MICROSTRUCTURE OF FINELY COMMINUTED PORK MEAT INFLUENCED BY SODIUM CHLORIDE

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SUMMARY

The histochemical method for detection of fat and Image Analysis System (Imager 512) for a description of the differences in the microstructure of meat emulsions were used. The examination was carried out on meat emulsions containing no or 3% of added sodium chloride. The addition of sodium chloride caused better, uniform dispersion of fat droplets of varying size. Average area of fat in the samples without sodium chloride was about 5,3 times as large as in the samples with 3% addition of sodium chloride.

Introduction

Microstructure of meat emulsion is influenced by pH of meat , time post mortem, method and degree of comminution, number , quality and quantity of constituents . Meat emulsion is not a uniform structure but a polydispersed system.During bowl chopping sodium chloride. is added to the meat emulsion . Its functions are important and multiple : it activates proteins, enhances the water-binding capacity, increases viscosity of proteins, enhances the emulsifying activity, improves consistency, increases pH value and is bacteriologic /Terrel R.N. 1983/. The increase of water binding capacity caused by sodium chloride consists in the adsorption of chlorine ions by meat. It results in the opening of the muscle proteins structure due to the reduction of inter-attractive forces /J.Mroczek , 1991/.The increase of the solubility of globular proteins , especially myosin, results from the increase of the ionic strength followed by a configurational changes of proteins and by osmotic effect of disrupture of cell membrane /D.Chomiak , 1987/88 /.

Until now mainly the technological effects of sodium chloride addition to the meat emulsion have been observed such as decrease of thermal losses, improvement of consistency etc.While seeking the relation between methods of meat emulsion production, its rheological and technological properties and its structure, the emulsion has been tested with the application of histologic and histochemical methods. The microstructure of the meat emulsion with and without salt , at different degrees of chopper bowl filling, has been checked. Histologic tests allow to determine the structure characteristics,constituents distribution and binding stability of meat emulsions what is not possible when only chemical and technological method are applied / G.Hildebrandt and others , 1980 , K.Katsaras , 1990/.

Material and methods

Material

Meat emulsions were prepared according to standard procedure. The only variable element was the degree of chopper bowl filling: 100% or 70%. Meat emulsion consisted of muscle tissue, fat tissue and ice in the weight ratio 4:1:1.Two extreme levels of sodium chloride have been tested: 0% and 3% . The tested batches have been as follows:

0-100 , meat emulsion without salt , 100% chopper bowl filling
0-70 , meat emulsion without salt , 70% chopper bowl filling
3-100 , meat emulsion with 3% salt addition, 100% chopper bowl filling
3-70 , meat emulsion with 3% salt addition, 70% chopper bowl filling

Methods

For histologic tests the samples of meat emulsion have been taken immediately following chopping, formed into the cubes 10 x 10 x 10 mm and frozen in liquid nitrogen. The frozen cubes have been transferred to cryostat and on stabilizing the temperature on the level of -25°C cut into sections 10 \m.Serial sections have been put on the basic glass plates coverd with proteins and dried for about 30 min.in room temperature. Then they have been stained with Van Gieson method to visualize connective tissue and with oil red/ V.Dubowitz and others, 1973, D.K³osowska , 1990/ to identify the fat. The preparations stained with oil red have been estimated with the application of Imager 512- Image Analysis System. In each preparations at the enlargement of 12,5 x 10 ten areas of the size of 63362,2536 \m² have been analysed in order to define an average area of fat and sizes of the smallest and largest areas appearing in the meat emulsion.

Results and discusion

The results have been shown in the fig. 1, 2, 3 and 4 and in the table 1.
In fig.1 the section surface of 0-100 meat emulsion is filled with a uniform meat mass in which dark, large fat areas and small air gaps are visible.
In fig.2 the section surface of 0-70 meat emulsion is filled with much more small fat areas as well as bigger air gaps than in the fig.1 .
In the structure of 3-100 meat emulsion / fig. 3 / one can observe plenty of small fat droplets accompanied by several bigger ones loosely distributed.
Fig.4 shows the 3-70 meat emulsion structure, in which a smaller dispersion of bigger fat droplets in comparison to batch 3-100 can be seen.
In the table 1 the areas of fat observed in histologic preparations made of the meat emulsions with and without sodium chloride are presented. In the emulsion without salt the number of fat areas is around 265 for 0-70 and 330 for 0-100. The smaller number but of the bigger total area is in the meat emulsion without salt chopped in the bowl not fully filled as compared to that chopped in a standard way. Meat emulsions chopped with sodium chloride present much better dispersion and emulgation. The number of fat areas in histologic preparations is 1270 to 1508, being by 3,8 to 5,7 bigger than those without salt. Average fat areas in the structure of the batch without and whith 3% sodium chloride are 391,52 \m ² and 62,19 \m ² respectively.In emulsions with 3% added salt lower fat contents calculated from the histologic picture has been found in spite of an identical raw material formula of all the batches with and without salt. Therefore, it is very probable that in the meat emulsions with salt a part of fat has been really emulgated thus becoming invisible in the histologic preparations.

Conclusions

1. The addition of sodium chloride to the meat emulsions resulted in the uniform dispersion of fat in the protein lattice , not to be obserwed in the emulsions without sodium chloride.

2. 3% addition of salt to the meat emulsion resulted in raise of the number of fat areas by about 5 times as compared to the emulsion without sodium chloride with simultaneous decrease of their unit area by 5,3 times.

3. In the meat emulsions chopped according to standard procedure and containing no added salt the average fat surface was about 380,72\m ² and in the emulsion with salt - 71,92 \m 2.

4. Minimum fat surfaces in the meat emulsions with and without sodium chloride were equal - 0,7-1,0 \m 2.

5. Maximum fat surfaces in the meat emulsions without and with salt were 13 509 \m ² + / - 126,23 and in the emulsion with salt 5 104 \m ² +/- 98,99 respectively.

6. Less filled chopper bowl did not result in any substantial change of the areas of fat surfaces in all the emulsions, nevertheless it affected the quantity of air gaps in the emulsions.

Literature

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Fig.1 Microsructure of the meat emulsion 0-100. Preparation stained by Red Oil O. Dark stained fat areas. Bar =100 \m.
Fig.2 Microstructure of the meat emulsion 0-70. Preparation stained by Red Oil o. Dark stained fat areas. Bar = 100 \m.
Fig.3 Microstructure of the meat emulsion 3-100. Preparation stained by Red Oil O. Dark stained fat areas . Bar = 100 \m.
Fig.4 Microstructure of the meat emulsion 3-70. Preparation stained by Red Oil O. Dark stained fat areas. Bar = 100 \m.
Table 1. Characteristic of the structure of meat emulsions.