Mikro- und ultrastrukturelle Veränderungen in hitzebehandeltem gefriergetrocknetem Fleisch.

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Es wurden die mikro- und ultrastrukturellen Veränderungen untersucht, die im Kalbfleisch bei seiner Hitzebehandlung (Braten und Schmoren), Gefriertrocknung und Rehydratation auftreten. Die eingetretenen Veränderungen, die keine wesentlichen Abweichungen in der Mikro- und Ultrastruktur des Kalbfleisches nach der Hitzebehandlung und nach der Rehydratation des gefriergetrockneten Fleisches aufweisen, werden erörtert.

Das hitzebehandelte, portionierte und gefriergetrocknete Fleisch besitzt eine hohe Rehydratationsgeschwindigkeit. Es wird die Frage über die Gefriertrocknung von portionierten Fleischwaren vom Type des Schinkens, Filets u.a. diskutiert.

Microstructural and ultrastructural changes in cooked and freeze-dried meat

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Microstructural and ultrastructural changes were studied in veal upon cooking (roasting and stewing), freeze-drying and rehydration. A demonstration and discussion is presented of the changes that show no substantial differences in the microstructure and ultrastructure of veal after cooking and the rehydration of the freeze-dried meat.

Cooked, portioned and freeze-dried meat has a high rate of rehydration. The problem is discussed of freeze-drying portioned meat products such as hams, loins, rolls, etc.

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Modifications micro- et ultrastructurales dans la viande lyophilisée après un traitement thermique

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On a étudié les modifications micro- et ultrastructurales de la viande de veau pendant le traitement thermique(rôtissage et mijotage), la lyophilisation et la réhydratation. On a examiné les changements qui n'avaient pas manifesté de différences essentielles dans la micro- et ultrastructure de la viande de veau après le traitement thermique et la réhydratation de la viande lyophilisée.

Après son traitement thermique, la viande portionnée et lyophilisée présentait une vitesse de réhydratation élevée. On a discuté le problème de la lyophilisation des produits carnés portionnés du type du jambon, des filets, etc...

Микроструктурные и ультраструктурные изменения в мясе тепловой обработки и сублимационной сушки

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Исследованы микроструктурные и ультраструктурные изменения, наступающие в телятине при тепловой обработке (запекании и тушении), сублимационной сушке и повторной гидратации. Показаны и рассмотрены наступившие изменения, которые не обнаруживают существенных различий в микроструктуре и ультраструктуре телятины после тепловой обработки и после повторной гидратации мяса сублимационной сушки.

Мясо, подвергнутой тепловой обработке, порционированию и сублимационной сушке, обладает высокой скоростью повторной гидратации. Рассматривается вопрос о сублимационной сушке порционированных мясопродуктов типа ветчины, филея, рулетов и пр.

Microstructural and ultrastructural changes in cooked and freeze-dried meat

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The quality of freeze-dried meat depends on a number of conditions, exerting a substantial influence on the organoleptical, biochemical and histological properties of meat.

The microstructural and ultrastructural changes occurring in the freeze-drying of meat have been studied by many authors (1, 2, 6, 7, 9, 10, 11) and it was found that the higher the meat freezing rate and the lower the heating plates temperature during meat drying, the more insignificant are the accompanying changes.

In recent years, a considerable interest is shown in the freeze-drying of cooked meat (3, 4, 5). Cooked and freeze-dried meat is reported to be rehydrated very quickly and to have a consistency resembling the one of roast beef (4).

The present investigations aimed at studying the microstructural and ultrastructural changes occurring upon the freeze-drying of cooked meat.

Experimental

Materials and Methods. Studies were carried out with veal Longissimus dorsi muscles taken 120 hours post mortem. Muscle pieces of defined dimensions, 20 cm long, 15 cm wide and 5 cm thick, were roasted or stewed. After cooling, 15 mm thick portions were formed and freeze-dried at the following parameters: freezing at a temperature of $-50^{o}C$ with natural air convection; drying in a vacuum sublimation chamber at a residual pressure of $9.10^{-2} \div 1.10^{-1}$ mm mercury column; heating plates temperature, $+60^{o}C$; drying cycle duration, about 24 hours; dried product moisture content, 0,3 to 1,05%.

