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Bacteriological quality of drinks from vending machines

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SUMMARY

A survey on the bacteriological quality of both drinking water and flavoured drinks from coin-operated vending machines is reported. Forty-four per cent of 25 drinking water samples examined contained coliforms and 84% had viable counts of greater than 1000 organisms ml at 30 °C. Thirty-one flavoured drinks were examined; 6% contained coliforms and 39% had total counts greater than 1000 organisms ml. It is suggested that the D.H.S.S. code of practice on coin-operated vending machines is not being followed. It is also suggested that drinking water alone should not be dispensed from such machines.

INTRODUCTION

Legislation governing the quality of potable water in the UK has been limited to the obligation of water authorities to supply 'wholesome' water and for local authorities to monitor the wholesomeness of supplies in their area (Lewis, 1983). The European Community (E.C.) directive on water quality recently implemented seeks to define strict criteria for water intended for human consumption (European Community, 1980). The effect of the E.C. directive on mains supplies is minimal, as microbiological standards differ little from those already accepted. However, as Lewis pointed out, an important effect of the directive is that it covers all potable water after it has left the mains supply. The E.C. directive also applies to water intended for use in the production of food or drink. The problems of drinking water on ships, aeroplanes and trains and of tanked water in schools or hospitals have already been mentioned (Lewis, 1983). Coin-operated vending machines have not been investigated to date.

It was therefore decided to examine bacteriological quality of both water and flavoured drinks supplied by such machines. This followed the unsatisfactory results obtained when water from chilled drinks dispensers of the reservoir type was examined (Hunter, 1985). Machines of this type are now common in works canteens, leisure centres and many other areas. Most provide a selection of hot and cold drinks, many are able to dispense drinking water. They provide a cheap way of serving beverages to any workforce and have virtually replaced the traditional tea lady.

METHODS

From November 1985 to February 1986 environmental health officers in several areas of South Wales were encouraged to submit specimens to the laboratory. Drinking water samples were received from 25 machines, four of which were sampled on more than one occasion. Flavoured drinks were received from 31 machines, none of which were re-sampled. A total of 55 machines was examined. On only one occasion was water and flavoured drink submitted from the same dispenser. Specimens were taken into sterile containers without superficial disinfection of the outlet nozzle, but after running one or more drinks to waste. Specimens were then submitted to the laboratory in a cool box within 6 h.

A questionnaire was also completed for each specimen detailing machine supplier, whether the machine was the subject of a complaint, cleaning methods and the presence of holding tanks.

Water samples were examined by the membrane filtration method and cultured on Membrane Enriched Teepol Broth (D.H.S.S., 1982). Samples of drinks unable to pass through membranes were tested by the multiple-tube method using Minerals Modified Improved Formate Lactose Glutamate Broth (D.H.S.S., 1982). Initial confirmation of coliforms was by subculture into Brilliant Green Lactose Bile Broth for presumptive positives from the multiple-tube method and Lactose Peptone Water for colonies from the membranes. Screening for the presence of *Escherichia coli* was by subculture into Lauryl Tryptose Mannitol Broth with tryptophan at 44 °C. Coliforms were further identified by using the API 20E system.

Total viable counts were estimated by 1 ml pour plates of broth neat sample and several tenfold dilutions of sample in sterile water. They were cultured at only one temperature (30 °C) for 48 h (D.H.S.S., 1982). Several subcultures were made from each positive sample and classified on the basis of Gram reaction, cytochrome oxidase and oxidation or fermentation of glucose.

The pH of flavoured drinks was measured by pH indicator papers (Whatman Ltd).

RESULTS

The results of coliform and total counts are shown in Table 1. The EEC directive gives maximum acceptance coliform counts as less than 1 per 100 ml and guidelines for total counts as less than 10 per ml at 37 °C and 100 per ml at 22 °C. On the basis of coliform counts, 11 of 25 (44 %) water samples tested were not satisfactory. Only 2 of 31 (6 %) flavoured drinks were unsatisfactory. If one takes a total count of 1000 colonies per ml at 30 °C as being a reasonable level higher than either of the recommended limits, then 21 of 25 (84 %) water samples and 12 of 31 (39 %) drink samples were not satisfactory.

