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Effect of the mode of cutting on the microstructure of cooked perishable sausages

S. DANCHEV*, G.P. GIRARD**, P. VELINOV*** AND V. SHNECKEL

* Higher Institute of Food Industry, Plovdiv, Bulgaria
** Institut de recherches sur la viande, Clermont Ferrand, France
*** Meat Technology Research Institute, Sofia, Bulgaria

Introduction

Cutting is a basic process in the production of cooked perishable sausages. It should ensure an intensive crushing of the meat raw materials and a comparatively high degree of emulsifying (Pionov, I. & Danchev, S., 1983).

Girard and Danchev (1983), when studying the effect of the cutting period on the stability of the filling mass, established two stages which were referred to as 'insufficient cutting' and 'overcutting'. The latter were separated by a transient period corresponding to the highest thermal stability of the filling mass and the highest yield of finished product. In the case of the meat raw materials and the conditions applied, the optimum duration of cutting was 10-12 min.

The studies of Dolata and Rywotycki (1984) showed that the revolutions of the knives and the cutter plate affected considerably the quality of the material to be cut. The increase in the revolutions resulted in improving the quality of the cut material and shortening the optimum cutting period. However, this shortening had no direct (linear) dependence on the revolutions of the knives and the cutter plate.

The studies of the microstructure of sausages provided a possibility of visual and impartial assessments of the physicochemical changes occurring in the cutting process. Cassens et al. (1977) suggested histochemical methods for the presentation of lipids (fats) and connecting tissues and found important differences in the size and the distribution of lipids in frankfurters of various producers.

Theno and Schmidt (1978) carried out light- and scanning electron microscopic studies of three commercial types of beef and pork frankfurters supplied on the local market.and found important differences in the structure of protein matrix and the distribution of fats.

The studies of Cassens et al. (1977) and Theno and Schmidt (1978) discussed the microstructure of a variety of frankfurters without specifying the production conditions.

Velinov et al. (1983) studied the effect of cutting and microcutting using the same devices with applying various cutting edges. The frankfurters produced in cutter and microcutter with sharp-set knives revealed a considerably finer micro- and ultrastructure of protein matrix incorporating fatty globules of smaller size surrounded by well-shaped protein membranes.

The aim of the present studies was to investigate the effect of the mode of cutting on the microstructure and the water-retaining power of cooked perishable sausages.

Material and Methods

The studies were carried out on lean pork from the hind quarters and fatty tissue from the backbone of the animal carcass yielded 48h after slaughter. Lean pork had pH 6.4, fatty content 9.2% and water-retaining power 9.5%, while the fatty tissue showed fatty content 86.7%, water content 10.6% and connecting tissue 2.7%.

The composition of the filling mass was as follows: 40% of lean pork, 30% of fat, 30% of ice, 2.2% cooking salt and 0.4% of tripolyphosphate (containing 3% P_2O_5). The mixture was prepared by two modes: Ist - using a cutter (M-S120K) only, and IInd - using a cutter and a colloidal mill (KM-3). Filling and thermal treatment were conducted in accordance with the conventional production technology of frankfurters.

Samples were taken from the finished products in order to determine the microstructure by light- and electron microscopy and the yield of finished product.

Light microscopy. Samples of ca 1 cm^3 were frozen in isopentane chilled in liquid nitrogen. Cryostat cuts 10   thick were fixed in a 10% formol-calcine solution for 30 min and coloured with oil red O for identifying the lipids and with picro-ponceau for illustrating the connecting tissue after Cassens et al. (1977). The observations were conducted under a microscope Docuval-Karl Zeiss, Jena - DDR.

Electron microscopy. Samples of 2x1x1 mm were fixed with a 5% glutaraldehyde solution for 2 hours, postfixed with a 2% osmium tetraoxide solution in a Milgnint buffer at pH 7.2 - 7.4 for 2 hours at a temperature of 4°C, dehydrated in an ascending order of alcohols, passed through propylene oxide and included in Durcopan. Ultrathin cuts obtained with an ultramicrotom LKB - III were coloured with uranyl acetone and lead citrate after Reynolds. The observations were made with a transmission electron microscope TESLA BS-613 at 80 kV.

Results and Discussion

The microstructure picture of frankfurters produced with a cutter M-S120K is shown in Fig. 1 and 2. It is characterized

Fig. 1. Light microscopic picture of a cut of frankfurters produced acc. to mode I. 20000 enlarged.

