QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF ACCELERATED PROCESSED PORK

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INTRODUCTION

The conventional method of handling pork in the United States involves chilling the carcass after dressing for 24 h at approximately 0°C. After the chill period, the carcass is normally shipped to its destination or fabricated into primal cuts. Accelerated processing differs from that of conventional processing in that the carcass is fabricated into cuts prior to chilling. The ambient temperature at which the carcass is fabricated is 20-25°C. The length of time that the carcass is held at ambient temperature is usually less than 10 h and depends upon the species and processing method. Some researchers have conducted studies in which the carcass was held at 20°C for 6, 8, or 10 h (Kastner et al., 1976). After this holding period, the retail cuts are then chilled in a cooler at -1 to +1°C. Since the carcass has undergone rigor mortis prior to chilling, the effects of "cold shortening" are reduced.

The advantages of accelerated processing of meat over the conventional method of fabrication have been previously elucidated (Falk et al., 1975). One of the greatest advantages of the former method is that processing costs may be reduced through a savings in storage time and space, energy, labor and transportation space. Conventional methods of processing require from two days to two weeks before the finished products reach the retailer. Also, excess fat and bones can be processed at a central location with greater efficiency. In addition to those previously mentioned advantages, meat processed by the accelerated method, if handled properly, is equal in tenderness to the conventional processed meat (Kastner et al., 1973).

One of the major limitations of accelerated processing is the potential for increased microbial proliferation on the meat surface, thus increasing the likelihood of spoilage and contamination by pathogenic organisms. Very little research has been conducted to determine the size and taxonomy of the microbial population of meat processed by the accelerated method. This investigation was designed to study the acceptability of accelerated processed pork and to compare the microbial population of both processing methods.

MATERIALS AND METHODS

Five market hogs were sacrificed, skinned, and otherwise slaughtered conventionally. The left side of the carcass was consistently selected for conventional processing; whereas, the right side of the carcass was selected for accelerated processing. The conventionally processed side of the carcass went immediately into refrigerated storage (1°C) after slaughter. The accelerated processed side of the carcass was held at room temperature (20-25°C) for 4 h and subsequently fabricated into loin roasts, boneless boston butt roasts, and ground pork before being placed in refrigerated storage (1°C). After 24 h storage at 1°C, the conventionally processed sides were fabricated into the same cuts as the accelerated processed sides and returned to storage at 1°C. Unseasoned pork was used instead of sausage so that seasonings would not influence the flavor characteristics.

Bacterial Characteristics

The procedure for determining microbial load involved the swab technique and blending and dilution of ground samples. Taxonomy was determined by using procedures of Buchanan and Gibbons (1974) and the USDA Microbiology Laboratory Guidebook (1974) as guidelines. Sampling for microbial growth was conducted at 0, 4, 24, 48, and 120 h postmortem. Sampling locations were on the dorsal portions of the loin, boston butt, and picnic area of the carcass prior to fabrication. After fabrication, sampling locations on the loin and boston butt were adjacent to previous locations, and samples for ground pork were randomly taken. The initial isolation and dilution procedure was performed identically for each cut and sampling time, except for ground pork.

Initial Isolation and Dilution Procedure

Samples of meat were swabbed aseptically within a specified 12.9 cm^2 area of the sterile swabbing templates. The samples were then diluted and plated according to standard dilution and plating procedures of Speck (1976) and incubated for 48 h at 25°C. The ground pork samples were prepared by placing 20g of ground pork in a sterile blender and adding 180 ml of sterile distilled water. The ground pork was blended for five minutes then diluted and plated according to standard dilution and plating procedures of Speck (1976).

Isolation of Microorganisms Procedure

Following enumeration of microorganisms, the plates were allowed to incubate at room temperature for an additional 48 h to facilitate pigment production. The colonies were then differentiated according to pigment, morphology, size, and location. The different organisms were then counted and a count, as total organisms on the plate, was recorded and a percentage taken. Each different colony was introduced into various selective

broths and then transferred onto three types of media--Violet Red Bile Agar (VRBA), Pseudomonas Isolation Agar (PIA), and Mannitol Salt Agar (MSA). PIA plates were incubated at room temperature for 24-48 h and MSA and VRBA plates were incubated at 37°C for 24 h. Plates were then checked for growth and pure colonies were obtained from isolated colonies.

Identification Procedure

The pure cultures were transferred to trypticase soy agar (TSA) and incubated at room temperature for 18-24 h. After incubation, a gram stain was conducted on each isolated colony and the results were recorded. Gram negative organisms were transferred to TSA slants and incubated according to standard procedures (Bailey and Scott, 1970).

An inoculum from the TSA slant was then used to perform additional identification procedures using API-10 biochemical strips. Special selective media were used for the identification of Gram positive microorganisms. Additional tests conducted to confirm preliminary identification included catalase, oxidase, litmus milk, dextrose, nitrate, and urease. Microorganisms were keyed by genera.

Color and Overall Appearance Characteristics

Color and overall appearance scores of all samples were rated by use of 8-point rating scales. Rating scale nomenclature was as follows: color (8 = very bright red; 1 = gray or green discoloration) and overall appearance (8 = extremely desirable; 1 = extremely undesirable). The scoring times for the accelerated processed cuts were 4, 24, 48, and 120 h after slaughter; whereas, the conventionally processed cuts were evaluated at 24, 48, and 120 h postmortem.

