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The Storage Stability Of Electrically Stimulated Hot Boned Refrigerated Ground Beef

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Story in Brief

The storage stability of electrically stimulated ground beef was studied. An incubation temperature of 22 C was found accurate (correlation coefficient of 0.96) for the estimation of the psychrotrophic bacterial population of the product. Electrical stimulation prolonged the lag phase of the bacterial population but inhanced its growth rate (between the third and fifth days of storage). The shelf life of the electrically stimulated ground beef was extended by 3 days as compared to the nonstimulated control (4-5 vs 7-8 days respectively).

Introduction

The importance of ground beef is increasing every year in the U.S. The present consumption is 18.2 Kg/capita and it is believed that it will reach 22.7 Kg/capita a 25 percent increase (Meat Plant Magazine, 1977).

The bacteriological quality of raw ground beef is of concern to all segments of the industry. Reduced shelf life, discoloration of the product as a result of bacterial growth are often encountered. Goepfert (1976) reported an Aerobic Plate Count (APC) of 5×10^6/g in 34 percent of 955 samples of ground beef examined. Duitshaever (1977) showed that more than 50 percent of 108 samples examined were in the range of 5×10^6 to 5×10^7/g. The source of meat

for ground beef and the holding time of the meat may contribute to the bacteriological quality and storage stability of the product. Proposed microbiological standards for ground beef in some states were set at a maximum range of 1.0×10^6 to 5.0×10^6/g (Geopfert, 1976). The United Kingdom has proposed a level of 10^6/g (Green, 1976) while in Canada the maximum limit is 10^7/g (Pivnick, 1977).

Although several studies on the storage stability of ground beef have been completed, there is relatively little, if any, studies on the effect of prefabrication procedures on the microbiological quality and storage stability of the product. The purpose of this study was to show the effect of electrical stimulation and hot boning on the refrigerated storage stability of ground beef.

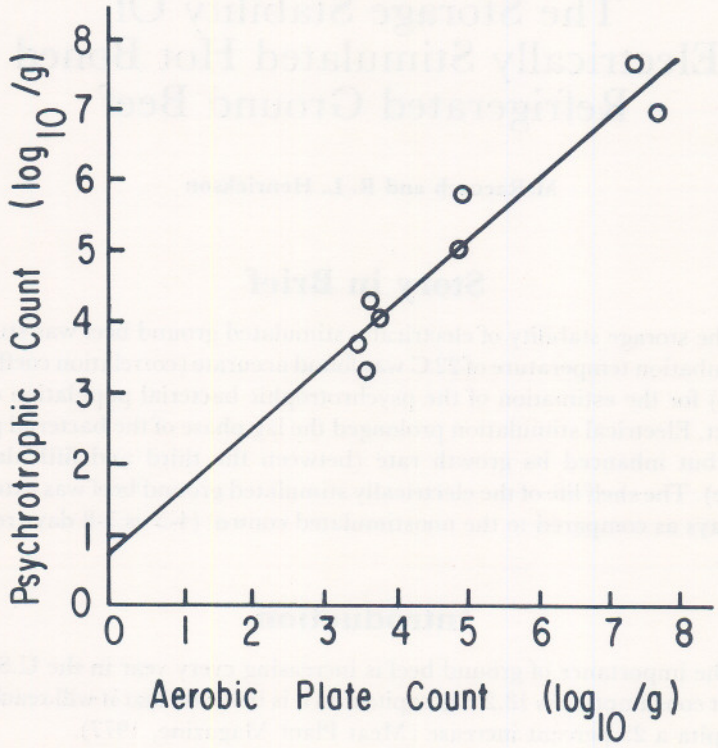

Figure 1. The linear regression between the Aerobic Plate Count and Psychrotrophic Bacterial Count of electrically stimulated hot boned ground beef

Materials and Methods

Electrical stimulation

Sides of beef were stimulated according to Raccach (1978).

Ground beef

Portions of the chuck from the stimulated and control sides were removed at 1.5 hr post mortem, ground then frozen (−25 C) until used.

Bacteriological examinations

Twelve portions each of 250g were packed using a polystyrene foam tray wrapped with PVC (Polyvinyl Chloride). The ground beef was stored at 5 C and a 10g sample was taken daily (22-24 hr). The sample (10g) was blended for 2 min using 90 ml 0.1 percent Peptone (Difco) water. Further dilutions were obtained using the same diluent. The Aerobic Plate Count (APC) was examined by spreading appropriate dilutions of examined samples on pre-poured Plate Count Agar (Difco) plates incubated at 22 C for 48 hr. The Psychrotrophic Bacterial Count (PBC) was examined using the same culture medium incubated at 7C for 10 days.

Calculation of the bacterial number of generations

The number of generations (G) was calculated according to the following formula:

$$G = T/3.3 \log b/B$$

Where: T = Time period; b = number of bacteria at the end of a given time period;
B = Initial number of bacteria.

Shelf life determination

The meat samples were examined for "off odors" by a three member panel. A sample evolving "off odors" was considered spoiled.

Statistical analysis

The correlation and the linear regressions between the APC and the PBC was calculated. The results of the APC of the stimulated sample and its control were subjected to the analysis of variance and to the least significant range test (Steel, 1960.)

