Technological and histochemical methods for the determination of protein-fat emulsions stability in meat products

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Some protein-fat emulsions on the basis of unconventional, vegetable or milk protein additives are discussed. The formulae for obtaining stable emulsions were determined. The results were confirmed by histochemical studies. The work made complex technological and histochemical determinations of the stability of protein-fat emulsions in some perishable smoked-and-cooked sausages.

Technologische und histologisch-chemische Methoden für die Bestimmung der Stabilität von Eiweiss-Fett-Emulsionen in Fleischerzeugnissen

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Es wurden einige Eiweiss-Fett-Emulsionen auf Basis nichtkonventioneller Pflanzen- und Milcheiweissadditive untersucht. Dabei wurden die Formeln zur Erhaltung von stabilen Emulsionen bestimmt. Die Ergebnisse wurden durch histologisch-chemische Untersuchungen bestätigt. Es wurden komplette technologische und histologisch-chemische Bestimmungen über die Stabilität der Eiweiss-Fett-Emulsionen in einigen Brühwurstarten festgelegt.

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Méthodes technologiques et histo-chimiques de détermination de la stabilité des émulsions protéine-graisse dans les produits carnés

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On examine certaines émulsions protéine-graisse à base d'additifs non traditionnels de protéines végétales et laitières. On détermine les formules d'obtention d'émulsions stables. Les résultats sont confirmés avec des recherchés détaillées histo-chimiques. On fait des déterminations complexes technologiques et histo-chimiques concernant la stabilité des émulsions protéine-graisse dans certains saucissons cuits-fumés de courte durée.

Технологические и гистохимические методы определения стабильности белково-жировых эмульсий в мясных изделиях

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Рассматриваются некоторые белково-жировые эмульсии на основе неконвенциональных - растительных и молочных - белковых добавок. Определены формулы получения стабильных эмульсий. Результаты подтверждены гистохимическими исследованиями. В работе сделаны комплексные технологические и гистохимические определения стабильности белково-жировых эмульсий в некоторых скоропортящихся варено-копченых колбасах.

Technological and histochemical methods for the determination of protein-fat emulsions stability in meat products

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In the production of some groups of meat products it became a practice to use stable protein-fat emulsions of the nonconventional type. This is impelled by many factors but attention should be given to the following:

- the nature of the animal breeding and the different conditions of the first technological processes in the treatment of meat.
- the frozen and defrosted meat, the physical - chemical and microbiological changes and reasons for the formation of a new structure.
- quantity and quality chnages in the colloid properties of muscle proteins, loosing their possibilities to swell and a decreased emulgation capability.
- use of fat meats,low quality meat materials and others.

The role and types of the different protein additives for the emulsions is of a special importance for the quality of the emulsions, the quantity of emulgated fat to an unit of protein and their stability.

The industrial methods in meat production show us that many factors lead to the unstability of the protein-fat emulsions during the thermal treatment and produce losses of product,amounting to 2 - 3%.
During the last fifteen years were published about 160 research results, using model systems, industrial and production schemes, biophysical and histochemical methods, which elucidate to the research workers the mechanism of the protein-fat emulsions, but at the same time there are a number of problems tied to the stability of the protein emulsions which are still obscure.

Material and methodics

The studies were made in laboratory as well as in production environment, using sodium caseinate PRB as protein additive, hard back fat and different percentage relations of hot (90°C) and cold water. Towards the end of the emulsion formation we added 2% NaCl and 0,1% penthasodium polyphosphate. The ready protein emulsions were used as fortifiers and stabilizators in the production of perishable structural and nonstructural sausages.

For the preparation of the protein-fat emulsions was used a mixer "Honorex" having a possibility of 2000 - 4000 r/min. The sodium caseinate was submitted before use to a complete physico-chemical and miscrobiological analyses using the standard methods.

For proving the most suitable technological parameters for the protein-fat emulsions, we used the scale determining the hydrophylic-lypolitical balance after the modified method of Griffin, the emulgation capacity after Iborich and Mitich. The stability of the emulsions was determined by centrifugation on a "Janiicky" centrifuge at 6000 - 8000 r/min, with heating, organolepticaly and histochemicaly.