Histological studies were carried out on muscle blocks, 1,5 cm x 1 cm x 1 cm, taken from raw meat, after cooking, and after freeze-drying and rehydration. The samples were fixed in formalin, embedded in paraffin and the sections prepared were dyed with hematoxyline-eosine, and after Van Gieson. Electron-microscope investigations were carried out on samples of muscle fibres of 1mm x 0,5 mm x 0,5 mm, taken from raw meat, after cooking, and after freeze-drying and rehydration. After fixation in 5% glutaraldehyde for 2 hours, post-fixation with osmic acid for 2 hours, dehydration and passing through propylene oxide, an embedding was done into Durcupan ACM - Fluka. Sections prepared at a BS 490 A ultramicrotome, contrasted with uranyl acetate and lead citrate were observed under a BS 613 electron-microscope.

Results and Discussion

The cooking (roasting and stewing) of meat had caused clearly expressed microstructural changes. Under the influence of high temperature, a heat denaturation of muscular and connective tissue proteins had occurred. Muscular fibres had preserved their outlines, but were fragmented by transverse splits (Fig. 1). The hystological picture of the freeze-dried and rehydrated meat shows the same fragmentation of muscular fibres, but in some places it is more clearly outlined (Fig. 2).

The electron-microscopical picture of raw meat 120 h. post mortem is illustrated in Fig. 3. The I-disks, A-disks, H-zones, Z-lines and M-lines could be seen in the figure. A swelling and destruction could be observed in mitochondria.

In the cooking of meat, as a result of the heat denaturation set in, a coagulation of myofibrillas, sarcoplasm and sarcolemma can be observed. The sarcomeres are contracted. The Z-lines are highly reduced and in their places, light bands could be seen, in which small granules could be distinguished. M-lines are reduced as well and in their place light bands with small granules can be seen. The thick filaments are coagulated and are transformed into a fine gra-

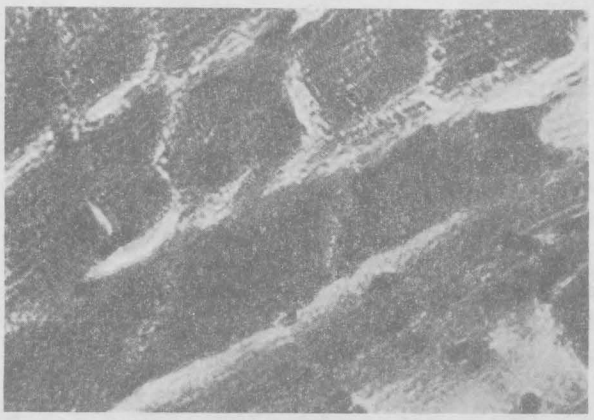

Fig. 1. Longitudinal section of stewed meat. Magn. 160 x.

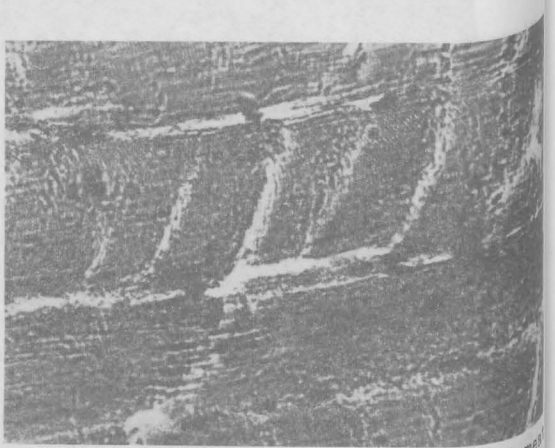

Fig. 2. Longitudinal section of stewed mea after freeze-drying and rehydratio Magn. 160 x.

Fig. 3. Longitudinal section through a part of a muscle fibre from re meat 120 hrs. post mortem. Magn. 14000 x.