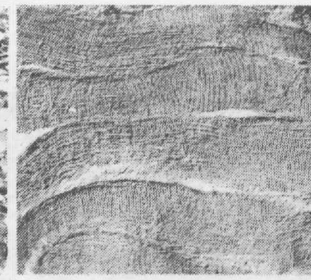

Fig. 2. Light microscopic picture of a cut of frankfurters produced acc. to mode I. 80000 enlarged.

by a coarser structure of protein matrix and larger fatty globules. In some places large parts of intact muscular fibres in cross-section and groups of fatty globules were reported (Fig.1) Maintaining the entirety of the muscular fibres was excellently illustrated using the interference microscopy (Fig. 2). Frank-

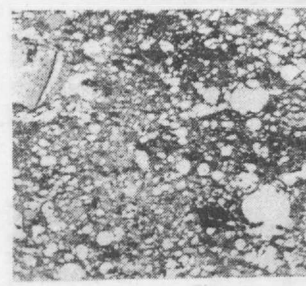

Fig. 3. Light microscopic picture of a cut of frankfurters produced acc. to mode II. 20000 enlarged.

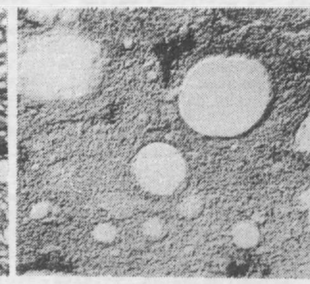

Fig. 4. Light microscopic picture of a cut of frankfurters produced acc. to mode II. 80000 enlarged.

furters produced from filling mass handled with a cutter and a colloidal mill KM-3 were characterized by a considerably finer structure of protein matrix and smaller and more evenly distributed fatty globules (Fig. 3 and 4). This microstructure was almost similar to that described by Theno and Schmidt (7,8) for frankfurters Brand C which they considered as a real meat emulsion according to the definition of Hansen (1960).

The results from the electron microscopic studies of frankfurters produced with filling mass by the two modes of cutting supported those obtained from the light microscopic studies. The ultrastructure of frankfurters produced with a cutter M-S120K was characterized by a coarser structure of protein matrix and by fatty globules of poorly shaped protein membranes (Fig. 5). In some places, parts of muscular fibres of well maintained ultrastructure of myofibrils characteristic of heat treated meat were found (Fig. 6).

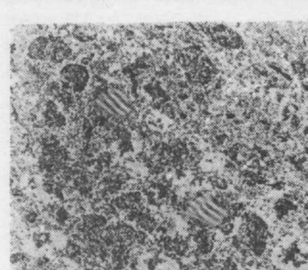

Fig. 5. Electron microscopic picture of a cut of frankfurters produced acc,to mode I. 4750 enlarged.

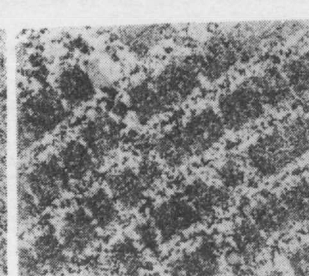

Fig. 6. Electron microscopic picture of a cut of frankfurters produced acc. to mode I. 10000 enlarged.

Frankfurters produced from filling mass handled in a cutter and a colloidal mill revealed a fine structure of the protein matrix presented in the form of fine granular mass of coagulated muscle proteins (Fig. 7 and 8). The fatty globules were surrounded with well shaped protein membranes the entirety of which was disrupted in some places due to the heat treatment.

The yield of finished product obtained in processing of meat raw materials after the IInd mode of cutting amounted to 97% in relation to the initial filling mass while the quantity of finished products obtained after the Ist mode of cutting was 94% compared to the basic filling mass.

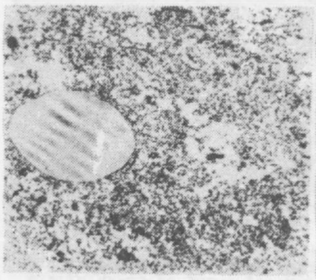

Fig. 7. Electron microscopic picture of a cut of frankfurters produced acc. to mode II. 10000 enlarged.

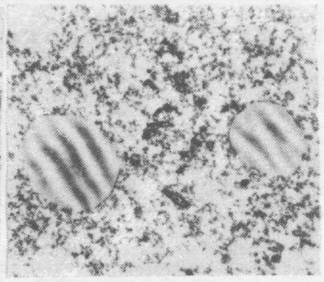

Fig. 8. Electron microscopic picture of a cut of frankfurters produced acc. to mode II. 10000 enlarged.

The studies conducted showed that the microscopic research methods provided extended data on the changes occurring in the meat raw materials during the technological process.

It was evident that processing of filling mass in a cutter and a colloidal mill resulted in obtaining a finer microstructure, a better distribution of fatty tissue and a higher stability of meat emulsion. The present studies also confirmed that using more finely cut meat raw materials higher yields were obtained. The application of microstructural research methods provided further possibilities of optimizing the technological processes.

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