Application of the protein concentrate of sour-cream buttermilk to the production of cooked sausages. III. Effect of the protein concentrate on the stability of the meat emulsions in the stuff and filling mass for cooked sausages

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Introduction

The process of emulsification of fats during the preparation of the filling mass proved to be one of the main problems in the production of cooked sausages. The stability of the meat emulsions obtained determined the ability of the filling mass to retain its main reological properties in the utmost degree till the end of the technological treatment (6,7). The presence of unstable emulsions exerted a negative effect on the qualitative indexes of the finished products. Therefore, upon additional introduction of non-meat raw materials the meat emulsions should stabilize the disperse nature of the filling mass with imparting the required characteristics (8,9).
To this effect, the protein concentrates used as additives or meat substitutes for the production of cooked sausages should have technological compatibility with the meat raw materials to participate in obtaining the properties of the filling mass by supporting the emulsifying action of the meat proteins and contributing to the increase in the stability of the emulsions obtained.
In the present work we made it our object to establish the effect of the protein concentrate used (1) on the stability of the meat emulsions in the filling mass for cooked sausages.

Material and Methods

The studies were carried out with stuff of beef, stuff of lean pork and filling mass for structured and non-structured cooked sausages.
The stuff and the filling mass were prepared in accordance with the technology being now applied in our country. A protein concentrate of sour-cream buttermilk having a dry matter content of 20-23% and pH 6.5 was added to the meat raw materials. The introduced quantities amounted to 5, 10, 15 and 20% in relation to the weight of the meat raw materials. Samples with no protein concentrate added were also prepared from the same meat materials.

The stability of the meat emulsions was examined by the method of Kozin (2) modified after C.W. Hutton and A.M. Campbell (5). The dry matter content and the hydrogen-ion concentration (pH) were also determined.
The results were processed by the methods of mathematical statistics (3,4). The tables summarize the final results as M±t.m., where M is the arithmetic mean of n=15, m is the mean-square error of the average results and t is the criterion of Student for the confidence interval of 95% adopted by us.
In order to establish the effect of the separate amounts of protein concentrate on the stability of the meat emulsions, a single-factor analysis of dispersion (4) was made and the final results are given in the adequate table.

Results and Discussion

The results about the effect of the experimental amounts of protein concentrate on the stability of the meat emulsions for the stuff and filling mass of structured and non-structured cooked sausages are shown in Tables 1 and 2.

Table 1 - Stability of the meat emulsions of stuff and filling mass for cooked sausages produced with a protein concentrate of sour-cream buttermilk (cm^3 liquid phase separated during centrifugation)

Product tested	Controls	5% protein conc.added	10% protein conc.added	15% protein conc. added	20% protein conc. added
Stuff of beef	6.97±0.33	5.83±0.65	6.07±0.45	8.31±0.52	11.17±0.70
Stuff of lean pork	7.83±0.89	6.03±0.33	6.15±0.55	7.87±0.78	9.20±0.57
Filling mass for structured sausages ('Hamburgsky')	4.37±0.33	3.78±0.28	3.22±0.24	6.24±0.55	10.21±0.81
Filling mass for non-structured sausages ('Ruen')	6.51±0.44	5.63±0.50	4.21±0.39	8.18±0.39	11.34±0.44

It is evident that the addition of a protein concentrate in amounts of 5% and 10% increased the stability of the meat emulsions in the stuff of beef and pork, and in the filling mass

for non-structured cooked sausages (the 'Ruen' sausage). This was confirmed by the lower mean values obtained for the amount of separated liquid phase during centrifugation of sam-
Table 2 -

Product tested	Results of the single-factor analysis of dispersion $\alpha = 0.05$, $p = 5$, $q = 15$		
Stuff of beef	$F_i=78.77 > F_f=2.54$ $R_v = 0.71$	$X_1-X_2= 1.14>R_v$ $X_2-X_3= 0.24<R_v$ $X_3-X_4= 2.24>R_v$ $X_4-X_5= 2.86>R_v$ $X_1-X_3= 0.90>R_v$	$X_1-X_4= 1.34 > R_v$ $X_1-X_5= 4.2 > R_v$ $X_2-X_4= 2.48 > R_v$ $X_3-X_5= 5.10 > R_v$
Stuff of lean pork	$F_i=24.42 > F_f=2.54$ $R_v = 0.77$	$X_1-X_2= 1.8 > R_v$ $X_2-X_3= 0.12<R_v$ $X_3-X_4= 1.72>R_v$ $X_4-X_5= 1.33>R_v$ $X_1-X_3= 1.68>R_v$	$X_1-X_4= 0.04 < R_v$ $X_1-X_5= 1.37 > R_v$ $X_2-X_4= 1.84 > R_v$ $X_3-X_5= 3.05 > R_v$
Filling mass for structured sausage ('Hamburgsky')	$F_i=164.64>F_f=2.54$ $R_v = 0.63$	$X_1-X_2= 0.59<R_v$ $X_2-X_3= 0.56<R_v$ $X_3-X_4= 3.02>R_v$ $X_4-X_5= 3.97>R_v$ $X_1-X_3= 1.15>R_v$	$X_1-X_4= 1.87 > R_v$ $X_1-X_5= 5.84 > R_v$ $X_2-X_4= 2.46 > R_v$ $X_3-X_5= 6.96 > R_v$
Filling mass for non-structured sausage ('Ruen')	$F_i=118.33>F_f=2.54$ $R_v = 0.72$	$X_1-X_2= 0.88>R_v$ $X_2-X_3= 1.42>R_v$ $X_3-X_4= 3.97>R_v$ $X_4-X_5= 3.16>R_v$ $X_1-X_3= 2.30>R_v$	$X_1-X_4= 1.67 > R_v$ $X_1-X_5= 4.83 > R_v$ $X_2-X_4= 2.55 > R_v$ $X_3-X_5= 7.13 > R_v$

