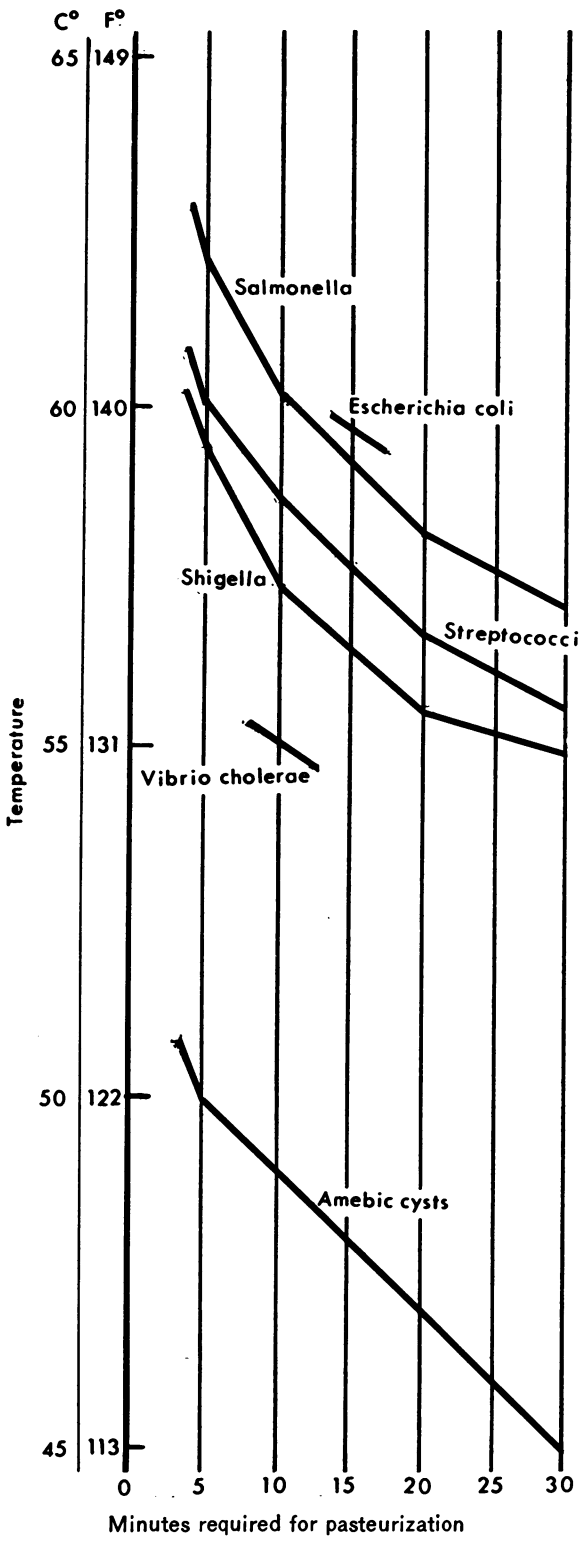
Temperature and time required to rid tapwater of intestinal pathogens by pasteurization



days. Since outside temperatures ranged from the eighties to the nineties in degrees Fahrenheit, incubation was no problem. After 2 days, the number of coliform colonies on the filter were counted. The colonies exhibited the greenish metallic shean characteristic of the coliform bacteria.

Results of Tests

The quality ratings of water supplies were in accordance with the 1962 Public Health Service Drinking Water Standards (*2*). The maximum number of allowable coliform organisms is two per 100 ml. The presence of three or more coliform organisms in 100 ml. samples was considered evidence of unsatisfactory water quality.

In a few hotels the cold tapwater was tested repeatedly and the coliform count was zero. In most of the hotels, however, the number of coliform organisms in cold water was at a level that would confirm the traditional advice: "Don't drink the water." Only two hotels had carafes in their rooms; as expected, the water in the carafes was particularly unsafe (*3*).

The hot water drawn from faucets was uniformly safe bacteriologically. Water temperatures ranged from 57° C. to 69° C. Fifteen samples had no coliform, one culture had a single colony, and another had two colonies.

Since travelers cannot be expected to carry water thermometers, a rule of thumb is that if the unmixed stream from the tap is too hot to be tolerated by hand, the water is hot enough to be bacteriologically modified. A small thermometer is, of course, preferable. Pasteurization is not a method of sterilization: it is a heat treatment sufficient to kill some, but not all of the micro-organisms and to attenuate other pathogens. The time-temperature relationships required for pasteurization may not always prevail even though the temperature of the water delivered at the tap may be in excess of 140° Fahrenheit. Yet only 5 to 10 minutes are required to affect most pathogens at this temperature (see chart).

On a worldwide basis, the most common pathogens causing enterocolitis are the *Salmonella* and *Shigella* groups, *Vibrio cholerae*, *Entamoeba histolytica*, some viruses, and, infrequently, *Escherichia coli*. Most intestinal pathogens are very sensitive to heat. *E. coli* is

somewhat more heat resistant (see chart). *V. cholerae* is killed in 10 minutes at 55° C. (*4*). *E. histolytica* is readily destroyed by heat, and the more resistant amebic cysts are killed in 5 minutes at the relatively low temperature of 50° C. or 122° F. (*4a*). This fact may be of practical interest since amebic dysentery is a most common waterborne disease. The sensitivity of amebic cysts to heat contrasts with their resistance to commonly applied concentrations of chlorine which are unable to destroy the cysts (*5*).

The heat resistance of bacterial spores is much higher; however, they are not of importance as intestinal pathogens. It is not known whether the heat resistance of the homologous serum hepatitis virus in injectable materials applies also to the infectious hepatitis virus A. Infectious hepatitis virus A can survive a temperature of 56° C. (133° F.) for 30 minutes; its capability of survival at higher temperatures is unknown (*6*).

In exploring the practical usefulness of pasteurized water, traveling companions and I drank the hot tapwater after cooling it; used it for toothbrushing and mouthwashing; washing glasses, dishes, and fruit; diluting drinks; and other purposes, without acquiring enteritis. The usual precautions in selecting foods were followed; for example, avoidance of salads, ice, ice cream, and fresh fruits that we could not peel or wash in hot water.

Reluctance to use hot tapwater for drinking may be illusory for the following reason. In Accra, Ghana, we confirmed a suspicion that travelers unknowingly drink piped hot water anyway. Hot tea or coffee, assumed to be relatively safe, is commonly prepared by filling a pot from the hot water faucet and adding instant coffee or a teabag. This is an everyday practice, which may explain the unedifying taste of these beverages.

My objective in preparing this report is partly to point to a relatively safe source of water in regions with low sanitary standards. Another purpose is to suggest further bacteriological tests with hot tapwater in other developing countries more frequently visited by travelers. Such tests may provide a broader basis for conclusions about the comparative safety of "pasteurized" water.

Summary

Samples of hot tapwater from faucets in hotel rooms were cultured for coliform organisms. A total of 49 tests were made in 17 establishments. The hotels were in countries of West Africa, a region with a particularly high incidence of intestinal infections. The bacteriological quality of these hot water samples was satisfactory. With few exceptions, the cold tapwater was unsafe for drinking.

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