The weight of all sample emulsions were 200 g for the maintenance of a stable temperature during the emulgation. The wanted weights of the protein additive, the fat and the added water were determined after the modified method of Morison et al.,as follows:

- weight of added water (AW) = 200 - (weight of protein additive + % of added fat) (1)

- % total fats (TF) = ($\frac{\text{weight of pig fat + weight of protein additive x \% fats}}{\text{total weight of the emulsion}}$ x 100 (2)

- % protein additive = $\frac{\text{weight of the protein additive x 100 - (\% of humidity - \% fats)}}{\text{total weight of the emulsion}}$ (3)

Since the emulsion is calculated as a three component systemm separately from the added salt, the percentage of the added water would be :
- % AW = 100 - (% protein additive + % total fats) (4)

The histochemical demonstration of the fats globules was made with Oil Red "O" (Lilly) and on the surrounding protein covers with Amydoschwartz10 B (Kononskyi).

The samples for the electro microscopic studies were fixed and dehydrated after the conventional methods and were included in Durcopan. Ultra thin layers, prepared on a ultramicrotome Tesla BS 490 A after colouring with uranylacetate and leadcitrate were seen on an electron microscope Tesla BS 613.

Results and discussiom

The most rational formula for obtaining a stable emulsion of protein-fats,proved to be the relation 1 : 5 : 6 (protein - fats - water), proved by the given methods. In determining the physical properties, we used the test for stability after Townsend including elasticity, hardness, cohesion, from 8 points to none 0 points.

On figure 1 are given the limits for a warm emulsion (the full curve) and of a cold emulsion (dotted curve), inside are all 19 and more poi ts for the evaluation of the physical properties. It is observed that the minimum percentage of added water, which could be included in an acceptable emulsion is between 11 and 16% for the warm emulsion and from 16 to 21% for the cold emulsion, with a 30% level of total fats,accordingly calculated for warm and frozen meat in the cutter. The result show that with the use of cold emulsions in the processing of frozen meats, the water quantity added is increased so as to obtain better physical qualities for the thermaly treated emulsions.

On fig.2 are shown the results of the thermal stability and composition of the emulsion. 90% of all crossings for all cruves for the constant components,denominate,that the region for 90% or higher thermal stability,decreases sharply in storage at frozen condition and increases the need of added water about 5% for maintaining the stability of the emulsion.Itis clear therefore that one element in the emulsion can not variate without effecting at least one of the other components or even both of them. The decrease of the total fat content to 30% could be done without inflicting any damage to stability, but decreasing the percentage of the added water might break the emulsion as a whole.Since the percentage of the added water can not variate in similar wide limits,then from the three components of the emulsion the water is the most critical facotr for keeping the emulsifying stability. This is confirmed also from the very pointed maximum,on the curves of fig.3,in which the water is not constant and of the lack of a maximum on fig.4 where the water is maintained constant.

Since the stability of the emulsion is increased with increasing the level of saltssoluble proteins, the addition of additional quantities of protein additive might prove to be harmful to the emulsifying stability.

On fig.3 is shown the influence of adding water to the thermal stability, and on fig.4 the influence of the total fats on the thermal stability with a constant water of 19%. The histochemical sudies (fig.5) show that the fats-protein emulsion is characterized with a multitude equal in size fats globules surrounded by a protein membrane. The histochemical studies for emulsions prepared by warm and cold methods,show that the first have better stability in comparison to the second. They keep their stability in cold storage for 7 to 10 days at t^{o} = 0 - 4^{o}C.From the used colour agents for the fats globules best results were obtained with oil red "O" and sudan IV, followed by sudan III. The

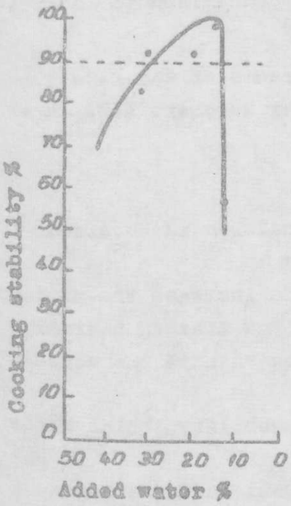


Fig. 3

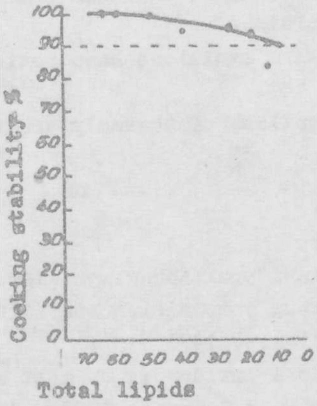


Fig.4

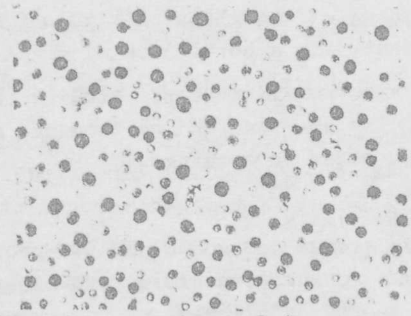


Fig.5 Fat-protein emulsion
Meat globules are coloured with oil red "O" and the protein membranes with amydoschwartz 10B in dark blue.

