Influence of Selected Oven and Endpoint Temperatures upon the Ultrastructure of Turkey Meat

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(Received for publication October 31, 1985)

ABSTRACT The influence of selected oven and endpoint temperatures upon the ultrastructure of turkey meat was evaluated by scanning and transmission electron micrographs. Increasing endpoint and decreasing oven temperatures influenced turkey meat as shown by increased fiber shrinkage, increased ultrastructure disintegration, and decreased clumping on the fiber surface.

(Key words: turkey meat, electron microscopy, oven temperature, endpoint temperature, cooking method)


INTRODUCTION

The influence of endpoint and cooking temperatures upon quality characteristics of turkey has been extensively reported (Holmes and Woodburn, 1981). The onset of heat stress research has been to determine the effect of heat treatments on cooking time, cooking losses (moisture and fat), juiciness, tenderness, color, and flavor as well as a number of other quality parameters of meat. In these studies an attempt was usually made to relate these changes in quality to changes in structure or composition to enhance the ability of the investigator to understand the phenomena being investigated. This study reports a comparison of the influence of oven temperature and endpoint temperature of meat upon the microstructure of turkey.

MATERIALS AND METHODS

Five-month-old Nicholas Large White thawed half turkeys were roasted at five oven temperatures (149 to 232 C) to three endpoint temperatures (75 to 95 C). The central composite rotatable design was applied to the two independent variables using procedures published by Zondagh et al. (1986). Although micrographs were obtained from all eight combinations of the two independent variables, only the extremes are reported in this Research Note.

For electron micrographs (Zondagh, 1985), six cooked pectoral turkey meat samples, randomly selected adjacent to the thermouple recording endpoint temperatures, were placed in glutaraldehyde-Sorensen buffer. Three samples were critical-point dried for scanning electron microscopy (SEM) (80 X) and three samples were dehydrated, plastic embedded, and stained for transmission electron microscopy (TEM) (5400 X). Both SEM and TEM (shown in Fig. 1) were selected as representing the trends qualitatively evaluated over all temperature ranges.

RESULTS AND DISCUSSION

Selected representative turkey micrographs (Fig. 1) show abundant collagen and elastin fibers. The extensive amount of sarcomplasmic reticulum material on the turkey muscle is expected (Schafer and Powrie, 1971). The TEM (Fig. 1B,D,F,H) show the classical structures reported by Dutson and Carter (1985). Fiber coverings appear partially torn off in the SEM (Fig. 1A,C,E,G).

Changes (Fig. 1) on the surface and overall appearance of the fiber during heating are emphasized by samples at the temperatures selected. The large amount of granular material shown in Fig. 1A was reduced in size and distinction, becoming more amorphous, as endpoint temperature increased to 95 C (Fig. 1C). This reduction was expected. The outer covering appears to be the sarcomplasmic reticulum, consisting of primarily connective tissue that would have begun to be hydrolyzed and to shrink at this endpoint temperature and time combination. Again, the lesser changes in collagenous and reticular fiber material at the higher oven temperature of 232 C (Fig. 1G,H) as compared with

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FIG. 1. Scanning electron micrographs (A, C, E, G) and transmission electron micrographs (B, D, F, H) of turkey meat from birds heated to different endpoint temperatures at three oven temperatures: A, B 75 °C (A, B), and 95 °C (C, D) in a 191 °C oven; and to endpoint temperature of 85 °C at oven temperatures of 149 °C (E, F) and 232 °C (G, H).
149 C (Fig. 1E,F) could be related to the shorter total cooking time. Alexander et al. (1951) has also indicated that endpoint temperature alone is not an "adequate guide to the satisfactory cooking" of turkey. However, work reported by Zondagh et al. (1986) indicates these relationships are complex. The TEM indicated reduction in the fiber size, separation, and cohesiveness with increasing endpoint and lower oven temperatures.

Although the current work can only be viewed as providing a descriptive tool, two conclusions can be drawn. The micrographs emphasize that heat influences the total muscle system. Time of heat stress appears to be a factor. In all of the micrographs from which this report was selected, it appeared evident that there is a broad general influence upon connective tissue, myofibrillar tissue, and sarcoplasmic protein. However, separating out the effect of endpoint and oven temperatures from the interactions of cooking time on specific protein components is difficult. A key to enhancing the usefulness of electron microscopy appears to be the development of quantitative tools to relate these descriptive changes in muscle ultrastructure to quality changes.

ACKNOWLEDGMENTS

Appreciation to Tom Savage of the Department of Poultry Science for turkey carcasses of a known uniformity. Appreciation to Bob Dickson, Department of Animal Science, for assistance in the preparation of the dressed turkey halves.

REFERENCES


