

Influence of re-freezing and storage on the technological properties of meat.

I. Change of Structural and Mechanical Properties of Veal.

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The present series of reports shows the complete experimental results obtained during the investigation of the influence of re-freezing and storage on the technological properties of meat. This was caused by the great interest taken by specialists of various countries in the summary report on the said problem that we submitted to the XXIIIrd European Congress of meat research workers which was held in 1977 in Moscow.

This report deals with the changes of the structural and mechanical properties of veal during its primary and secondary freezing at  $-10^{\circ}$ ,  $-20^{\circ}$ ,  $-30^{\circ}$  and  $-40^{\circ}\text{C}$ .

M.Longissimus dorsi obtained from carcasses of calves in warm and chilled state was used for the study.

For the characterization of the changes of the structural and mechanical properties the values of the following indices: elasticity, structural solidity, plastic solidity and tenderness after Grau were established.

DER EINFLUSS VON WIEDERHOLTEM GEFRIEREN UND LAGERN AUF DIE TECHNOLOGISCHEN EIGENSCHAFTEN VON FLEISCH

I. Veränderungen der strukturmechanischen Eigenschaften von Kalbfleisch

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In der vorliegenden Reihe von Veröffentlichungen werden die vollständigen experimentellen Resultate vorgestellt, die bei der Untersuchung des Einflusses von wiederholtem Gefrieren und Lagern auf die technologischen Eigenschaften von Fleisch erhalten wurden. Das ist eine Folge des grossen Interesses von Spezialisten aus verschiedenen Ländern gegenüber des von uns gehaltenen kurzen Vortrages zu dieser Frage auf dem XXIII. Europäischen Kongress der Wissenschaftler der Fleischindustrie im Jahre 1977 in Moskau.

In dieser Veröffentlichung werden die Veränderungen der strukturmechanischen Eigenschaften von Kalbfleisch bei seinen erstmaligen und wiederholten Gefrieren bei  $-10^{\circ}$ ,  $-20^{\circ}$ ,  $-30^{\circ}$  und  $-40^{\circ}\text{C}$  betrachtet.

Zur Untersuchung wurde m.Longissimus dorsi verwendet, erhalten von noch warmen und gekühlten Kälberschlachtkörpern. Zum Charakterisieren der Veränderungen der strukturmechanischen Eigenschaften wurden die Werte für folgende Kenngrössen bestimmt: Elastizität, Strukturfestigkeit, plastische Festigkeit und Zartheit nach Grau.

INFLUENCE DE LA DEUXIÈME CONGÉLATION ET STOCKAGE SUR LES PROPRIÉTÉS TECHNOLOGIQUES DE LA VIANDE

I. Changements des propriétés structurales et mécaniques de la viande de veau

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La présente série de rapports montre les résultats expérimentaux complets obtenus par l'étude de l'influence de la deuxième congélation et stockage sur les propriétés technologiques de la viande. Cela est provoqué par le grand intérêt montré par les spécialistes de différents pays pour le rapport concis sur ce problème que nous avons présenté au XXIII<sup>e</sup> Congrès européen des chercheurs en viande qui s'est tenu à Moscou en 1977.

Ce rapport examine les changements des propriétés structurales et mécaniques de la viande de veau durant sa première et deuxième congélation à une température de  $-10^{\circ}$ ,  $-20^{\circ}$ ,  $-30^{\circ}$  et  $-40^{\circ}$  C.

L'expérimentation a porté sur *m. Longissimus dorsi* des jeunes taureau au moment de l'abattage, à l'état frais et réfrigéré.

Pour la caractéristique des changements des propriétés structurales et mécaniques on a déterminé les valeurs des indices suivants: élasticité, solidité structural, solidité plastique et tendreté d'après Grau.

Влияние повторного замораживания и сохранения на технологические свойства мяса.

I. Изменения структурно-механических свойств телятины.

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В настоящем цикле исследований будут представлены полные экспериментальные результаты, полученные при исследовании влияния повторного замораживания и сохранения на технологические свойства мяса. Это вызвано проявленным большим интересом от специалистов разных стран к представленному нами обобщённому докладу по этому вопросу на состоявшемся в Москве, XXIII Европейском Конгрессе работников мясной промышленности.

В этом сообщении рассматриваются изменения структурно-механических свойств телятины при её первичном и повторном замораживании и сохранении при  $-10^{\circ}$ ,  $-20^{\circ}$ ,  $-30^{\circ}$  и  $-40^{\circ}$  C.

Для исследований использованы пробы от мускула *longissimus dorsi* получаемые от туш двухгодичных телят в тёплом и охлажденном состоянии.