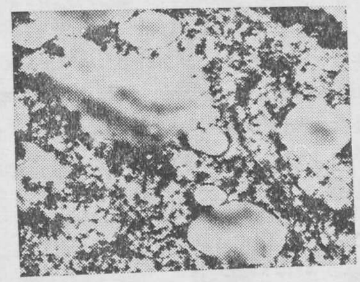


Fig.6 Electron microscopy (19000x)
Sample of thermaly treated perishable structurized sausage.

staining of the globules with oil red "O" has definite advantages in comparison to Sudan IV expressed in a better staining and easiness of the method.

The electron microscopic studies (fig.6) show, that the protein membranes of the fats globules are torn and on them are noted very clearly, the described by Borchert L.L. et al 1967, pores or openings.

Conclusions

Using sidium caseinate NRB for protein fats emulsions, most stable emulsion is obtained by the formulation 1:5:6 (protein-fats-water).

The use of cold emulsions for treatment and processing of frozen meats increase the minimum needs for water for obtaining good physical properties for the emulsions treated thermaly.

The thermal stability decreases sharply in cold storage and increasing with 5% the added water,helps keep the stability of the emulsion.

The histochemical studies exhibit, that warm emulsions have better stabbility, which keeps for 7 to 10 days at a temperature of 0 - 4°C.

The electron microscopy confirmed the stability of thermaly treated perishable sausages produced with frozen meat.

Literature

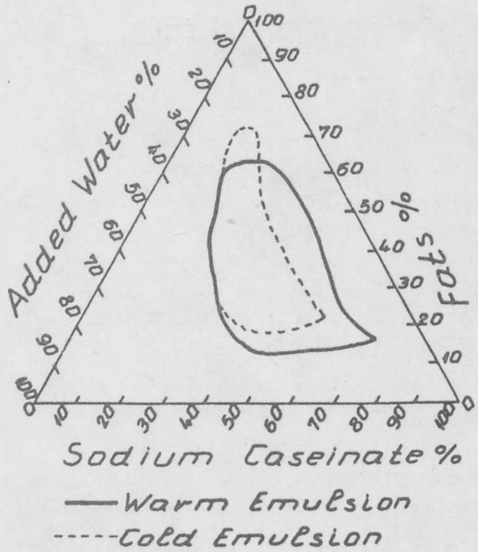
1.Kononskyi A.I. - Gistochimia, 1976, Kiev

2.Lilly R. - Patogistologicheskaya tehnika i prakticheskaya gistohimia, 1969, Moskow

3.Morrison G.S. et al - Relationship between composition stability of sausage-type emulsions, J.F.Science, 1971

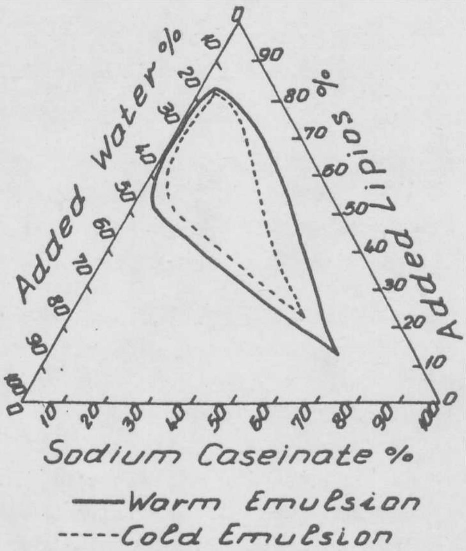
4.Johnson H.R. et al - Physical and chemical influences on meat emulsion stability in a model emulsitator, J.F.Science, 1977,2,522 - 531

5.Borchert L.L. et al,1967, J.F.Science



1:5:6

Fig.1



1:5:6

Fig. 2