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# CHANGES IN LIPID FRACTIONS DURING THE RIPENING OF FAST-RIPENING SAUSAGES MANUFACTURED USING STARTER CULTURES

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During recent years, quite extensive literature has accumulated on the application of microbial cultures in the manufacture of fermented meat products.
The enzymatic activity of starter cultures exerts an influence on colour formation, binding, flavour formation and the storage life of fermented meat products (Schiefer 1978).
The sensory quality of raw sausages depends on the accumulation of fermentation products from the degradation of carbohydrates, proteins and lipids (Pyrcz and Pezacki, 1981).
As a result of lipolysis in the process of raw sausage ripening, an increase occurs in the contents of free fatty acids (FFA) which participate in the formation of the flavour qualities of the products (Stanculescu et al., 1970; Wahlroos and Niinivaara, 1969).
According to Cantoni et al. (1967a) and Nurmi and Niinivaara (1968), micrococci are the major microorganism group responsible for lipolysis in dry sausages.
There is evidence on the positive effect of lipase-producing yeasts on the flavour of fermented meat products (Buyanov, 1981; Nestorov et al., 1983).
Data are also available on the production of lipases by lactobacilli (Oferholm et al., 1968; Stoychev, 1972a,b).
The objective of the present work was to determine the effect of a freeze-dried microbial preparation of ours, composed of micrococci and lactobacilli, on the lipid fraction of two fast-ripening dry salami products.

## Materials and Methods

The experiments were conducted using two new fast-ripening dry salami products (Product I and Product II) manufactured by experimental technologies: Product I, composed of one-grade (non-sorted) beef, lean pork and belly fat; and Product II, consisting of one-grade beef and semi-fat pork.
Samples manufactured in accordance with the technology served as controls, and in the experimental variants, a freeze-dried starter preparation containing lactobacilli and micrococci was introduced. The preparation was made in the Institute of Meat Industry, Sofia.
Three experimental series each were produced, every one of 100 kg, under industrial conditions. Product ripening during the first 48 hours took place at 25°C; smoking followed, for 6-8 hours at 18-20°C, and drying at 15°C for all the variants.
The extraction of the lipids from the experimental material was effected by the method of Bligh-Dyer. The isolation of triglycerides (TG) and free fatty acids (FFA) was accomplished by thin-layer chromatography on silica gel G and using hexane:diethyl ether:acetic acid (60:30:17) as eluant. The spots were identified after spraying with Rhodamine G. Quantitative analysis was made by gas chromatography with an internal standard of arachic acid, C20:0, for free fatty acids, and triarachin for triglycerides (Christie, 1982).
The molar percentages of the individual fatty acids were estimated by the height of the relevant peak and retention time.

## Results and Discussion

The results we obtained on the levels of TG and FFA in the beginning and in the end of manufacture for the two fast-ripening products are shown in Fig. 1.
A reduction is observed in TG level during ripening with a corresponding increase in FFA in both products.
TG level in the experimental lots of salami was lower, compared to triglyceride level in controls, by 5 to 8%.
An extensive literature demonstrating lipolysis during dry sausage ripening has accumulated, during which ripening, FFA level may be from 1 to 7% (Stanculescu et al., 1970; Terplan, 1969; Wahlroos and Niinivaara, 1969).
Our results demonstrated (Fig. 1) that, in the experimental lots of products, FFA level is higher by 2 and 3%, compared to controls.
An important index of the quality of meat products (storage life, aroma and taste) is the fatty acid composition of lipids. The results obtained by us with regard to the fatty acid composition of triglycerides and free fatty acids in product I, are illustrated in Fig. 2 and Fig. 3.
It can be observed that the salami manufactured without a starter preparation do not change the fatty acid composition of TG after ripening. The ratios of fatty acids are preserved which indicates that lipolysis, if any, affects equally all the positions of TG.
In the salami manufactured using starter preparations, characteristic changes are observed in TG after the ageing period (on day 15), which are expressed in terms of reducing the molar percentages of saturated acids, myristic, C14:0; palmitic, C16:0; and stearic, C18:0; and an increase in oleic acid.
The results obtained on the fatty acid composition of free fatty acids indicated, that both in controls and in experimental products, lipolysis does exist, which is nearly twice as intensive in the salami manufactured with a starter preparation.
The qualitative fatty acid composition of control and experimental salami changes in one direction. An increase is observed in unsaturated fatty acids, C16:1; C18:1; and C18:2, after ripening. The ratio of unsaturated to saturated acids increases in control products from 0,8 to 1,3, and in the experimental ones, from 0,5 to 1,2.
The fatty acids characteristics of FFA in control and experimental products, similar to what is observed in TG, confirmed the non-specificity of the action of microbial lipases in the products with a starter preparation. We attribute the higher levels of oleic and linolic acids in the experimental products to the activity of the microbial lipase of the starter preparation microorganisms which attacks preferentially unsaturated fatty acid bonds in triglycerides rather than saturated fatty acid bonds.
Nestorov et al. (1984) found an increase in the contents of C18:1 and C18:2 till the 18th day in loukanka dry sausages manufactured using a yeast culture.
Lipases are known to hydrolyse preferentially the outer fatty acids of a TG molecule (Alford et al., 1971).
According to Demeyer et al. (1973), lipases attack specifically position 1 or position 3, where stearic and octadecenoic acids are known to be found. Linolic acid is liberated at the highest rate in the fraction of FFA.
In the second product, the same regularity is observed with regard to the fatty acid composition of TG and FFA (Fig. 4 and Fig. 5).
Saturated FA in all the salami analysed decreased on day 15, while unsaturated FA increased.
The highest intensity of free fatty acid accumulation was found in experimental products.
The increase, on day 15, of linolic acid within the composition of free fatty acids