The variants are designated as follows: X_1 - controls; X_2 - test samples with 5% of protein concentrate; X_3 - test samples with 10% of protein concentrate; X_4 - test samples with 15% of protein concentrate, and X_5 - with 20% of protein concentrate.

ples with 5% and 10% of protein concentrate compared to those without concentrate, and by the presence of statistical difference (Table 2). No similar difference between the samples with 5% and 10% of protein concentrate was found in the stuff of beef and lean pork which showed that the addition of protein concentrate in amounts to 10% changed to the same degree the stability of the meat emulsions.

The stability of the meat emulsions increased to the most considerable degree in the filling mass for non-structured cooked sausages made with 10% of protein concentrate which was confirmed by the lowest values obtained for the amount of separated liquid phase.

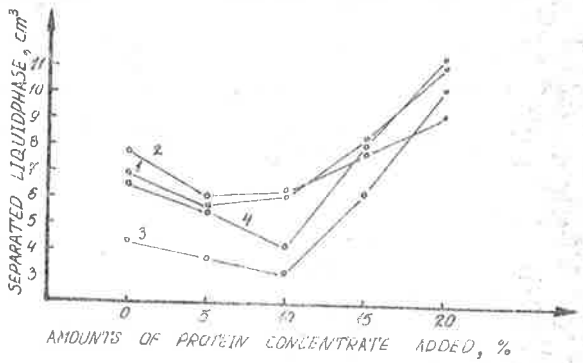

Figure 1. The variants are designated as follows: 1 - stuff of beef; 2 - stuff of lean pork; 3 - filling mass for structured cooked sausages, and 4 - filling mass for non-structured cooked sausages.

In the case of the filling mass for structured cooked sausages prepared with 5% and 10% of protein concentrate, and in that without a concentrate, no statistical difference was observed in relation to the amount of separated liquid phase which showed that the stability of the emulsion in these sausages was slightly affected by the addition of protein concentrate. This was probably due to the extent and the character of the machine treatment of the meat raw materials.

When using 15% and 20% of protein concentrate for the preparation of stuff and filling mass for structured and non-structured cooked sausages, the results for the amount of separated liquid phase were statistically different compared to those obtained from the samples without a concentrate and with 5% and 10% of protein concentrate. This revealed that the aforesaid amounts (15% and 20%) changed considerably the stability of the meat emulsions. In these variants the amount of the liquid phase separated during centrifugation was higher, therefore, it follows that the stability of the meat emulsions decreased to a certain degree.

Figure 1 shows the variation in the stability of the meat emulsions in stuff and filling mass for cooked sausages prepared with a protein concentrate of sour-cream buttermilk. The dry matter content (Table 3) of stuff and filling mass for cooked sausages made with various amounts of a protein concentrate of sour-cream buttermilk changed slightly which is seen from the lack of authentic difference between the individual mean values.

Table 3 - Dry matter content in stuff and filling mass for cooked sausages made with a protein concentrate of sour-cream buttermilk (%)

Product tested	Controls	5% of protein conc.added	10% of protein conc. added	15% of protein conc. added	20% of protein conc. added
Stuff of beef	24.87±0.98	25.06±0.59	24.81±1.00	23.92±0.65	23.47±0.55
Stuff of lean pork	29.19±0.96	29.95±1.11	28.56± 0.35	28.90±0.94	28.56±0.98
Filling mass for structured sausages ('Hamburgsky')	30.33±0.50	30.12±0.55	29.05±0.74	28.45±0.55	27.46±0.70
Filling mass for non-structured sausage ('Ruen')	32.12±1.16	32.67±1.11	32.05±1.02	29.46±1.26	29.17±0.78

A similar trend was observed for the pH values (Table 4) which raised slightly only when using larger amounts of a protein concentrate (15% and 20%).

Conclusions

1. The addition of a protein concentrate of sour-cream buttermilk in amounts up to 10% to the meat raw materials during preparation of stuff for cooked sausages and filling mass for non-structured cooked sausages increased the stability of the meat emulsions. No changes occurred in the stability of the meat emulsions in the filling mass for structured cooked sausages.

2. Upon addition of a protein concentrate of sour-cream buttermilk in amounts exceeding 10% to the meat raw materials during preparation of stuff and filling mass for cooked sausages, the stability of the meat emulsions decreased.

Table 4 - pH values of the stuff and filling mass for cooked sausages made with a protein concentrate of sour-cream buttermilk

Product tested	Controls	5% of protein conc. added	10% of protein conc. added	15% of protein conc. added	20% of protein conc.
Stuff of beef	6.21±0.04	6.10±0.04	6.15±0.04	6.22±0.04	6.31±0.07
Stuff of lean pork	6.16±0.02	6.19±0.04	6.26±0.04	6.27±0.04	6.31±0.04
Filling mass for structured sausage ('Hamburgsky')	6.27±0.04	6.25±0.07	6.27±0.04	6.35±0.07	6.36±0.07
Filling mass for non-structured sausage ('Ruen')	6.27±0.09	6.26±0.07	6.32±0.04	6.34±0.02	6.38±0.02

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