Results and Discussion

The linear regression of the APC and the PBC of the electrically stimulated samples (n=6) is shown in Figure 1. The equation of the regression line was $Y=0.78+0.85X$ (where: y=PBC; 0.78=y intercept; 0.85=slope and X=APC). The correlation coefficient (r) was 0.96 significant at $P<0.01$. Figure 2 shows the linear regression of the APC and the PBC of the control (non-electrically stimulated) samples (n=6). The equation of the regression line was $Y=-0.3+1.06X$ with a correlation coefficient (r) of 0.99 significant at

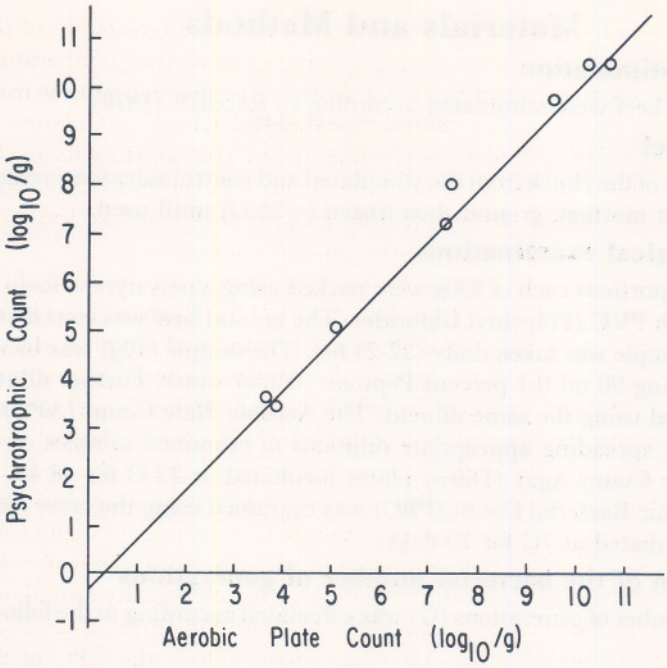

Figure 2. The linear regression between the Aerobic Plate Count and Psychrotrophic Bacterial Count of hot boned ground beef

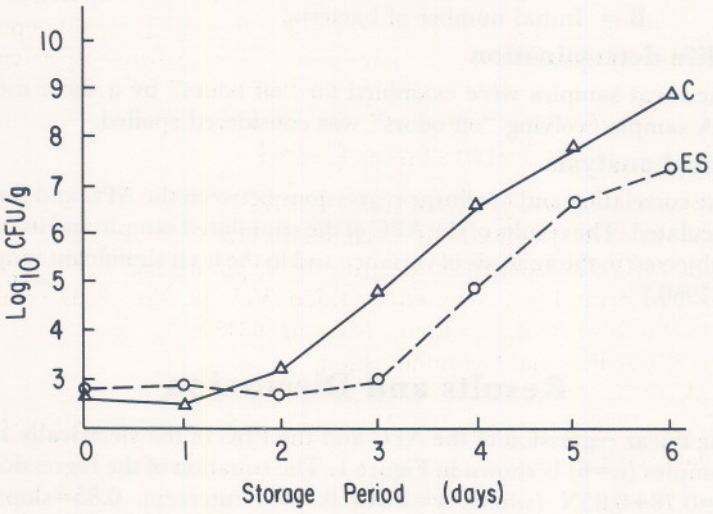

Figure 3. The growth of the endogenous flora of electrically stimulated hot boned ground beef stored at 5 C (C=control; ES=electrically stimulated; CFU=colony forming unit)

$P<0.01$. These results show that one can get an accurate estimation of the psychrotrophic population of ground beef by using an incubation temperature of 22 C. This elevated temperature (22 C) shortens the incubation time from 10 days (7 C) to 48 hr. Since the psychrotrophic bacterial population is responsible for spoilage it is also responsible for the storage stability of the refrigerated product. It is essential for quality control purposes to have rapid means for estimation of the psychrotrophs' level, in order to take the right measures concerning marketing and processing the meat.

A 22 C incubation temperature was used for monitoring the APC of the electrically stimulated and control samples stored at 5 C(Figure 3). As it can be seen the bacterial population of the electrically stimulated sample had a lag phase of 3 days as compared to 1 day of the control bacterial population. Probably the electrical stimulation impaired the bacterial cells metabolism resulting with an extended lag phase. The shelf life (i.e. time to "off odor") of a refrigerated product in general and of a meat product in particular is determined among other causes by bacterial growth. A processing procedure that will induce a long lag phase and slow growth rate of the bacterial population will also extend the shelf life of the product. "Off odors" were detected after 4-5 days in the control samples but after 7-8 days in the electrically stimulated samples. Electrical stimulation extended the shelf life of the ground beef by 3 days. A significant difference ($P<0.05$) was found among the APC of the electrically stimulated and control samples on the third, fifth and sixth days of storage. The bacterial population of the electrically stimulated sample formed 12.2 generations between the third and fifth day of storage as compared to 9.9 generations with the control. These results showed that the bacterial population of the electrically stimulated samples had a faster growth rate as compared to the control, without affecting the shelf life of the product.

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