corresponds to its reduction in the composition of TG.
Linolic acid (C18:2) is hard to preserve since it is readily oxidized upon storage. Levels above 20% cause rancidity in fats.
In our experiments, however, its level was not high (up to 7%) which, on the one hand, was a source of improving the flavour qualities of the sausage, without shortening storage life.
The sensory evaluation of all the products analysed demonstrated that the differences found between experimental and control products in the level and the composition of FFA exert a positive effect on the formation of the specific flavour of those products.

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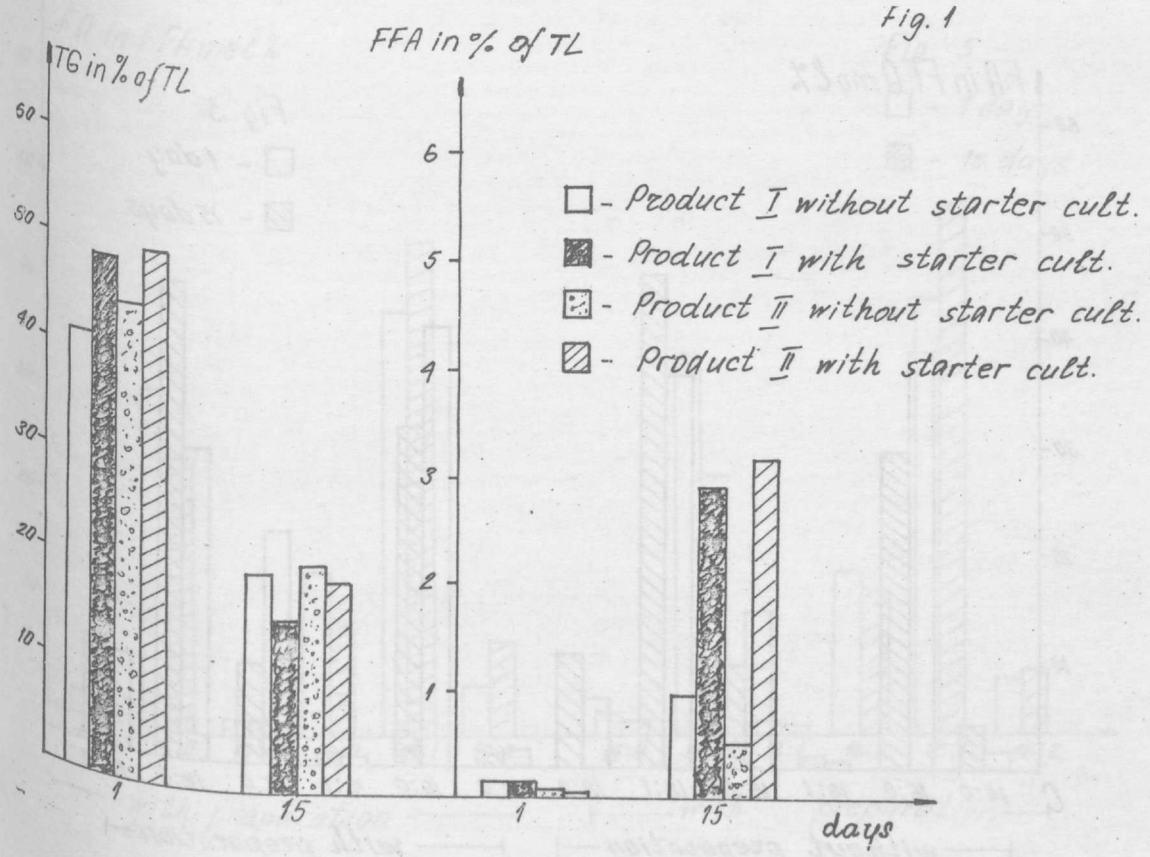
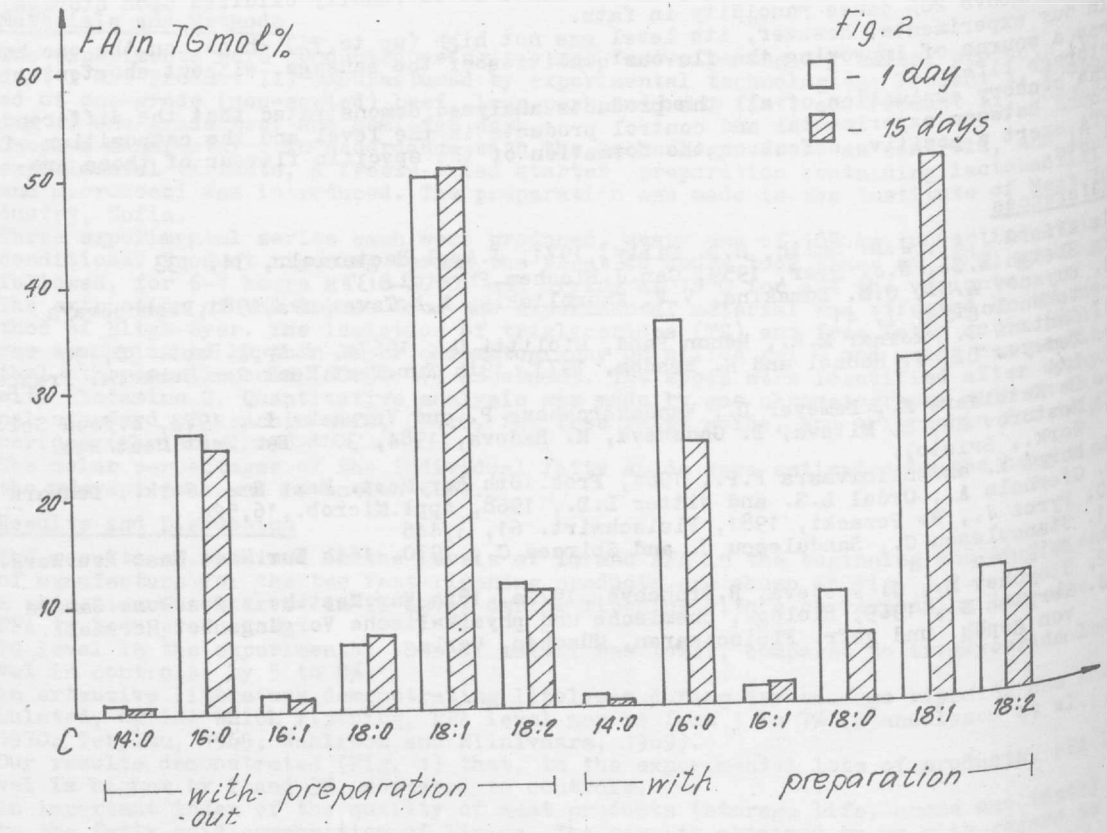
Fig. 1




FA in TG mol%
Fig. 2
- 1 day
- 15 days
60
50
40
30
20
10
C
14:0
16:0
16:1
18:0
18:1
18:2
14:0
16:0
16:1
18:0
18:1
18:2
without preparation
with preparation

