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Adhesive Tape Method for Estimating Microbial Load on Meat Surfaces [1]

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ABSTRACT

Acetate and mylar adhesive tapes were used to estimate microbial loads on surfaces of 60 red meat samples. The conventional method of excision, rinsing and blending of meat was used as a comparison. The mylar tape method was found to provide statistically significant correlation compared with the conventional method. We suggest that when the tape count is > log 2 CFU/cm², bacterial counts are high on meat surfaces (ca. log 5-7 CFU/cm²); between log 1-2 CFU/cm², counts are intermediate (ca. log 3-4 CFU/cm²) and < log 1 CFU/cm², counts are low (ca. log 3 CFU/cm²). The tape method is easy to perform and requires little time and material. With multiple transfers, it may be used to evaluate counts at different incubation temperatures and on different types of agar media.

Workers concerned with food plant sanitation, food spoilage and food preservation need to monitor the microbial load on surfaces of food products and in food processing environments. Baldock (*1*) reviewed the various methods and procedures for sampling surfaces for microorganisms in relation to food plant sanitation. Vanderzant et al. (*13*) identified nine ways to evaluate microbial loads on meat and meat products surfaces: skin or meat tissue excision, swabbing, rinsing, direct agar contact, skin-scraping, impression (tape), vacuum, light scattering, radiometric and bioluminescence evaluation and blending with sterile diluent methods. They also listed the following factors that influence selection of test procedures: type of sample, objective of the test, microbial levels expected, presence of bactericidal compounds on surface of sample, resources available for sampling and laboratory analysis, environmental conditions during sampling and precision and accuracy requirements.

Of those procedures and methods, the agar-contact method and impression tape method are said to be the easiest to use, especially in field testing.

Use of adhesive tape for sampling microorganisms from human skin has been reported by Edwards and Hartman (*2*), Kooyman and Simons (*3*), Milne and Barnetson (*6*), Thomas (*10*), Ulrich (*11*), Updegraff (*12*) and Wilson (*14*). Newfarmer and Robe (*7*) reported on the effectiveness of a commercial tape-plate system in sampling microorganisms. But adhesive tape for sampling microorganisms from red meat surfaces has not yet been extensively used. This report describes a simple system for estimating microbial loads of red meat surfaces with an adhesive tape (acetate or mylar) as the sampling devise and agar medium as the growth substrate. Results were compared with those from the conventional plate-count method of excised, rinsed and blended and rinsed samples, a method credited with providing accurate microbial counts on meat (*4*).

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MATERIALS AND METHODS

Meat samples

Sixty meat samples were obtained from the Department of Animal Sciences and Industry, Kansas State University, half of them directly from the wholesale short plate region of the washed carcasses and these are considered fresh samples. Companion wholesale short plate samples were excised, vacuum-packaged and stored for 14 days at 2 C before sampling. These were the stored samples. Samples were excised anterior of the 13th rib and 6.0 to 8.0 cm dorsal to the ventral midline.

Acetate adhesive tape procedure

For the first 40 samples (20 fresh, 20 stored) acetate adhesive tapes (7.9 × 13.1 cm with adhesive area of 7.9 × 12.4 cm; Dynatech Laboratory Inc., Alexandria, VA) were used. After removing the protective paper from the tape, the adhesive side was pressed on the surface of the carcass plate region (Fig. 1) or plate pieces. The adhesive side of the tape has been determined to be free of microorganisms in our laboratory by agar contact method. Contact time on meat was approximately 20 sec. The tape charged with microorganisms was then transferred to sterile plate-count agar (Difco) contained in a rectangular "petri dish" (8.5 × 12.5 cm; Fig. 2). During the experiments we wore disinfected rubber gloves to minimize contamination. After contact time of 5 min, the tape was removed and the plate was then incubated at 32 C for 24 h for mesophilic counts.

For 20 samples, the tape was further transferred to another sterile agar plate. The second agar plate was incubated at 7 C for 10 days for psychrotrophic counts. Preliminary data indicated that the tape could be transferred five times before appreciable reduction of counts on the plate was observed. After incubation, the number of colonies on the plate was counted directly when the number was fewer than 500 per plate and then was reported as log CFU (colony forming units)/cm². When larger numbers were encountered, a template with 160 squares was used to estimate the number of colonies on the plate. At predesignated intervals the number of organisms in 16 squares was counted. The total number in 16 squares was multiplied by 10 to obtain the total number of CFU/cm² on the plate. When the organisms in a square were too numerous to count, an arbitrary "saturation" number of 200 colonies was assigned, so the maximum colonies countable were 32,000. As a comparison, two pieces of meat (32.26 cm²) adjacent to the tape sampling area were excised aseptically (*19*), placed in 100 ml of sterile rinse solution (buffered diluent) (*5*) for 1 h and then shaken 100 times before the plate count was made (*5*).

