# CHANGES IN MUSCLE PROTEINS STRUCTURE AND WATER CONDITION IN CURED PORK DURING HEATING

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## INTRODUCTION

The conformation of meat myofibrillar proteins and its changes under various effects are known to be greatly determined with the main qualities of the finished meat products, since these qualities are related to the state, spatial configuration and interactions of prorein macromolecules in myofibrils as well as to the state of the water in contact with proteins. The availability of data on conformational changes of myofibrillar proteims in the dynamics of processing, on the one hand, and on the changes of the water state in meat, on the other, helps regulate the course of the processes in such a way that high-quality products are manufactured.

## MATERIALS AND METHODS

The tests were performed by means of intrinsic protein fluorescence /4/ and thermogravimetric /5/ methods. As the object of the study served pork longissimus dorsi muscle with pH 5.95 and 5.45 taken within the first 3 hours p.m.; pork was aged for 3-96 hrs and kept in cure for 24 hrs.

## RESULTS

Plots of the fluorescence peaks of pork aged for different periods and having different pH-values, as related to temperature, show that changes in the muscle proteins of cured and non-cured /6/ meat during heating differ greatly. Unlike non-cured pork, temperature curves of cured meat are clearly two-humped ones, i.e. in the process of heating from 50 to 90°C muscle proteins of cured pork have two denaturation transitions with a coagulation one in-between them (Fig.1). The maximum temperatures $(T)_{max\bar{\lambda}}$ and the extent of protein structure loosening are different and depend on ageing time and pH of the meat. An exception is only pork with pH 5.95 taken 24 hrs p.m. (i.e. rigor meat). During such meat heating there is only one denaturation transition, its development being at maximum at the temperature (appr. 75°C) at which the maximum number of coagulation rearrangements is observed in meat of different ageing times.

In pork with pH 5.95 the first denaturation transition reaches its maximum at 65-70°C, the second one at 73-80°C, the highest temperature of the 1st transition $(T_1)_{max\bar{\lambda}}$ being observed in meat cured 48 and 72 hrs p.m. The temperature of the maximum development of the 2nd transition (with the exception of rigor meat) during ageing for up to 96 hrs does not change and equals 80°C. The degree of protein structure loosening ($\Delta\lambda$) is also highest when meat is cured 2-3 days p.m.; by the 4th day it decreases with temperature. It is of interest that in the meat cured within the first 3 hours p.m. the temperature of the maximum development of the 1st denaturation transition and the degree of protein structure loosening turned out to be much lower as compared to the meat aged for 48 and 72 hours.

In PSE pork (pH 5.45) cured 3 hours p.m. the maximum development of the 1st denaturation transition is at 68°C, this temperature remaining practically unchanged within two-day ageing followed with a reduction down to 63°C. The temperature of the maximum development of the 2nd denaturation transition ($T_2$) during ageing changes only slightly, from 82°C on the 1st day post mortem down to 80°C by the 2-4th days. The degree of the denaturation loosening of the proteins of such pork in the course of heating is highest when pork is cured within the first hours p.m. Then it is decreasing in the region of the 1st denaturation transition down to the 4th day, in the region of the 2nd one - down to one day, starting to increase after that.

Thus, PSE pork differs from normal pork in that it is characterized with the highest temperature of the maximum development of both denaturation transitions and with the greatest extent of protein structure loosening if meat is cured within the first hours post mortem. At the same time these properties of normal pork (pH 5.95) are maximal in case of meat curing 2-3 days p.m. The degree of protein structure loosening at the coagulation transition peak in PSE pork is highest when meat is cured within the first hours p.m.; the temperature of the maximum development of the 1st denaturation transition in PSE pork is lower (63-68°C as compared to 65-70°C) and that of the 2nd one is higher (80-82°C against 73-80°C) at all ageing times prior to curing.

Our previous experiments on non-cured pork allow to state that normal post-rigor pork (pH 5.9), both non-cured and cured, has the highest temperature of denaturation and the maximum degree of protein structure loosening 2-3 days p.m. A significant difference is that, unlike non-cured pork, meat cured within the first hours p.m. (3 hrs) has a lower temperature and extent of protein structure loosening at the denaturation maximum than at 48 and 72 hrs.

The temperature of the maximum development of the denaturation of cured PSE pork during heating did not change for 2 days post slaughter, whereas this feature of non-cured meat was maximal only within the first hours p.m.

The nature and reasons of the appearance of the 2nd denaturation peak during heating cured pork are not clear and are to be further studied.

