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Pour Plates or Streak Plates?

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The pour plate method of counting bacteria is more precise than the streak plate method, but, on the average, it will give a lower count.

Pour plates are usually the method of choice for counting the number of colony-forming bacteria in fluids (1). Their preparation is, however, time consuming. Other disadvantages are the reduced growth rate of obligate aerobes in the depth of the agar and the danger of killing heat-sensitive organisms with hot agar. These objections cannot be raised against the streak plate method. The present paper compares results obtained with the two methods.

Overnight cultures of *Escherichia coli* (ATCC 10536) in nutrient broth were diluted in phosphate-saline buffer, *p*H 7.3, to suspensions containing 1,000 to 3,000 organisms per ml. Streak plates were 100 mm diameter plastic petri dishes containing 15 ml of antibiotic test medium (Difco 0243) with 2% agar. With a capillary pipette (diSPO Micropipets, P4518-100, 100 μliter, Scientific Products, Evanston, Ill.), 0.1 ml of bacterial suspension was deposited on the agar. The pipette, sealed at one end and bent to 90°, was used to streak the inoculum over the agar surface. Pour plates were made by pipetting 0.1 ml of bacterial suspension with a capillary pipette into an empty petri dish and adding 15 ml of agar cooled to 48 C. Colonies were counted after overnight incubation at 37 C. The results were obtained with three different suspensions, with about 50 plates for each count (Table 1).

The colony counts for all six determinations seemed to be approximately normally distributed (*see* Fig. 1). The numerical value of the mean was significantly higher (*t* test) for the streak plates than for the pour plates, although samples were taken from the same bacterial suspension. The sample variance of the distribution of pour plate counts did not differ significantly (*z* test) from the numerical value found for the mean.

TABLE 1. *Comparison of the distribution of colonies on streak plates with the distribution on pour plates after inoculation with samples taken from the same bacterial suspension*[a]

Date of count	Plating method	n	$\bar{x}$	s^2	Chi square	z[b]	F[c]	t[d]
June 13	Streak	48	119.54	180.30	8.46	2.49 (<0.05)[e]	1.72 (0.05-0.10)	−1.75 (0.05-0.10)
	Pour	53	115.36	104.85	8.94	0.47 (0.32[f])		
June 23	Streak	50	49.76	84.55	3.08	3.50 (<0.01)	2.09 (<0.02)	−3.82 (<0.01)
	Pour	56	43.82	40.48	0.96	0.40 (0.34[f])		
June 26	Streak	49	174.56	307.00	0.38	3.75 (<0.01)	1.79 (<0.05)	−2.71 (<0.01)
	Pour	47	166.04	171.82	1.51	0.17 (0.43[f])		

[a] Abbreviations: n, total number of plates; $\bar{x}$, estimate of parameter μ; s^2, estimate of parameter σ^2.
[b] For $\mu = \sigma^2$.
[c] For $\sigma_s^2 = \sigma_p^2$, with subscripts $_s$ and $_p$ indicating streak and pour plate methods, respectively.
[d] For $\mu_s = \mu_p$, with subscripts $_s$ and $_p$ indicating streak and pour plate methods, respectively.
[e] Values in parentheses indicate probability of finding z, F, or t greater than the tabulated value.
[f] Not significant.

The colony frequencies on the plates (the plate counts) are theoretically distributed by Poisson distribution (2). The result obtained thus represents the maximal precision attainable with the pour or streak plate method of counting colony-forming cells under the conditions of the experiment. It should be pointed out that, for large values of the mean, a Poisson distribution very closely approximates a normal distribution with a variance equal to the mean. The sample variance for the streak plate counts was, however, numerically larger than the mean. It was also significantly larger than the sample variance for the

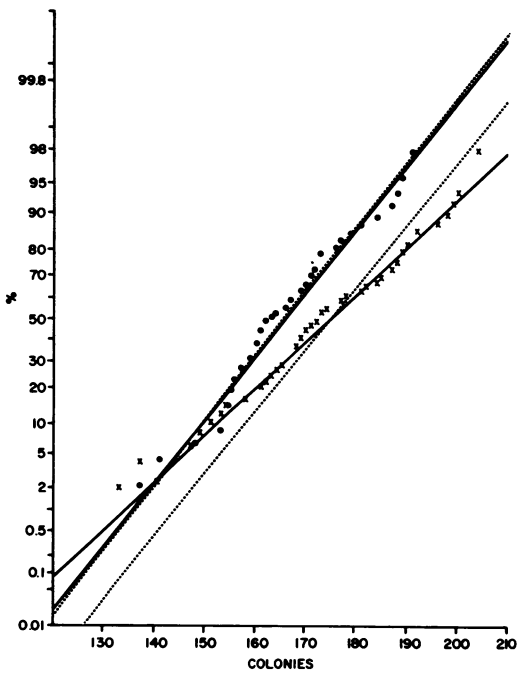

FIG. 1. *Distribution of colony counts obtained with samples of a suspension of Escherichia coli plated as pour plates (●) and as streak plates (×). Uninterrupted lines are probit lines of cumulative normal distributions representing the plotted points. The interrupted lines are probit lines of cumulative normal distributions with variances numerically equal to the mean.*

pour plate counts. The precision of the pour plates was thus not repeated with streak plates.

The results of the third experiment (June 26) listed in Table 1 are graphically illustrated in Fig. 1.

The smaller average count found with the pour plate method is probably due to loss of viability of some bacteria coming into contact with hot agar. Some organisms were also lost because the capillary pipette could not be completely emptied on the bottom of the empty petri dish. A minute remnant of fluid remained, which could be removed by touching the tip of the pipette to an agar surface. The number of organisms thus lost was 2.7% of the average total count, with a coefficient of variation of 66%. After streaking of the streak plates, the number of organisms remaining on the surface of the pipette and thus lost from the plate count was found to be about 3.9% of the average count, with a coefficient of variation of 90%, which is probably the reason for the smaller precision of streak plates as compared to pour plates.

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