Для характеристики изменений структурно-механических свойств определяли стойкости следующих показателей: эластичность, структурная прочность, пластическая прочность, нежность по Грау.



at  $-40^{\circ}\text{C}$  were slight.

The data for the plastic solidity of the muscle tissue given in Fig. 2 show that in the whole the values of the said index were slightly influenced by the storage temperature as well as by the the state of meat and the durability of storage. In this instance, after certain hesitations in the beginning of storage an appearance of some equalization of the values which started to show a trend toward decreasing was pointed out. In general in this case with increasing the storage temperature a trend toward decreasing the extent of changes was revealed while it was most markedly expressed at  $-40^{\circ}\text{C}$ .

Out of the indices characteristic of the structural and mechanical properties, a clearly marked difference between the influence of the storage temperature on the values of the index determined was outlined in case of tenderness after Grau only. The changes at  $-10^{\circ}\text{C}$  can be distinguished on the one hand, and these at the rest of the temperatures of storage on the other hand. At freezing up to  $-10^{\circ}\text{C}$ , regardless of the initial state of meat the tenderness was improved (the index values increased). During the subsequent storage till the 210th day an authentic worsening of the tenderness occurred and then the latter revealed no changes till the end of storage. At the rest of the temperatures the freezing process itself was accompanied by worsening the tenderness as it was better observed with warm meat than with chilled one. At the subsequent storage some hesitations were noted which disappeared till the 4th month since the beginning of the storage after that a retention with warm meat was observed while in case of chilled meat some improvement of the tenderness occurred. With the exception of warm meat preserved at  $-40^{\circ}\text{C}$ , the tenderness remained worse than the initial one in all the other cases.

In generalization it could be assumed that irrespective of the final storage temperature and the initial state of meat, the freezing process itself exerted a comparatively slight influence on the structural and mechanical properties of meat.

At the subsequent storage of meat, irrespective of the temperature at which it was carried out, some changes of the structural and mechanical properties in bilateral direction occurred. It is characteristic that they were limited within the first 3-5 months of storage. The further storage was not marked by so active changes. It should be noted that the values of the indices characteristic of the structural and mechanical properties in this period regardless of whether a trend toward decreasing or increasing was shown, remained within the limits of the initial ones or close to them.

As far as the influence of the various storage temperatures on the structural and mechanical properties of frozen meat was concerned, the results obtained showed that except for the storage at  $-10^{\circ}\text{C}$  the other storage conditions exerted almost the same influence on the said properties.

A characteristic feature was that the values revealing the changes of the elasticity of chilled meat remained lower than these for warm meat at all the temperature conditions of storage except for  $-30^{\circ}\text{C}$  where they were similar with these for warm meat.

The influence of secondary freezing and storage on the technological properties of veal frozen in warm state was established by comparing the values of the indices accepted for the two kinds of cold treatment. That is why graphs Nos 1, 2 and 3 show the data plotted in parallel about the relevant indices in case of primary freezing and storage of warm veal and these of its secondary freezing after 75, 120 and 210 days of primary storage and subsequent secondary storage for 150 days.

The general analysis of the structural and mechanical properties given in Figs. Nos 1, 2 and 3 shows at first that the refreezing process itself exerted though a small influence

which was authentic with relation to the values of the established indices in a number of cases. This influence was more markedly expressed at the secondary freezing of meat in the initial stage of primary storage (75 and 120 days) and essentially more slightly shown in the later stages of storage of meat in frozen state. This peculiarity was noted at all the storage temperatures studied.

At studying the influence of the storage durability of refrozen meat on its structural and mechanical properties it was established that in spite of some more definite deviations (such as the elasticity index at  $-20^{\circ}\text{C}$  and 75 days of primary storage given in Fig. 1), the changes of the indices characteristic of the said properties maintained the character and the dynamics of the changes determined at examining the influence of the primary freezing and storage on the same properties based on the absence of a similarity of the deviations at the secondary freezing as compared with the data for the primary storage of frozen meat. It could be noted that the deviations of the values of the established indices were more important at refreezing and subsequent storage achieved in the initial period of primary storage.

The experimental results obtained at the secondary freezing of veal frozen in chilled state showed that the changes of the values of the indices characteristic of the structural and mechanical properties of refrozen meat followed the curve revealing the same changes in case of primarily frozen meat too. In this instance, by contrast with the already considered case of freezing and storage of warm veal, no differences in the value of the deviations depending on the moment of secondary freezing as well as on the durability of the secondary storage were observed.

#### Literature

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