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Comparison of Various Brands of Membrane Filters for Their Ability to Recover Fungi from Water

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Five brands of ethylene oxide- and autoclave-sterilized membrane filters were examined for their ability to recover fungi from natural waters. Results showed that the recovery on Gelman membranes was consistently higher than on the other brands tested.

The use of the membrane filter technique in water quality examination and assessment is well established and has been accepted as a standard method for evaluating bacterial water quality. Although membrane filter methodology has become widely accepted as an effective and efficient microbiological tool, there are no standardized quality control procedures available to users of these membranes to determine and compare their ability to capture, resuscitate, and grow microorganisms. It is now realized that different commercial brand membranes vary in characteristics such as pore morphology, air and water flow rates, presence or absence of hydrophobic areas, and presence of either residual inhibitory compounds or toxic materials. Recently, Standridge (8) reported that there were differences between pore structures of the Millipore HC membranes and the Millipore HA and Gelman GN-6 membranes as shown by electron micrographs. From a close examination of these micrographs, it was apparent that both Millipore HC and Gelman GN-6 membranes had expanded surface pore structures. It is hypothesized that the expanded-pore structure noted by Standridge might have been responsible for the many reports concerning the superiority of the Gelman membranes in resuscitating and enumerating bacteria from water (2–6).

In view of the above observations with bacteria, we decided to compare and evaluate the ability of various brands of both ethylene oxide- and autoclave-sterilized membranes to recover fungi from natural waters.

Five different brands of ethylene oxide- and autoclave-sterilized membrane filters were used in the study. The following 47-mm, 0.45-μm gridded membrane filters were evaluated: (i) Gelman GN-6, 64194, lot no. 80578, sterilized at 121°C for 10 min; (ii) Millipore HAWG 047SO, lot no. 10573-4, ethylene oxide sterilized by the manufacturer; (iii) Millipore HAWG 047AO, lot no. 3448-10, sterilized at 121°C for 10 min; (iv) Millipore HCWG 047S3, lot no. 37158-9, ethylene oxide sterilized by the manufacturer; (v) Sartorius SM 13756, lot no. 306342735, ethylene oxide sterilized by the manufacturer; (vi) Sartorius 11406, lot no. 3060-92709, sterilized at 121°C for 30 min; (vii) Johns-Manville 045M 047SG, lot no. 409A257, ethylene oxide sterilized by the manufacturer; (viii) Johns-Manville 045M 047GA, lot no. 438K529, sterilized at 121°C for 20 min; (ix) Oxoid N47/45, lot no. 3380, sterilized at 121°C for 15 min.

Surface water samples were filtered in appropriate volumes, and the membranes were plated on modified aureomycin-rose bengal-glucose-peptone agar and modified streptomycin-terramycin-malt extract agar (1), and incubated at 15°C for 5 days. During these tests the majority of membrane filters showed uniform moisture diffusion and were devoid of hydrophobic areas. The only noticeable exceptions were some autoclaved Oxoid and Sartorius membranes, which were found to have several hydrophobic areas. In addition, upon autoclaving, the Millipore HA, Sartorius, and Oxoid filters became somewhat fragile and slightly distorted due to shrinkage.

The approximate time required for the filtration of 30-ml portions of water samples was determined to obtain information on the relative flow rates of the membranes. The fastest flow rate, filtration time 5 to 7 s, was observed with Millipore HC membranes, followed by Gelman membranes, which had a filtration time of 8 to 10 s. Exception for autoclaved Johns-Manville filters (filtration time, 12 s), the filtration time of all other membranes varied between 15 and 18 s.

A variety of membrane combinations were

TABLE 1. *Comparison of percentage[a] fungal recoveries on various brands of autoclave- and ethylene oxide-sterilized membrane filters*

No. of replicates	Medium[b]	Membrane type								
		Ethylene oxide sterilized				Autoclave sterilized				
		Millipore HA	Millipore HC	Johns-Manville	Sartorius	Millipore HA	Johns-Manville	Sartorius	Oxoid	Gelman
10	MARGPA	70	72	84	64	—[c]	—	—	64	100
	MSTMEA	56	62	59	65	—	—	—	70	72
8	MARGPA	—	—	—	—	96	73	81	50	100
	MSTMEA	—	—	—	—	73	104	83	86	120
5	MARGPA	33	53	50	43	47	60	43	—	100
	MSTMEA	27	47	47	33	40	50	40	—	77

[a] Mean values of fungal densities obtained from replicates were used to determine percentages based on Gelman count on MARGPA being 100%.

[b] MARGPA, modified aureomycin-rose bengal-glucose-peptone agar; MSTMEA, modified streptomycin-terramycin-malt extract agar.

[c] Not tested in this trial.

tested over a 2-month period using 5 to 10 replicates of each membrane type during each test. The results of some typical tests are presented in Table 1.

Although not pronounced, there were appreciable differences among various brands of membrane filters in their recovery of fungi from natural waters, with the Gelman GN-6 membrane being superior to all membrane filters tested. Although it is difficult to clearly establish that differences noted in physical characteristics and sterilization procedures directly affected their ability to enumerate fungi, certain generalizations can be made. The presence of hydrophobic areas on some membranes not only reduced the actual filtration area, but also prevented proper diffusion of nutrients to the upper surface of the membrane. Also, membranes that exhibited faster flow rates generally produced higher counts compared with those with slower flow rates. The variable flow rates of these membranes are suspected to be related to differences in their surface pore morphology. Furthermore, the autoclave-sterilized membranes showed higher recovery rates than the corresponding ethylene oxide-sterilized membranes.

In summary, the membrane filters could be ranked in order of decreasing fungal recovery as follows: Gelman (autoclaved) > Johns-Manville (autoclaved) > Millipore HC (ethylene oxide sterilized) ≃ Johns-Manville (ethylene oxide sterilized) > Millipore HA (autoclaved) > Oxoid (autoclaved) ≃ Sartorius (autoclaved) ≃ Sartorius (ethylene oxide sterilized) > Millipore HA (ethylene oxide sterilized).

From recent studies by Sladek et al. (7) and Standridge (8), it is suspected that surface pore size is directly related to the productivity of the membrane. Standridge (8) found that Millipore HC and Gelman membranes (as compared with Millipore HA membranes) had expanded surface pore structures. The possibility also exists that the autoclaved Johns-Manville filters, which were the second most productive membranes and had the third fastest flow rate, may also have an expanded surface pore structure. However, since there was a difference in recoveries between the top three membranes, i.e., Gelman, Johns-Manville (autoclaved), and Millipore HC (ethylene oxide), we suspect that the autoclaving process may remove some potentially toxic or inhibitory compounds, thus giving a slight edge on recovery performance to the Gelman and Johns-Manville membranes.

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