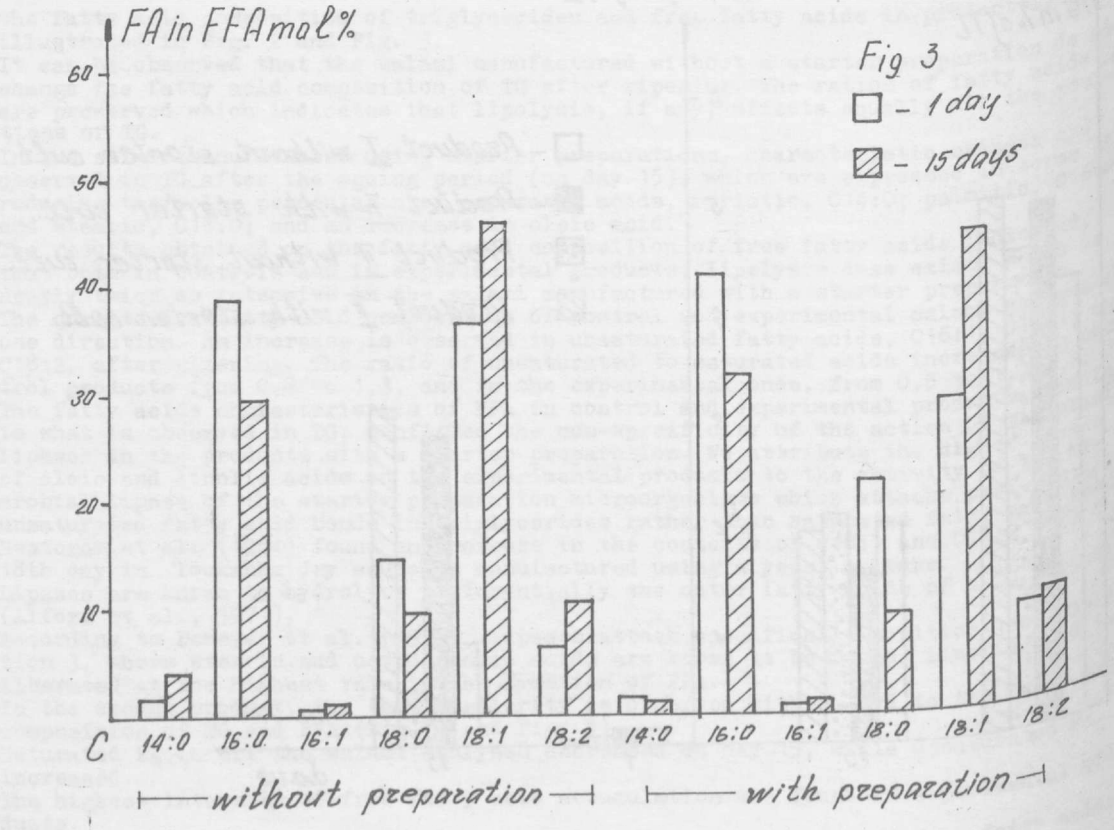

FA in FFA mol%
Fig 3
- 1 day
- 15 days
60
50
40
30
20
10
C
14:0
16:0
16:1
18:0
18:1
18:2
14:0
16:0
16:1
18:0
18:1
18:2
without preparation
with preparation