Organoleptic Characteristics

A taste panel was used to determine flavor, tenderness, and juiciness scores. Flavor, tenderness, and juiciness scores were rated according to the following scale: (8 = extremely desirable; 1 = extremely undesirable). A total of 20 samples (10 conventionally processed cuts and 10 accelerated processed cuts) of loin chops and ground pork were selected and served at random. Each sample was broiled until the internal temperature reached approximately 70°C.

Rancidity Characteristics

The Thiobarbituric Acid test was used to determine the oxidative rancidity of ground pork and boston butt samples. A total of six samples was used. The Spillman-Fox procedure (1979) was used to determine oxidative rancidity.

RESULTS AND DISCUSSION

There was no significant ($P>0.05$) difference in color and overall appearance between cuts. This observation suggests that the differences were due to the processing treatment.

Color and Overall Appearance

One-way analysis of variance was conducted on the differences in color and overall appearance at the various sampling times. Multiple range testing between accelerated and conventionally processed cuts was not conducted due to a significant interaction between the two treatments.

Means for accelerated processed samples at 4 h were significantly ($P<0.05$) higher than for all other times; whereas, scores for the other time periods were not significantly different. These results suggested that the fresher cuts were superior in color. Means for the conventionally processed samples at 120 h were significantly ($P<0.05$) lower than at the other time periods; whereas, mean scores for 24 and 48 h were not different ($P>0.05$). When color scores for both accelerated and conventionally processed cuts were combined, mean separation indicated that the mean scores at 4 h were significantly ($P<0.05$) higher than for other time periods. Mean scores for the other time periods (24, 48, and 120 h) were not significantly different from each other. This observation suggests that storage time may have more effect on color scores than processing method.

The pattern for overall appearance scores was similar to that of the color scores except that the conventional mean values at all time periods were not significantly ($P>0.05$) different. Like the color scores, the overall appearance scores at 4 h were significantly ($P<0.05$) higher than the other time periods. However, mean values at 120 h were numerically lower than the other periods.

Organoleptic Characteristics

No significant ($P>0.05$) differences in tenderness, flavor, and juiciness between the two fabrication processes existed. Statistical analysis for determination of differences in tenderness, flavor, and juiciness between the loin roasts and ground pork revealed no significant ($P>0.05$) differences between the cuts.

Microbial Characteristics

One-way analysis of variance was conducted on the differences in microbial load at various sampling times. Mean separation analysis was conducted among the various storage times for cuts of both processing methods; however, mean separation between accelerated and conventionally processed cuts was not conducted because there was a significant ($P<0.05$) interaction between the two treatments.
Microbial load was significantly ($P<0.05$) higher at 120 h than at other times for both the accelerated and conventionally processed cuts. This result was attributed to increased storage time permitting additional proliferation of the microbial flora population. These data suggest that storage time had more influence on microbial flora proliferation than processing method.

Staphylococcus represented the largest percentage of microorganisms isolated from both processing techniques. Those genera represented in descending order were Pseudomonas, Neisseria and Bacillus. Miscellaneous microorganisms that were isolated included Acinetobacter, Alcaligenes, Enterobacter, E. coli, Micrococcus, Klebsiella, Shigella, and Yeast.

Correlation Evaluation

Color was highly correlated with overall appearance for both the accelerated and conventionally processed cuts. This relationship is to be expected because as color deteriorates, overall appearance declines. There were also negative correlations between color and microbial load. As microbial flora proliferated, their utilization of oxygen on the meat surface and excretion of by-products of metabolism increased color degradation. Variation of tenderness, flavor, and juiciness scores was so small that meaningful correlations could not be developed. Regression analysis of conventionally processed pork was performed to develop the prediction equation: $\hat{Y} = a+b_1x_i+b_2x_i$ where $\hat{Y}$ = microbial load, a = intercept coefficient = 10.767, b_1 = color coefficient = 0.530, and b_2 = overall appearance coefficient = 0.182. The prediction equation for the accelerated processed regression analysis was $\hat{Y} = a+b_1x_i+b_2x_i$ where $\hat{Y}$ = microbial load, a = intercept coefficient = 7.889, b_1 = color coefficient = -0.136, and b_2 = overall appearance coefficient = -0.078. The multiple R's for the accelerated processed pork for color and overall appearance were not significant. This suggests that other variables that were not measured also contributed to the change in microbial load. The multiple R's for the conventionally processed samples for overall appearance were also insignificant ($P>0.05$). However, the multiple R for the conventionally fabricated pork for color was significant. Thus, 16.7% of the variation in microbial load can be attributed to changes in color scores.

Rancidity

Results of the TBA tests revealed that the malonaldehyde concentrations were all numerically close. All of the samples except one were near the threshold range for detection of a rancid off-odor. This result may be due to the frozen samples being stored for approximately 60 days. These data suggest that accelerated processing had no consistent effect on development of oxidative rancidity.

CONCLUSIONS

Results of this study suggested the following conclusions:

1. Conventionally processed cuts are slightly superior in color and overall appearance to the accelerated processed cuts until 120 h postmortem.
2. No significant ($P>0.05$) difference in tenderness, juiciness, and flavor exists between the accelerated and conventionally processed cuts.
3. No significant differences in microbial load may be anticipated between the two fabrication processes after 120 h of storage; however, the accelerated processed cuts have a higher microbial load than the conventionally processed cuts prior to 120 h.
4. The microbial population of the accelerated processed samples does not pose a public health threat at 120 h because no significant difference in microbial load or noticeable difference in the microbial population exists between the two fabrication methods.
5. TBA values reveal that there is little difference in rancidity between the two fabrication processes.
6. From a consumer standpoint, there is not enough difference between the accelerated processed cuts and the conventionally processed samples of pork to merit preference of meat from one processing technique over the other method.

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