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A Research Note

Comparison of a Dry Medium Culture Plate (Petrifilm SM Plates) Method to the Aerobic Plate Count Method for Enumeration of Mesophilic Aerobic Colony-Forming Units in Fresh Ground Beef

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ABSTRACT

Mesophilic aerobic microbial populations in fresh ground beef were enumerated with a new system, Petrifilm™ SM Plates (PSM), and with the conventional aerobic plate count (APC) method using standard methods agar (SMA). Total colony-forming units were determined in 119 fresh ground beef samples (29 extra-lean, 30 lean and 60 regular) purchased at nine different retail markets over a period of 6 wk. Linear regression analysis of PSM vs. APC counts gave a slope of 0.963, an intercept of -0.027, and a correlation coefficient of 0.951. Mean $\log_{10}$ counts on PSM were 5.86 compared to 6.11 on SMA ($P<0.01$) or a mean $\log_{10}$ difference of -0.25. These analyses indicate that the Petrifilm SM method would be a possible alternative for the aerobic plate count method.

The microbiological quality of ground beef is of concern to the foodservice industry and often is evaluated by colony count procedures. Considerable effort has been directed to determine the microbial levels of ground beef (*2,4*). A new dry medium system, Petrifilm™ SM Plates (PSM), has been developed as an alternative to the aerobic plate count (APC) method for the enumeration of total aerobic mesophilic bacteria. A report by Ginn et al. (*1*) indicated a satisfactory performance with raw milk samples using the new PSM method. The objectives of this study were to evaluate the comparability of the PSM method to the APC method employing standard methods agar (SMA) and to compare the enumeration data generated by the two methods.

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MATERIALS AND METHODS

Experimental design

One hundred and twenty fresh ground beef samples were tested. Samples were evaluated in duplicate on PSM and SMA (Difco plate count agar). Statistical analysis was conducted as a linear regression of the enumeration data from the paired comparison design.

Test samples

Fresh ground beef samples (extra-lean, lean and regular) were purchased in 1-lb prepackaged quantities, when available, from nine representative retail markets over a 6-wk period (5 stores × 4 samples per store per wk). Samples were randomly selected from meat counter displays, labeled, placed inside a Ziploc storage bag, transported on ice and refrigerated at 4°C until tested. Sixty samples were tested within 1 h of purchase. The remaining 60 were held overnight at 4°C and tested within 24 h.

Media

Petrifilm SM plates were supplied by 3M (3M Center, St. Paul, MN) and have been described previously (*1*). Two lots of Petrifilm SM and two lots of SMA were tested.

Sampling

A 25-g sample was aseptically removed with a sterile tongue blade and placed in a sterile Stomacher 400 bag (Dynatech Laboratories Inc., Alexandria, VA). An appropriate volume of sterile 0.1% peptone water was added to make a 1:10 dilution and the sample was stomached for 2 min. Appropriate 10-fold serial dilutions in 0.1% peptone were prepared. One ml of the selected dilution was distributed onto each of the duplicate PSM plates by lifting the top film, dispensing the 1-ml sample onto the center of the bottom film, replacing the top film with a rolling motion and distributing the sample evenly using a slight downward pressure on the plastic spreader supplied with the PSM plates. SMA plates were prepared according to the *Bac-*

teriological Analytical Manual (3). All analyses were done in duplicate for three dilutions. SMA plates were inverted and incubated at 35°C for 48 h. PSM plates were stacked no more than ten high and incubated horizontally (film side up) at 35°C for 48 h. Total colony-forming units were counted using a Quebec colony counter.

RESULTS AND DISCUSSION

This study was designed as a paired comparison of 120 fresh ground beef samples; however, one sample was excluded due to a laboratory accident. Geometric means of counts per gram were calculated from actual plate counts which fell in or nearest to the range of 30 to 300.

The data were examined by plotting $\log_{10}$ colony counts for PSM vs. $\log_{10}$ colony counts for APC. These data are presented in Figure 1 with the regression line and 95% confidence limits. The regression line, with a slope of 0.963 and an intercept of -0.027, was close to the line of equality of methods (interrupted or broken line with slope of one and intercept of zero). The negative intercept, along with slope nearly equal to one, indicated that PSM counts were lower than APC counts ($P<0.01$ by paired t-test) and that the difference (in the $\log_{10}$ scale) between PSM and APC was constant over the entire range of count values. The mean $\log_{10}$ difference of counts on PSM vs. APC was -0.25 (PSM = 5.86, APC = 6.11).

At the present time, microbiological standards for fresh ground beef have not been established. The methodology to evaluate the microbial populations in this food system is a tool to assess the quality of the product. Although the mean $\log_{10}$ counts on PSM (5.86) were lower than the $\log_{10}$ counts for SMA (6.11), the difference may represent variability of sample density after stomaching and dilution and before plating. The fat, protein and water components of this test system could be contributory factors to observed differences in SMA and those of the PSM system. The proposed alternative has the advantage of eliminating preparation and sterilization of medium, lot-to-lot variability of medium, the added advantage of a tetrazolium indicator dye which stains the colonies red and facilitates counting, and the PSM plates take less incubator space than the conventional petri dish.

The results of this study indicated that the relationship between the two methods is predictable and practical and that PSM may be a possible alternative for the enumeration of mesophilic aerobic microbial populations in ground beef under routine laboratory procedures. This is in agreement with observations by Ginn et al. (*1*) who also found the dry medium culture plate suitable as an alternative method for determining viable bacterial counts in raw milk. Additional studies on other food systems are contemplated.

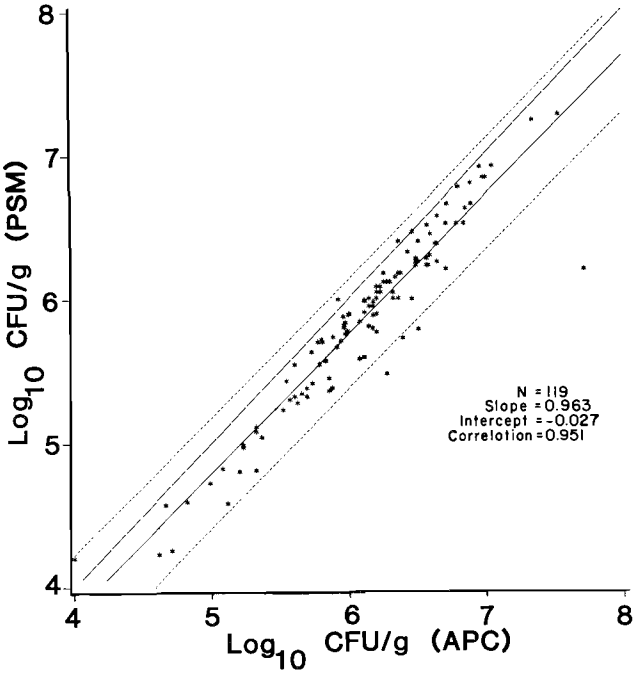

Figure 1. *Comparison of $\log_{10}$ colony-forming units/g for PSM vs. $\log_{10}$ colony-forming units/g for APC indicated by linear regression line (solid line), with 95% confidence limits (dashed lines), and line equality (broken line).*

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