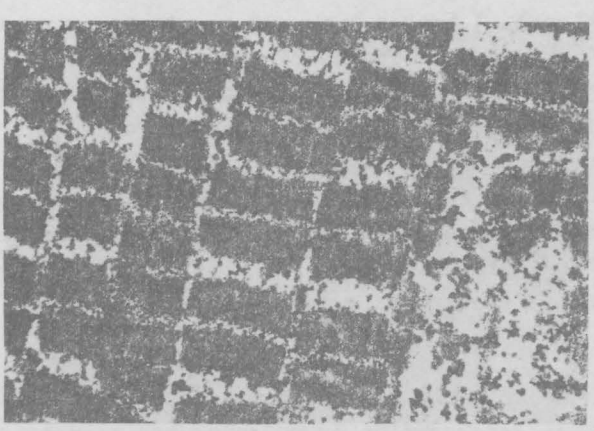

Fig. 4. Longitudinal section through a part of muscle fibre from stewed meat. Magn. 14000 x.

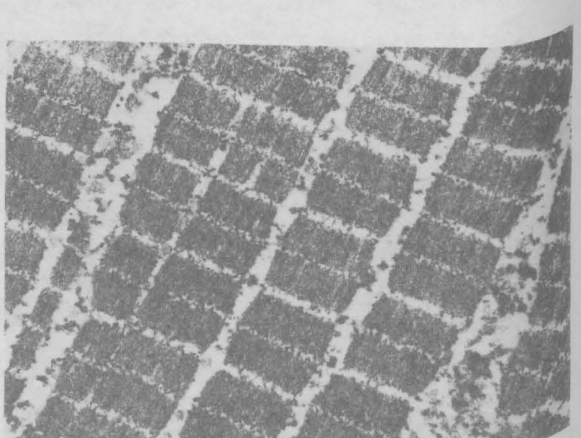

Fig. 5. Longitudinal section through a part of muscle fibre from stewed meat afte freeze-drying and rehydration. Magn. 10000 x.

nulated mass. In some places whole sarcomeres have disappeared and in their places fragments of them could be seen (Fig. 4).

The electron-microscopical picture of freeze-dried and rehydrated meat in comparison with the one described of cooked meat doesn't show any significant differences. In some places, the described changes in the places of Z-lines and M-lines are more clearly outlined (Fig. 5). Due to the effect of high temperature the sarcomere has lost its integrity and is transformed into a fine-granulated mass (Fig. 6).

According to data obtained by Luyet (8), freezing and defrostation of cooked meat do not change significantly the electron-microscopical picture obtained of meat cooking. He considered that the stable-coagulated material has achieved resistance towards further structural changes

during the freezing process. This statement of Luyet's has been proved by our studies, which show, that cooked meat possesses a considerable resistance towards the process of freeze-drying. This inevitably influences the faster rehydration of cooked freeze-dried meat. This result is of interest to the meat industry and provides possibilities and perspectives for the elaboration of technologies for the freeze-drying of cooked meat products such as hams, loins, rolls, etc.

The obtained results confirm the studies of Hinnergardt and Burger (1975) that freeze-dried portioned roasted veal gives a product, which rehydrates quickly and preserves well its consistency before freeze-drying.

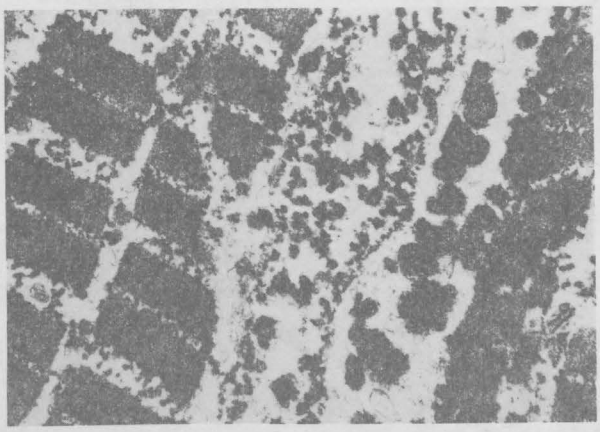

Fig. 6. Longitudinal section through a part of muscle fibre from stewed meat after freeze-drying and rehydration. Magn. 14000 x.

Conclusions

The studies carried out show that:

1. Cooked portioned meat possesses a high resistance towards freeze-drying and the micro- and ultrastructural changes set in during the freeze-drying are inconsiderable.
2. Cooked, portioned and freeze-dried meat has a high rate of rehydration and preserves well the consistency existing before the freeze-drying.

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