

Enzymatic processes at the ripening of raw sausages with special regard to the  
transaminase-systems GOT and GPT

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Authors have followed the change of activity of glutamic oxalacetic transaminase /GOT/ and glutamic pyruvic transaminase /GPT/ as a function of the ripening time of raw sausages. The enzyme-activities were calculated on the basis of fat content on the one hand and on the sarcoplasmic protein content on the other. It has been established that the transaminase-activity decreases. On the basis of these all it may be supposed that the transformation processes in the proteins came to their end in the first phase of the ripening within 40 days.

Enzymatische Prozesse bei der Reifung von Rohwurstarten, mit besonderer Rücksicht  
auf die Transaminase-Systeme GOT und GPT

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Verfasser haben die Änderung der Aktivität von Glutamat-Oxalacetat-Transaminase /GOT/ und Glutamat-Brenztraubensäure-Transaminase /GPT/ in Funktion der Reifungsdauer von Rohwurstarten untersucht. Die Enzymaktivitäten wurden einerseits auf den Fettgehalt, andererseits auf den Sarkoplasmaproteingehalt bezogen. Aufgrund der Untersuchungsergebnisse wurde festgestellt, dass die Transaminaseaktivität auf das Fett und den Sarkoplasmaproteingehalt bezogen, sich vermindert. Aufgrund von diesen allen kann man vermuten, dass die Veränderungen in den Proteinen in der ersten Phase der Reifung in etwa 40 Tagen zu Ende gegangen sind.

Procédés enzymatiques de la maturation des saucissons crus fumés;  
transformation du système de GOT et GTP

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Auteurs ont suivi les changements de l'activité des transaminases GOT et GPT en fonction de la durée de maturation des saucissons crus fumés. Les activités enzymatiques ont été rapportées d'une part à la teneur en graisse d'autre part à la teneur en protéine sarco-plasmique.

Sur la base des résultats des essais on a constaté que l'activité de la transaminase décroît. Par conséquent il est présumable, que les transformations ayant lieu dans la première phase de la maturation s'achèvent en 40 jours.

Ферментативные процессы при созревании сырокопченых колбас, с учётом  
трансаминазной системы GOT и GPT.

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Авторы исследовали изменение активности глутамат-оксал-ацетат-трансаминазы /GOT/ и глутамат-пировиноградная кислота-трансаминазы /GPT/ в зависимости от срока созревания сырокопченых колбас. Активность ферментов определяли в зависимости от содержания жира, с одной стороны, и белка саркоплазмы. В результате исследований определили, что активность трансаминазы снижается в зависимости от содержания жира и белка саркоплазмы. На основании всего этого можно предположить, что преобразования в белках в первой фазе созревания протекают приблизительно за 40 дней.

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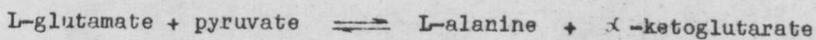
Much research has been carried out in order to elucidate the chemical-biochemical changes in raw sausages. It was found in our earlier work that changes in free amino acids taking place during ripening were due to the affects of proteolytic and other muscle enzymes /Körmendy and Gantner 1962/.

In our recent studies muscle enzymes were investigated namely glutamic-oxaloacetic transaminase /GOT/ and glutamic-pyruvic transaminase /GPT/. The methods for determination and characteristics of both enzymes have been already cleared in previous papers /Gantner and Hamm, 1964/.

As known GOT catalyses the following reaction:



whereas GPT catalyses the reaction:



The behaviour of these transaminases during heat treatment of meat has been investigated too. Two GOT isozymes, GOT<sub>S</sub> and GOT<sub>M</sub> were identified in our experiments.

It was established further that in the press juice of muscle only sarcoplasmic GOT<sub>S</sub> can be found immediately after slaughter or after some days storage in refrigerator. Freezing or drastic /physical, chemical/ effect causes damage of mitochondrial membranes and release of GOT<sub>M</sub>, consequently also GOT<sub>M</sub> appears in press juice. Remarkable quantities of the mitochondrial isozyme are detectable in the press juice after storage of muscle tissue at room temperature for a longer time. The mitochondrial structure containing bound GOT<sub>M</sub> is damaged at this temperature by the enzymes of micro-organisms and the muscle itself /Körmendy et al., 1965a; 1965b; 1971; Gantner et al., 1968; Hamm et al., 1969/.

