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INTENSIFICATION OF THE SALTING PROCESS IN THE MANUFACTURE OF MEAT PRODUCTS II. PHYSICO-CHEMICAL CHANGES IN SALTED MUTTON UNDER ELECTRICAL AND MECHANICAL TREATMENTS

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INTRODUCTION

An important requirement for raw meat to be processed into meat products is to possess good ability to retain its own and the additionally added water. It is well-known that this ability is directly related to and depends on the actual acidity of the medium (pH) (Danchev, 1987; Bendall, 1977).

When applying alternating electric current of certain frequencies on warm meat muscles, the latter are subjected to multiple contractions and relaxations which initiate the effect of massaging resulting in the relocation of salts after injection-salting. The mechanical treatment during the salting stage causes significant changes in the technological characteristics of raw meat mainly in their myofibrillar proteins(Bolshakov, 1981).

In view of this, the present work has aimed to study the effect of electrical and mechanical treatments on injection-salted warm mutton on its pH and water holding capacity which influence some of the technological properties of raw meat.

MATERIALS AND METHODS

The experiments were carried out with warm mutton taken from the hind legs. The legs were separated from the carcasses not later than 30 minutes after slaughter. Half of the legs were deboned by separating only the muscles from the femur. The remaining number of legs were processed with their bones in.

The deboned meat and the whole legs were subjected to preliminary shaping and then were salted using a multipoint injector. The saline concentration was 16°Be and the injected amount was 12% of the meat weight.

The meat samples thus prepared were treated in four different ways:
1. Control samples (CS): no preliminary treatment.
2. Electromassaging (EM).
3. Electromassaging and mechanical treatments repeated in 24-hour cycles (EM+MT).
4. Mechanical treatment repeated in 24-hour cycles (MT).

All samples, regardless the method of treatment, were cold-stored at +4°C for 72 hours. Electromassaging was performed by an EC-4 (Tzankof *et al.*, 1990) apparatus for three minutes. The multipoint electrodes used were of 2mm thick stainless steel cylinders. They were inserted into the muscles to a 2cm depth, 10cm apart. We used 90V square pulse voltage with 10ms pulse duration and 50Hz pulse-repetition frequency. During the treatment this regime provided 900V/m mean field intensity.

The mechanical treatment of the samples was performed in a tumbler (rotating cylinder) for 20 minutes at 4.2rad/s rotation speed, repeated at 24-hour cycles.

Samples were taken one hour after slaughter or 30 minutes after one of the above-mentioned treatments as well as after 4, 10, 24, 48 and 72 hours of storage at +4°C. The samples were measured for their hydrogen-ion concentration (pH) value and water-holding capacity. The pH was measured by OP-208/1 (Bulgarian Government Standards, 1989) pH-meter, and the water-holding capacity by filter paper method (Grau and Hamm,1954). The results were analyzed statistically according to Vojneshenkii (1969) and Hartmann *et al.* (1977). The confidence interval was defined as M+tm, where M is the arithmetic mean of n=15, m is the mean square error of the average result and t is Student's criterion for the allowed 95% confidence interval.

RESULTS AND DISCUSSION

The results of the effect of the preliminary treatment of raw meat on the pH values are presented in Figures 1 and 2. It can be seen that the pattern of the changes in these values are almost the same as that of the control samples. The control samples of the deboned meat showed a gradual pH fall and reached the ultimate pH after 48 hours of storage, while the ultimate pH in the bone-in samples was attained after 72 hours of storage, which is probably due to the slower autolytic changes in the latter samples. When raw meat is salted warm, the sodium chloride ions delay the pH changes (Bolshakov and Madagaev, 1982) and this explains the differences of the changes in the control sample.

The preliminary treatment of the warm salted raw meat caused considerable changes in the pH values of the four test samples. Each of the three methods studied exhibited significant changes over the CS. It is necessary to point out that the changes in the pH values of the EM effect and the EM+MT effect were maximal. This was true both for boneless and bone-in samples. The results showed that when EM was terminated, the pH values of these samples decreased more rapidly and reached the minimum at the 10th hour of storage. Evidently the electric current caused more intensive degradation of glycogen to lactic acid which caused the sudden drop of pH.

The pattern of the pH changes in the MT samples was the same as in the EM+MT samples; but the values remained comparatively higher than those for the samples subjected to EM and EM+MT until 48 hours of storage. After 72 hours of storage the pH of the MT samples was almost equal to the pH of the deboned EM samples and the bone-in EM+MT samples. After reaching the minimum values at around the 10th hour of storage, the pH of the test samples gradually began to rise and between the 24th and 32nd hours of storage became equal to the pH of the deboned controls while with the bone-in samples this equalization occurred between 36 and 48 hours. At the end of storage (72 hour), the pH of the test samples reached values that were 0.2 of a unit higher than the pH of the controls.

The results of the changes in the water holding capacity of raw meat are given in Figures 3 and 4. The changes in the water holding capacity of the samples were, to a certain extent, similar to the changes in the pH values. This is natural as it is known that the water holding capacity of meat is considerably dependent on the pH values (Bolshakov and Madagaev, 1982). The water holding capacity of the deboned CS reached the minimum value by 24 hours while in case of bone-in CS the minimum value was reached by 48 hours only. The test samples showed more significant drop in the water holding capacity in the initial stage of autolysis which was more clearly expressed in the EM samples. The changes of this factor in the MT samples were nearly corresponding to the changes of the CS except that the latter reached their minimum values at 24 hours of storage and then the water holding capacity began to increase and was always higher than that of the CS. This difference, even though not very significant, remained to the end of the storage period (72 hours).

According to the results, EM caused the most dynamic changes of this factor particularly when combined with MT. This was true both for boneless and bone-in meat. The water holding capacity of samples subjected to this treatment reached minimum values at the 10th hour of treatment. This conformed with the minimum values of the pH in the same samples at the same time.

With further storage, the water holding capacity of the above treated samples gradually increased and at the end of the experiment (72 hours) the difference in the water holding capacity was 2-3% higher than the CS. It should be pointed out that in deboned meat after the 16th hour of storage the water holding capacity of all tested samples was higher than that of the CS, while in the bone-in samples this occurred after the 20th hour. The higher water holding capacity of the test samples remained unchanged to the end of the experimental period.

The results of the pH and water holding capacity indicated that the EM of salted mutton, alone or in combination with MT, intensified the salting process and accelerated the advent and completion of rigor mortis thus contributing to the faster autolytic changes in the treated raw meat. The physiochemical changes in the meat subjected only to MT were not as strongly expressed in the samples subjected to the other two methods of treatment.

CONCLUSIONS

Electromassaging or electromassaging combined with mechanical treatment of warm injection-salted mutton accelerated the advent and completion of rigor mortis by the 10th hour of storage, and thus contributed to the faster autolytic changes in the treated meat.

The three methods of preliminary treatment (EM, EM+MT, MT) experimented by us increased the water holding capacity of meat. This effect was the highest in the samples subjected to EM combined with MT.

The mechanical treatment alone produced less significant effects on the pH changes and the water holding capacity as compared to electromassaging.

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