Mylar adhesive tape method

Mylar adhesive tape (4 × 1.31 cm; with adhesive area of 4 × 12.5 cm, Dynatech Laboratory Inc., Alexandria, VA) was tested on 20 meat

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Figure 1. *Removing acetate adhesive tape from carcass after sampling of microorganisms.*

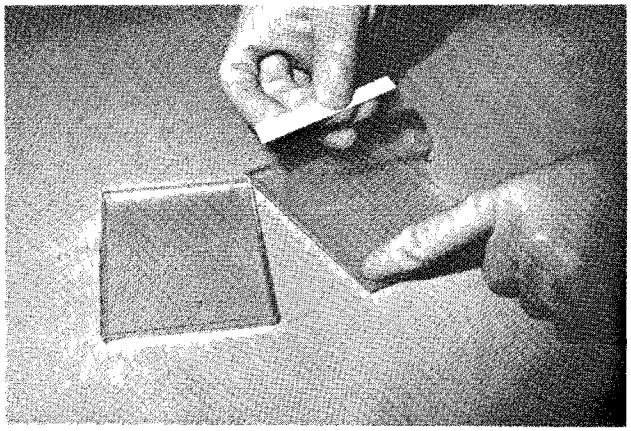

Figure 2. *Applying acetate adhesive tape to sterile agar surface. The lid of the rectangular "petri dish" is shown on the left.*

samples (10 fresh, 10 stored). The procedure was similar to the acetate tape method except that both the contact time on the meat surface and the agar surface were 1 min each. The counting procedure remained the same. The template used for this study had 75 squares, of which 10 were randomly selected and counted to estimate the number of plates with more than 500 CFU per plate. The multiplication factor was 7.5. For comparison, one piece of meat (32.26 cm^2) was aseptically excised adjacent to the tape sampling area, placed in 100 ml of rinse solution for 20 min, blended for 5 sec, and shaken 50 times before the plate count was made. In this experiment, both mesophilic and psychrotrophic counts of meat were monitored for the tape method and the conventional method.

RESULTS AND DISCUSSION

Results of psychrotrophic and mesophilic counts of the 40 (fresh and stored) samples by the acetate adhesive tape method and the conventional method are presented in Fig. 3. Microbial loads were log 0-5 CFU/cm^2 by the conventional rinse method and log $\bar{1}$ to 2 CFU/cm^2 by the tape method. Correlation coefficients between the two methods for 20 paired psychrotrophic counts was 0.64 and for 40 paired mesophilic counts, 0.51 ($P < 0.01$) (*8*).

In the mylar adhesive tape study (20 samples, fresh and stored), the microbial loads were log 0-7 CFU/cm^2 for the conventional blend rinse method and log $\bar{2}$ to 2 CFU/cm^2 for the tape method. Correlation coefficient between 20 paired psychrotrophic counts was 0.95 and for 20 paired mesophilic counts, 0.90 ($P < 0.01$, Fig. 4).

These data indicate that the tape method, especially with mylar adhesive tape, provides a reliable estimate of the microbial load on surfaces of red meat. The data suggest that when the tape count is > log 2 CFU/cm^2, bacterial counts are high on meat surfaces (ca. log 5-7 CFU/cm^2); between log 1-2, counts are intermediate (ca. log 3-4 CFU/cm^2) and < log 1 CFU/cm^2, counts are low

