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Effect of Aerosolized Lactic Acid on the Survival of Airborne Microorganisms

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There is much need for an inexpensive, safe, and effective disinfectant against airborne bacteria and other food-spoilage microorganisms in chilling rooms used to cool carcass meat immediately after slaughter or used for the storage of other kinds of perishable foods. A review of substances likely to meet these requirements suggested that lactic acid aerosols might be worthy of study. The use of lactic acid vapor as an aerial bactericide was briefly reported in 1944 (J. E. Lovelock, O. M. Lidwell, and W. F. Raymond, Nature **153:** 20, 1944), and later studies (Med. Res. Council Spec. Rept. Ser. 262, 1948.) indicated that at aerial concentrations within the range of 80 to 150 $\mu g/ft^3$ (3 to 5 mg per cubic meter) it was as effective an aerial bactericide against streptococcal and salivary organisms as any of the various other materials studied. It had the additional advantage of being inexpensive and nontoxic to humans at the concentrations recommended. In extending this earlier work to include airborne yeasts and molds, the survival rates of various psychrophilic microorganisms were investigated as described below. The psychrophilic strains tested included

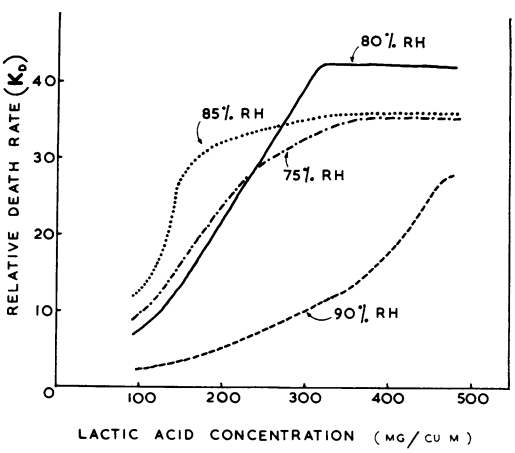

FIG. 1. *Effect of concentration of lactic acid and relative humidity on K_D values of Penicillium M107 at 0 to 1 C.*

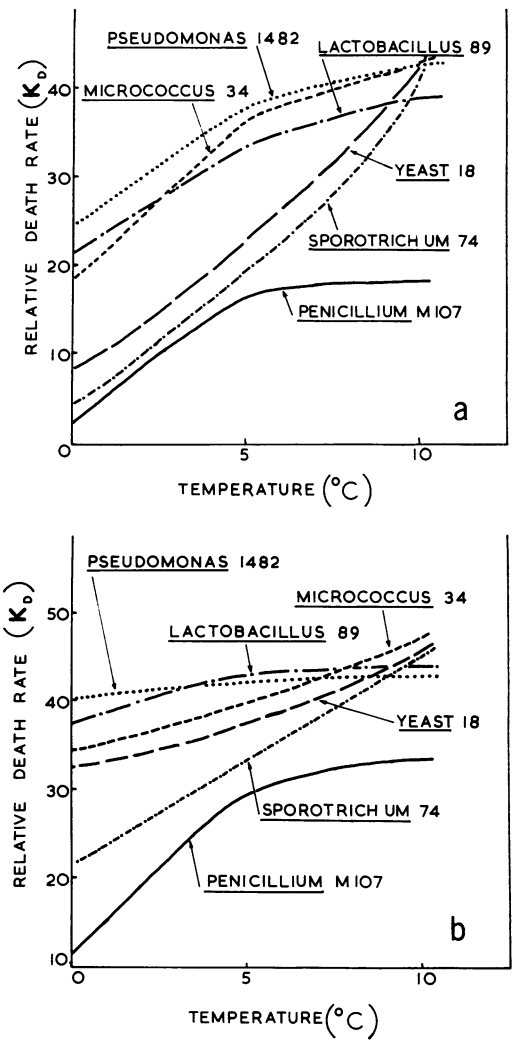

FIG. 2. *Influence of temperature on the disinfection rates (K_D) of a number of microorganisms at 90% RH in the presence of aerosolized lactic acid. (a) 120 mg of lactic acid per cubic meter and (b) 300 mg of lactic acid per cubic meter.*

Penicillium (M 107), *Sporotrichum* (74), a yeast (18), *Pseudomonas* (1482), *Lactobacillus* (89), and *Micrococcus* (34). The numbers listed are those of the Culture Collection of the Division of Food Preservation, Meat Research Laboratory.

The experiments were performed in a small refrigerated room having a volume of 10 cubic meters. Its temperature and relative humidity (RH) were varied independently over a range of 0 to 10 C and 75 to 90%, respectively. Suspensions of the microorganisms in distilled water were introduced into this room with an atomizing device, and the air subsequently was sampled with the improved slit sampler described by R. B. Bourdillon, O. M. Lidwell, and E. Schuster (Med. Res. Council Spec. Rept. Ser. 262, 1948). The aerosols were generated with the spray designed by G. Kaess and J. F. Weidemann (J. Appl. Bacteriol. **25**:180, 1962).

Under our experimental conditions, it was confirmed that the viable cells remaining in aerial suspension decreased exponentially with time. It follows that the killing rate characteristic of the disinfectant (K_D) is given by the difference $K - K^1$, where K is the total die-away rate per hour in the presence of disinfectant, and K^1 is the natural rate of loss of viability of the organism under similar conditions without the disinfectant.

K_D was affected by both RH (Fig. 1) and temperature (Fig. 2a and 2b). Maximal activity was always reached at a concentration of 300 mg of lactic acid per cubic meter, except for *Penicillium* M107 at 90% RH and 0 to 1 C. Further increases in lactic acid concentration did not increase the death rate (K_D). The effect of temperature was most marked when the maximal death rate had not been reached, and K_D increased with temperature up to 10 C, the highest temperature tested (Fig. 2a and 2b). Molds were more resistant than yeasts and bacteria, bacteria being the least resistant (Fig. 2a and 2b).

Optimal conditions for lactic acid disinfection in the test room were 75 to 85% RH at 5 to 10 C, and a concentration of 300 mg of lactic acid per cubic meter.

It is concluded that lactic acid may serve as a useful disinfectant in chilling rooms, or when it is important that toxic materials not be used.