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INTENSIFICATION OF THE SALTING PROCESS IN THE MANUFACTURE OF MEAT PRODUCTS. I. EFFECT OF ELECTRICAL AND MECHANICAL TREATMENTS OF SALTED MUTTON ON THE FREE AMINO ACID LEVELS

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Please refer to Folio 22.

INTRODUCTION

Electro-and mechanical massaging of raw meat (Bolshakov *et al.*, 1980; Bolshakov *et al.*, 1985; Gorshkova *et al.*, 1988) can expedite the penetration and dissemination of the saline solution, and the fermentation processes by releasing some tissue enzymes (cathepsins) from areas of their localization (Pavlovskij and Palmin, 1975; Pavlovskij and Simbireva, 1975). Warm meat has little flavour and aroma because it lacks or has low amounts of substances which are carriers of these properties.

The proteolytic changes occurring in meat during an intensive salting process have so far been studied for chilled and warm cattle meat (Bolshakov *et al.*, 1986; Brianskaja *et al.*, 1984) and literature on mutton are scanty. Therefore, the study was undertaken to study the effects of electrical and mechanical treatments during the salting stage of warm mutton on its levels of free amino acids. The hyderolytic protein degradation under the action of cathepsins has been assessed through the changes in the contents of free amino acids in the treated samples and the meat products prepared from them.

MATERIALS AND METHODS

The experiments were performed on warm mutton taken from the hind legs not later than 30 minutes after slaughtering the animals. Half of the legs were deboned by separating the muscles of the femur which were later used to manufacture mutton ham sausage. The remaining legs were treated whole and used for the preparation of cooked and smoked mutton rounds.

The meat obtained from the deboned and bone-in legs were subjected to preliminary shaping followed by salting using a multipoint injector. The saline solution used had a concentration of 16oBe, and the amount injected into the meat samples was 12% of their weight.

Immediately after this preliminary preparation, the samples were treated in four different ways:
1. One part of the samples was stored at +4 °C for 72 hours for further salting and ageing (control samples, CS).
2. Electromassaging (EM) and storing at +4 °C for 72 hours.
3. Repeated electromassaging and mechanical treatments (EM+MT) at 24-hour cycles and stored at +4 °C for 72 hours.
4. Mechanical treatment (MT)repeated at 24-hour cycles and stored at +4 °C for 72 hours.

The samples were electyromassaged with an EC-4 apparatus(Tzankov *et al.*, 1990) for three minutes with 2mm thick stainless steel cylindrical electrodes. The electrodes were inserted into the muscles to a 2cm depth, 10cm apart. The massaging process used square pulse voltage with 90V amplitude, 10ms pulse duration and 50Hz pulse repetition duration. At the time of EM the mean field intensity was 900V/m(Tzankov *et al.*,1990).

The mechanical treatment of the samples was performed in a tumbler (rotating cylinder) at rotation speed of 4.2rad/s for 20min. This treatment was repeated every 24 hours.

The meat thus treated was stored for 72 hours and was then used to manufacture ham sausage and cooked and smoked mutton rounds. The treatment of the raw meat and the final product technology were the traditional ones for these meat products.

Samples from the meat were taken one hour after slaughter, or 30 minutes after treating them by the above four methods, after 72 hours storage at +4°C, and from the ready products.

The levels of the free amino acids in the samples were determined by preliminary extraction with ethanol followed by qualitative and quantitative identification of the amino acids with amino acid analyzer AAA881, two big columns (ð=0.8x62cm), one small column (ð=0.7x6cm), temperature 53°C, Na-citrate buffers 3.25,4.25 and 5.28, photometer-filters at 570 and 440nm (Wood, 1958).

RESULTS AND DISCUSSION

The results of the levels of free amino acids in the meat samples are given in Tables 1 and 2. It can be concluded that the methods applied with the purpose of intensifying the salting process and the autolytic processes in the mutton samples led to the accumulation of free amino acid regardless of the type of treatment. The different types of treatment, however, caused different degrees of animo acid accumulation.

The changes in the total amino acids showed the following pattern. In the EM samples, 30 minutes after treatment, the level of free amino acids was lower than in the CS. The differences were as follows: in the boneless meat samples the free amino acid level was 14.6% lower and in the bone-in meat samples it was 20% lower. This decrease was probably connected with the artificially induced acceleration of the autolytic processes (i.e., rigor mortis) in the warm meat by means of the electric pulses. On the other hand, it is known that the salting agent, sodium chloride, initially can inhibit the fermentation processes resulting in accumulation of lower amounts of free amino acids.

The free amino acids in the other two types of samples, subjected to EM+MT and to MT only, 30 minutes after treatment were almost equal to those in the CS. MT caused certain destruction of the meat structure and thus increased the levels of free amino acids as compared to the ES samples.

The results obtained after storing the samples at +4°C for 72 hours indicated that the three types of treatment significantly accelerated the autolytic and proteolytic processes in the salted warm meat. This acceleration was most significant in the ES+MT samples, less expressed in the ES samples and the least in the MT samples.

The established differences were as follows: boneless meat- ES samples (7.62%); ES+MT samples (21.33%); MT samples (4%). Bone-in meat-ES samples (5.56%); ES+MT samples (13.02%); MT samples (1.88%).

A similar tendency in the results was established in the samples from the ready products. The level of free amino acids in the samples was considerably higher than that in the CS, and the differences observed were greater. The effect of the different types of treatment was the same. The strongest effect was of ES+MT, followed by the ES and the least was of the MT.

It is worth noting that the levels of free amino acids in the ready product from the deboned and bone-in meat were the highest. It can be explained by the fact that they had gone through the whole technological process whose stages would influence the autolytic and proteolytic processes in the meat.

The intensification of the salting process and the autolytic changes in the meat by the three treatments were caused by the action of the proteolytic enzymes (cathepsins). The ES and partly MT could enhance their action. The pulsating electric current caused destruction of the lysosomal membranes and faster release of cathepsins from areas of their

localization. EM of meat also caused reduction in pH values and provided optimum conditions for the cathepsins activity.

When the results for boneless and bone-in meat samples were compared, it could be seen that the applied treatments (EM, EM+MT, MT) gave better results in the boneless samples. In these samples, except for the initial ones (30 minutes after treatment), the absolute level of free amino acids was greater than that of the bone-in samples. The less expressed EM effect and the weak MT effect in particular were probably due to the fact that the muscles were fixed to the bones in certain positions and had smaller free surfaces.

As far as the quality of the identified free amino acids, the highest levels were observed for lysine, serine,glycine, alanine,glutamic acid etc.Furthermore, there was no evidence of specific influence of any of the three treatments on the priority increase of any of the amino acid level in the tested samples.

CONCLUSIONS

The additional treatment by electrical massaging (EM) and mechanical treatment (MT) under the above conditions during the salting stage of warm mutton intensified the processes of salting and autolytic (proteolytic) changes which was expressed in the accumulation of greater amounts of free amino acids in the experimental samples.

The accumulation of free amino acids, which are some of the most important precursors of the product's aroma and flavour, were most effective in the electromassaged and mechanically treated samples.

The experimental methods of treatment of warm mutton produced a better effect in the deboned meat samples than in bone-ones.

The treatments (EM, EM+MT, MT) did not cause priority increase in any of the amino acid levels studied.

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