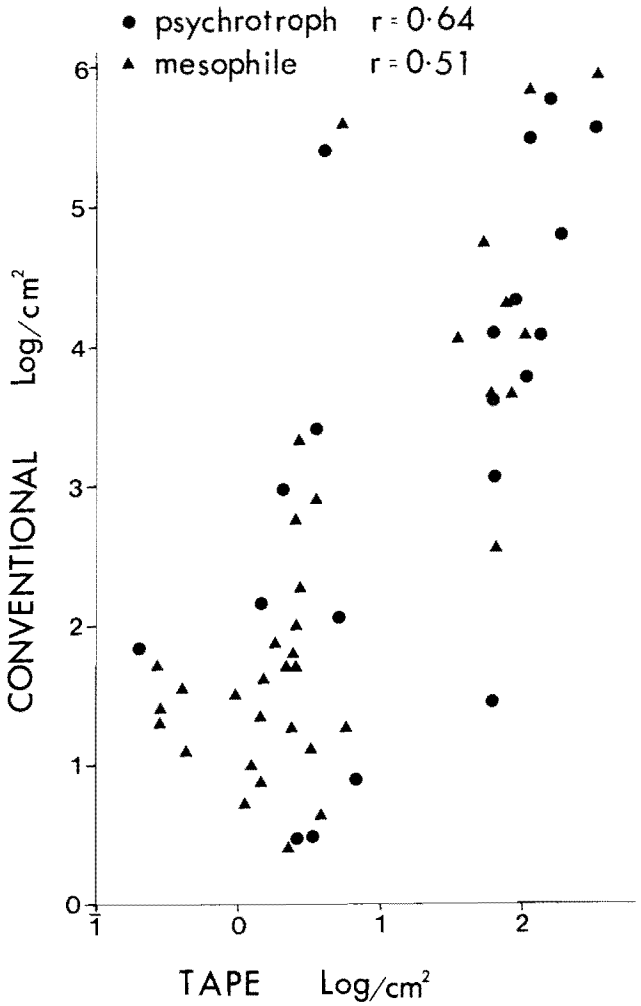

Figure 3. *Correlation of the conventional plate-count method and the acetate-adhesive-tape method for psychrotrophic and mesophilic microbial loads on meat surfaces.*

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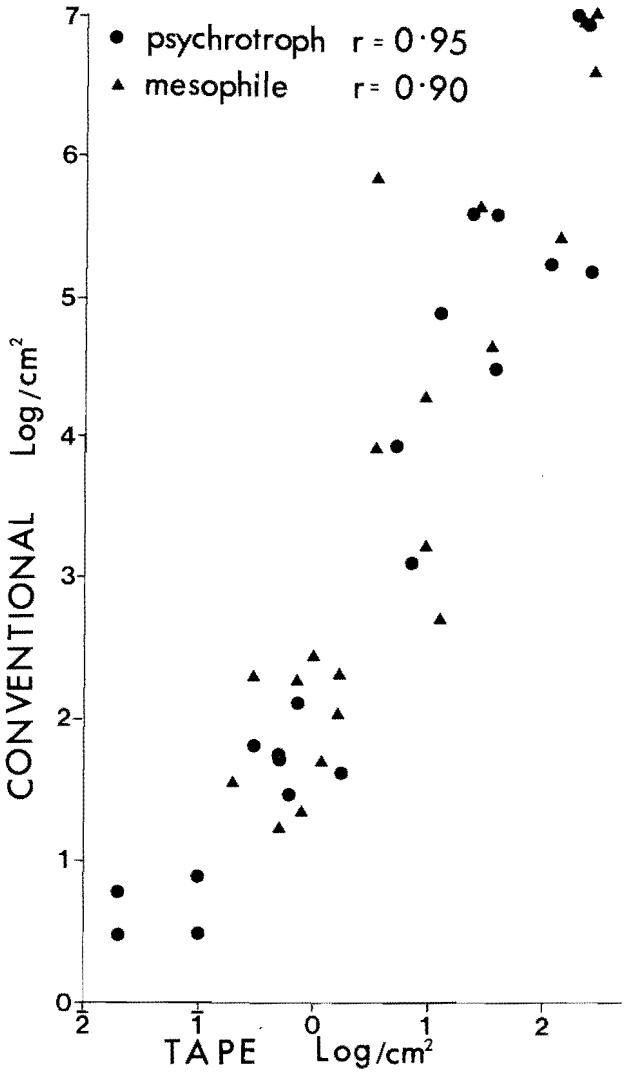

Figure 4. *Correlation of the conventional plate count method and the mylar-adhesive-tape method for psychrotrophic and mesophilic microbial loads on meat surfaces.*

(ca. < log 3 CFU/cm²).

The difference in correlation coefficients between the two paired studies probably stemmed from the 5-sec blending step used in the conventional method in the mylar tape study and also from increasing mylar-tape contact time on meat surfaces from 20 sec to 1 min which may have increased the number of bacteria adhering to the tape.

The tape method is easy to use and requires less time and material than the conventional method. With multiple transfers, it may be used to evaluate counts at different incubation temperatures and on different types of agar media. Its flexibility lets it follow the contours of meat surfaces during sampling. Further investigation should show that the tape method is applicable to other surfaces. Variables related to adhesive tape techniques include the nature of the surfaces studied, the effect of temperature, contact time, humidity, pH, electrostatic forces, agar media and perhaps other undetermined factors. As the tape method is easy to use, especially for on-site sampling, further investigation on the usefulness of the method is warranted.

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