## 1. Materials and methods

### 1.1. Materials

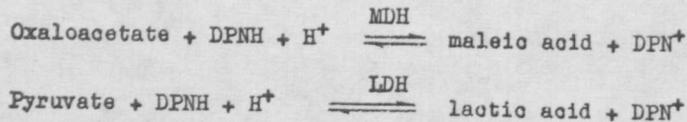
Samples of raw sausages were analyzed in 5 different phases of ripening. The sausage emulsion prior to stuffing /0 day/ the sausage immediately after smoking /10 days/, and after 40, 70 and 100 days of ripening respectively, were examined. In order of sampling periods 4, 5, 4, 4, 4, random samples were taken.

### 1.2. Preparation of samples

The separation and comminution of the outer layer and inner part of sausage and the extraction of enzymes with 0,03 M K-phosphate buffer of pH=7,4 were carried out according to Mihályi and Körmendy /1967/.

## 1.3. Determination of transaminase activities.

The measuring of enzyme activity was carried out by means of the indicator test:



The decrease of the concentration of DPNH /diphosphopyridinenucleotide/ was measured at 336 nm. The activities were expressed in Bücher-units /Bergmayer, 1962/ /their symbol is "E"/.

2. Results and Discussion

During ripening the samples are losing not only water but nitrogen too /Mihályi and Körmeny, 1967/. This is why the enzyme activities were not related to the nitrogen content but to fat content, assuming that total amount of fat does not change during ripening.

Fig.1. shows the change of GOT/fat ratio during ripening. It can be seen that decrease of enzyme activities lasts until the 40th day. In previous experiments it was found that the sarcoplasmic protein/fat ratio /  $\frac{S}{F} \cdot 100$  / decreased also sharply /Fig.1a/. It means that presumably two factors may cause inactivation of these enzymes: the protein denaturation and the increase of salt concentration, both of them due to water-loss.

The decreasing tendency of GPT/fat ratio during ripening /Fig.2./ is less rapid than with GOT.

In the next figure enzyme activities are related to sarcoplasmic protein content /Fig.3./. Here the activities also decrease during ripening i.e. the inactivation of the GOT is more rapid than denaturation of sarcoplasmic proteins. It seems possible, that a part of sarcoplasmic protein denatured while keeping their solubility.

Fig.4. shows the activity of GPT related to sarcoplasmic protein content. It can be confirmed by analysis of variance that no significant difference exists among the average values measured in various ripening periods. Since GPT activity in muscle is low and its variance is high, it cannot be proved whether the ratio GPT /sarcoplasmic-protein did change during ripening.

It has also been examined whether there are any differences between the outer and inner layers from enzymological point of view.

Fig.5. shows the differences of GOT activity between the outer and inner layers related to fat as a function of ripening time. No significant difference was found between the layers during the entire ripening period.

Fig.6. shows the same relationship with GPT.

The changes of GOT enzyme-activity in the outer and inner layers related to sarcoplasmic protein content shows significant difference on the 40th day being

the average activity in the outer layer somewhat higher. This difference is nevertheless in the other ripening periods not significant /Fig.7./

The difference of GPT enzyme activities between the layers related to sarcoplasmic protein content shows an increasing tendency during the ripening period which tendency is not significant /Fig.8./.

Summing up our results it can be concluded that changes in protein fraction are nearly completed in the first ripening period i.e. after 40 days. On the other hand the changes of the fat fraction are considerable during the whole ripening period. This was proved also by earlier investigations /Mihályi and Körmeny, 1967/.

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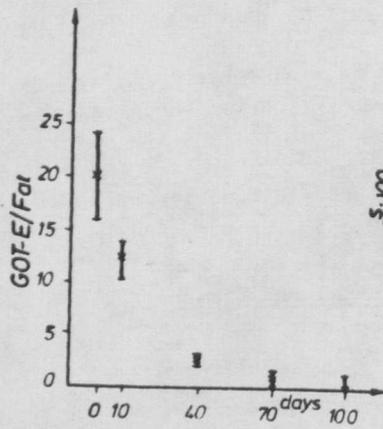