Thermogravimetric results on cured pork weight loss due to meat juice release correlate well with the data of fluorescence analyses, the former results evidencing the value of WHC. Higher rate and amount of the meat juice released must be related to the temperatures at which muscle protein coagulation takes place, since water in the meat is bound to them directly. Thermogravimetric curves of normal pork (pH $\leq$ 6.4) (1.5 hrs p.m.) confirm this completely (Fig. 2). Thus a significant increase of juice release rate at all ageing times prior to curing (except the first 24 hrs) is noted after the temperatures 70 and 80°C are reached, i.e. at the temperatures which are the maximum ones for the two denaturation transitions in the structure of muscle proteins of cured pork. In meat cured 24 hrs p.m. the above increase starts earlier, at 65°C, and the curve is of a more straightened character, i.e. the rate of juice release changes practically twice at this ageing time: up to 65°C and over. It should be remembered that

pork with such ageing time prior to curing has only one denaturation transition with its peak at 73°C. As for meat juice losses during heating throught the range of 20-90°C, most optimal for the pork with pH≤6.4 is ageing for 48 hrs p.m. In this case meat juice losses are the least ones. Thus, when 85°C is reached, weight losses of cured pork are as follows (Fig.2):

| | |
|---|---|
| 1.5 hrs post mortem | 13% |
| 24 hrs post mortem | 17% |
| 48 hrs post mortem | 9.4% |
| 72 hrs post mortem | 12.8% |
| 96 hrs post mortem | 10.5% |

These data also indicate that pork cured 1.5 hrs p.m. did not have the highest WHC during heating. Curing at 48, 72 and 96 hours p.m. yielded much better results.

CONCLUSIONS

1. Muscle protein structure and its changes in cured pork during heating differ greatly from those of non-cured pork.

2. The nature of changes in the muscle protein structure of cured pork in the process of heating is different and is related to pork ageing time prior to curing and to pH-value.

3. Normal pork (pH 5.8-6.4) cured at 1.5-3 hrs post mortem is much worse as judged by the state of protein and its contacting water, than after ageing 48-72 hrs p.m., i.e. it is of poorer processing properties.

4. The muscle proteins of cured pSE pork behave best of all during heating if pork is cured within the first hours p.m.

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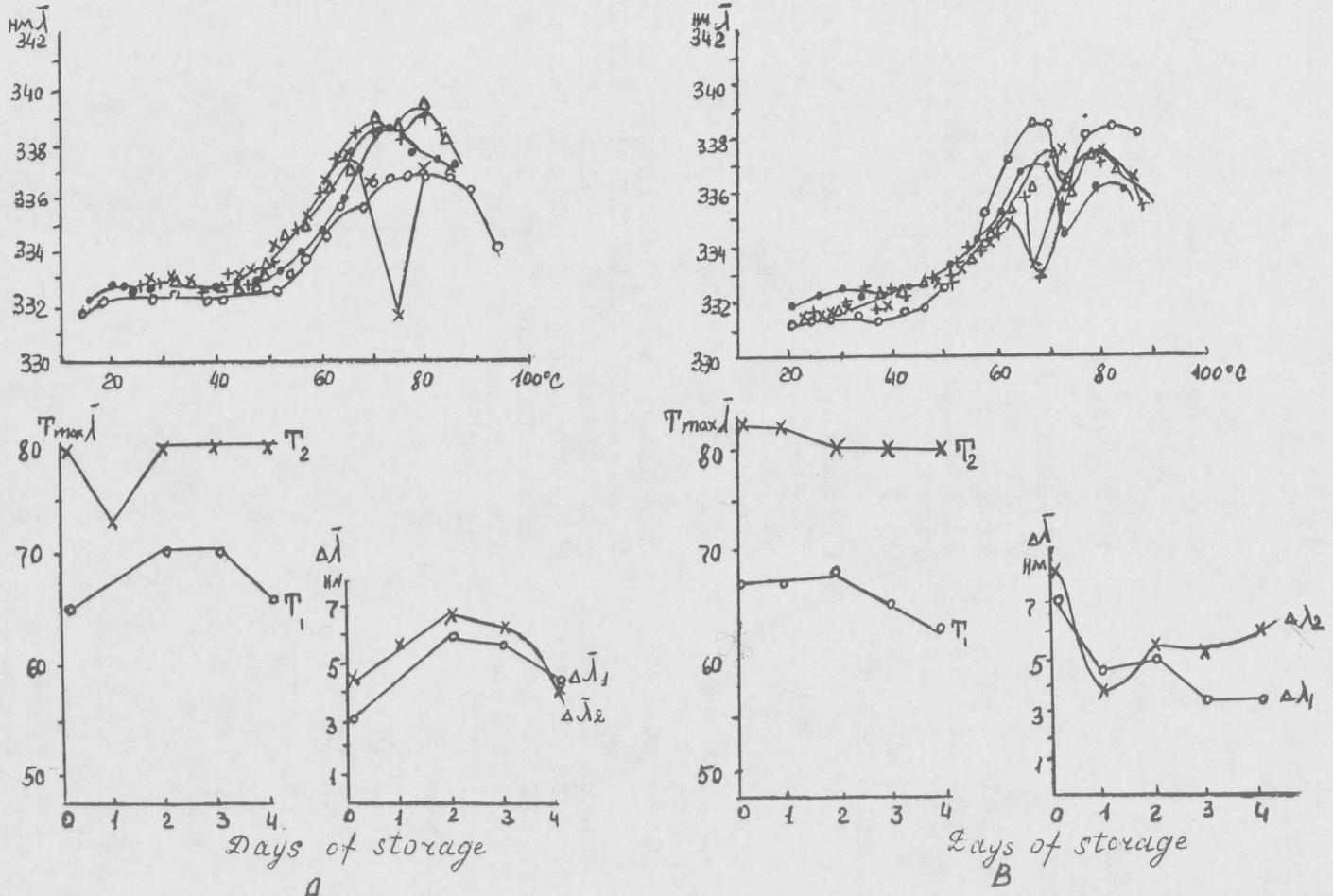