The pH of flavoured drinks fell within the range 1–3.

The initial identification of 130 subcultures taken from the total counts is shown in Table 2. Amongst the coliforms identified by API 20E, klebsiellas formed 9 of 13 isolates examined, 7 of which were *Klebsiella pneumoniae*. The remaining coliforms were *Enterobacter cloacae* (2 isolates), *Citrobacter freundii* and *Acinetobacter* var *anitratrus* (1 isolate each). However, the most frequently isolated

Table 1. *Bacteriological counts of drinking water and flavoured drinks*

	Coliform count/100 ml				Total viable count/ml (30 °C)					
	< 1	1–9	10–99	⩾ 100	< 10	10–10^2	10^2–10^3	10^3–10^4	104–10^5	> 10^5
Water	14	8	1	2	0	1	3	10	7	4
Drinks	29	2	0	0	10	2	7	6	5	1

Table 2. *Initial identification of isolates from total colony counts*

Gram reaction	Oxidase	O/F reaction	Number
Gram-negative	+	–	34
		O	18
		F	4
	–	–	28
		O	7
		F	3
Gram-positive bacilli			12
Gram-positive cocci			4
Yeasts			16
Other fungi			4
Total			130

Table 3. *Total viable counts of serial samples of water taken from vending machines*

	Viable counts per ml at 30 °C			
Machine	1st sample	2nd sample	3rd sample	4th sample
18	26000	17600	9200	288000
17	2000	160000	91000	
19	3100	27000	44000	
20	1040	400000		

organisms were non-saccharolytic Gram-negative bacteria, being either oxidase-positive or negative. The majority were probably 'environmental' organisms of little pathogenic significance.

Table 3 shows the results of total viable counts of potable water samples from machines sampled on more than one occasion. It is clear that there is a large sample-to-sample variation in the same machine. Only occasionally could the effect of thorough cleaning be recorded.

DISCUSSION

Whilst the relevance of coliform counts to the safety of potable water has always been controversial, the relevance of total viable counts is even more so. Nevertheless, the E.C. directive has established strict criteria for coliform counts, and guidelines have been suggested for total colony counts. Drinking water from the vending machines examined often did not meet these criteria. The results from the flavoured drinks seemed rather better, though the counts on several were still

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outside the suggested limits. A possible explanation for the difference might be the acidity of the flavoured drinks (pH between 1 and 3). At such a low pH one would not expect coliforms to survive for any length of time after sampling. The coliform counts of flavoured drinks at the time of consumption must therefore remain uncertain.

The D.H.S.S. has issued a code of practice on the use of vending machines (D.H.S.S., 1967). This code of practice covers the construction, cleaning, maintenance, siting and use of such machines. It suggests that machines which dispense milk drinks should be cleaned and sterilized daily, according to the manufacturer's recommendations. Machines dispensing other liquids should be similarly treated every 48 h.

The completed questionnaire indicated that cleaning practices vary from a daily superficial clean of the outlet nozzle to a thorough clean only every 3 months. Some machines had the facility to flush through tubing with hot water to assist cleaning. Many vending machines had cold water holding tanks. These were rarely if ever cleaned, and the few that were examined had liberal coatings of slime often extending down the tubing and occasionally appearing in the water sample. The D.H.S.S. guidelines were obviously not being followed.

A few complaints of an unpleasant taste in the water from vending machines were received. No infection from such vending machines has been identified in South Wales to date. However, the possibility of vague ill health being related to the consumption of such large numbers of organisms cannot be excluded. The acquisition of any potential pathogens present is of course always a possibility with such high counts.

It is suggested that coin-operated vending machines should no longer dispense drinking water. Whether hot and cold flavoured drinks made from such water can be assumed to satisfy the E.C. directive is uncertain. However, hot drinks should be of a sufficiently high temperature and cold drinks of sufficiently low pH to kill any coliform organisms present. Perhaps machine design should now be reviewed to facilitate adequate cleaning, which should in any case be carried out conscientiously on all dispensers.

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