Fig. 1.: Change of GOT activity /E/ related to fat/ during ripening

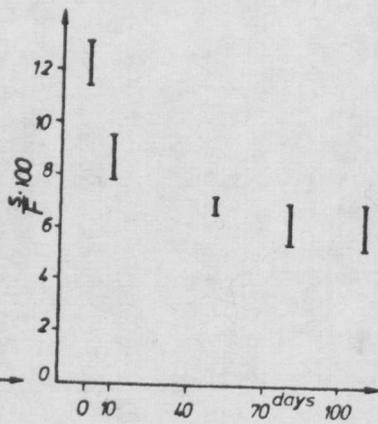


Fig. 1a.: Change of sarcoplasmic protein /S/ related to fat/ during ripening

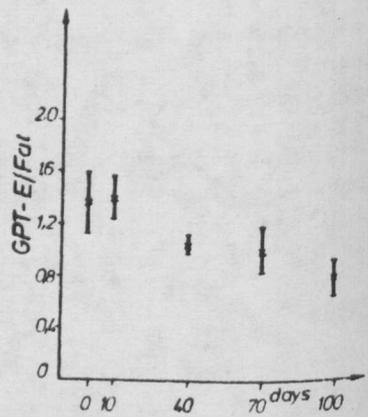


Fig. 2.: Change of GPT activity /E/ related to fat/ during ripening

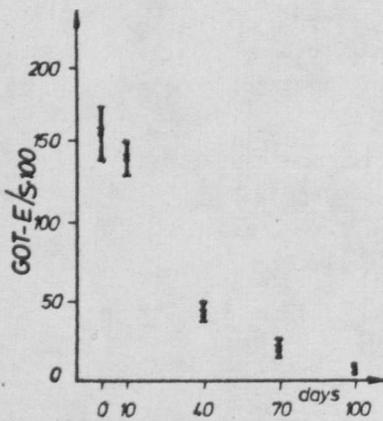


Fig. 3.: Change of GOT activity /E/ related to sarcoplasmic protein /S/ during ripening

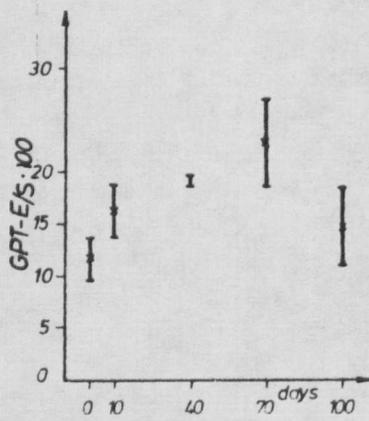


Fig. 4.: Change of GPT activity /E/ related to sarcoplasmic protein /S/ during ripening

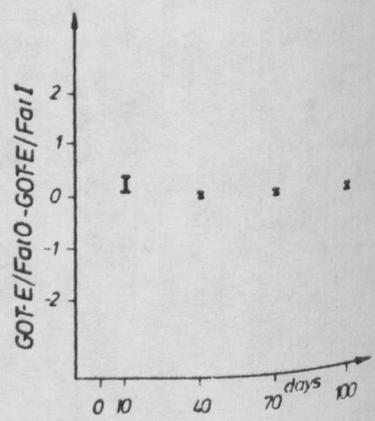


Fig. 5.: Change of the difference of the GOT activity /E/ outer/O/ and inner/I/ related to fat/ during ripening

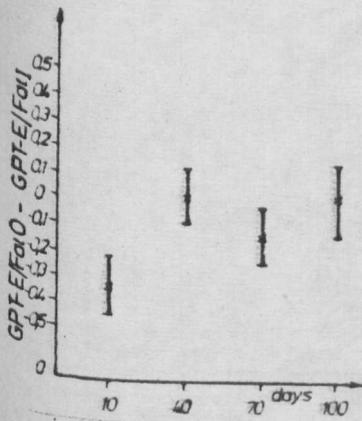


Fig. 6.: Change of the difference of the GPT activity/E/between outer/O/ and inner/I/ layers /related to fat/ during ripening

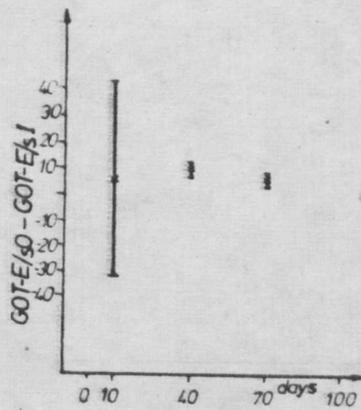


Fig. 7.: Change of the difference of the GOT activity /E/ between outer/O/ and inner/I/ layers /related to sarco-plasmic protein /S/ during ripening

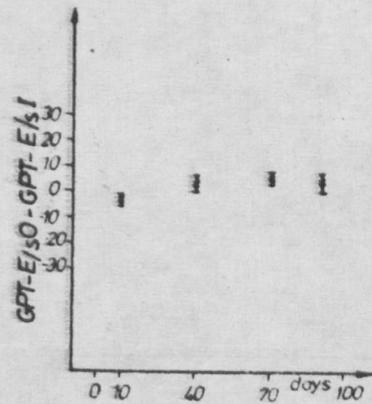


Fig. 8.: Change of the difference of the GPT activity /E/ between outer/O/ and inner/I/ layers /related to sarco-plasmic protein/S/ during ripening