Fig. 1. Maximum of the fluorescence spectrum ($\bar{\lambda}$), the temperature of maximal development of denaturation changes ($T_{max}\bar{\lambda}$) and the degree of protein structure loosening ($\Delta\bar{\lambda}$) in cured pork having pH 5.95 (A) and 5.45 (B) as related to post mortem holding time of raw meat prior to curing:
o – 3 hrs; • – 24 hrs; Δ – 48 hrs; + – 72 hrs; x – 96 hrs.

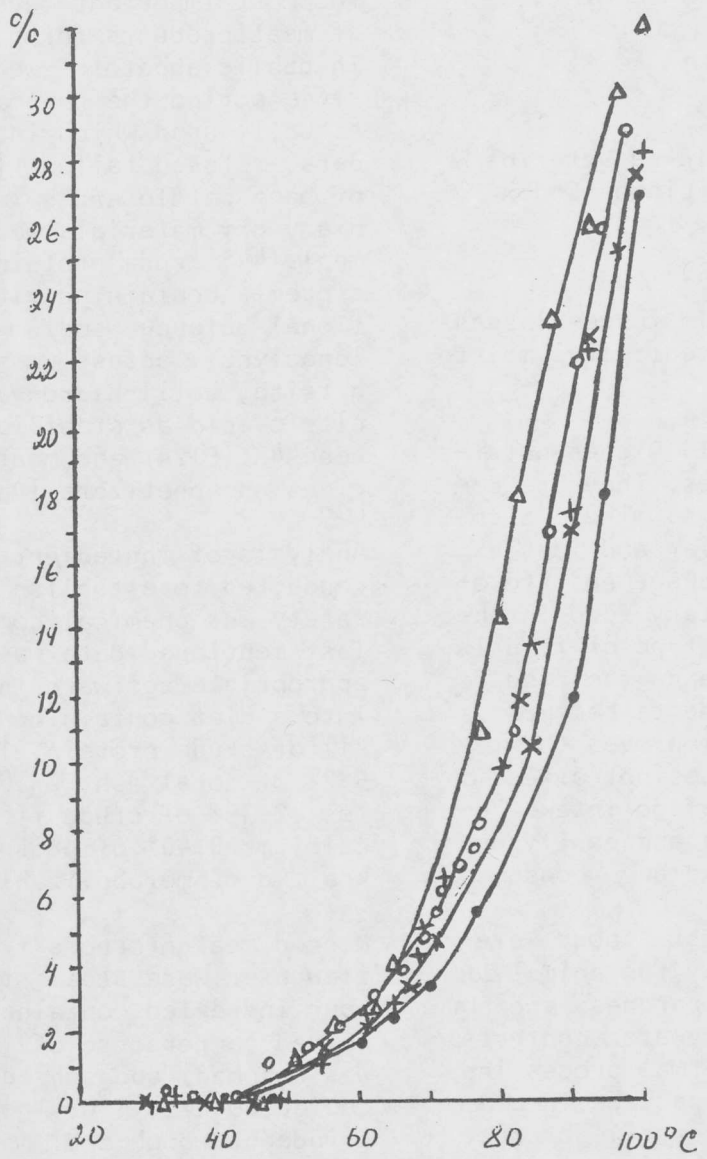


Fig. 2. Thermogravimetric curves of cured pork having pH 6.43 and aged for different time prior to curing:
o - 1.5 Hrs; Δ - 24 hrs; ● - 48 hrs; x - 72 hrs; + - 96 hrs.