Fig. 4

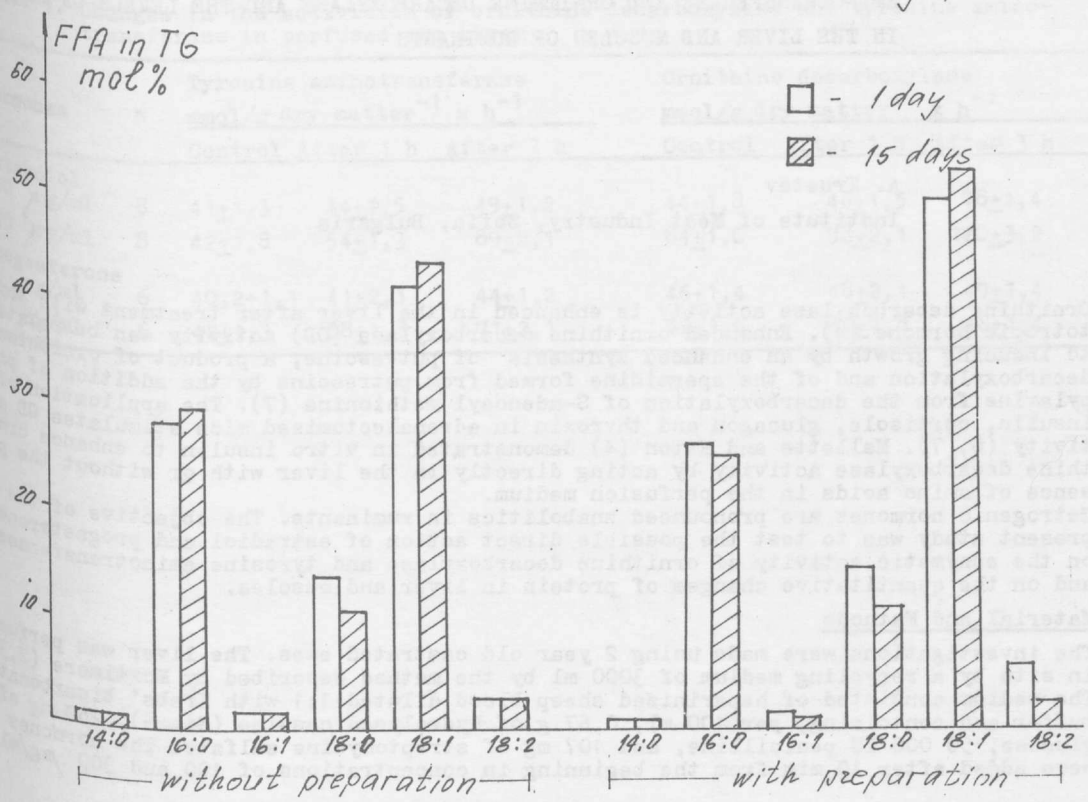
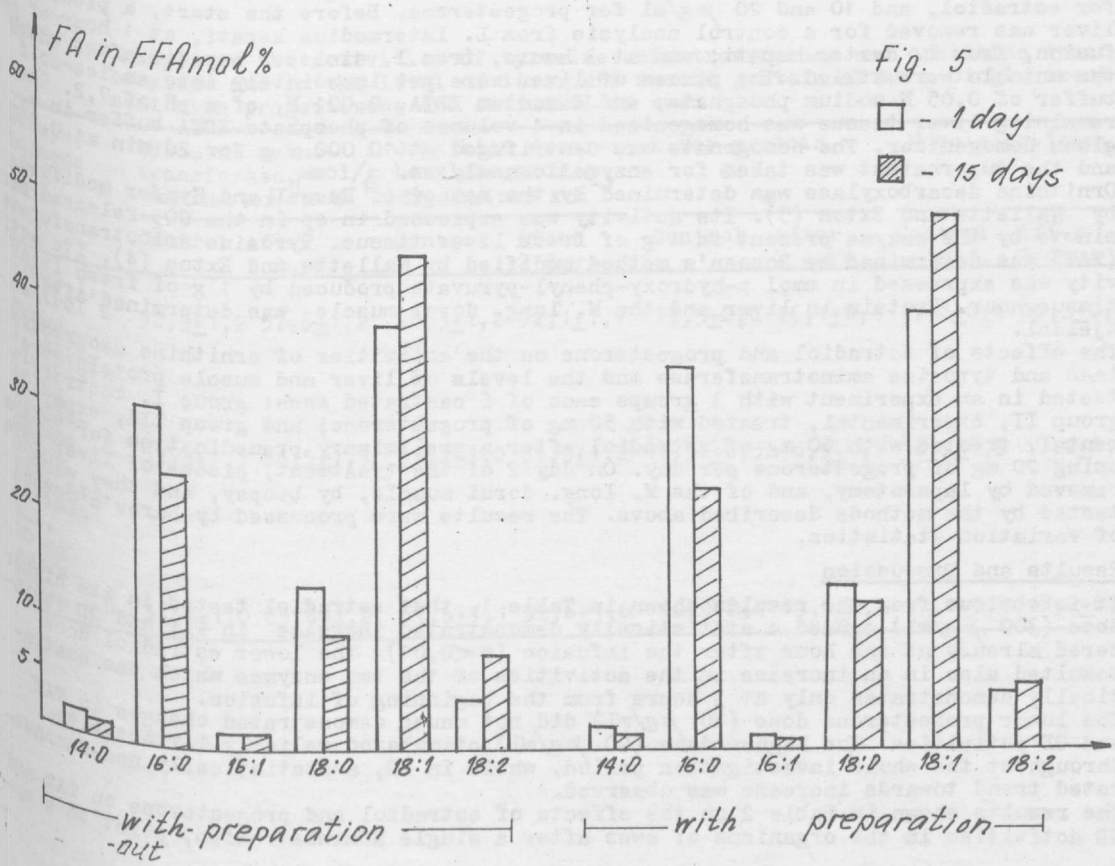

FFA in TG
mol%
60
50
40
30
20
10
□ - 1 day
▨ - 15 days
14:0
16:0
16:1
18:0
18:1
18:2
14:0
16:0
16:1
18:0
18:1
18:2
without preparation
with preparation

Fig. 5


FA in FFAmol%
60
50
40
30
20
10
5
□ - 1 day
▨ - 15 days
14:0
16:0
16:1
18:0
18:1
18:2
14:0
16:0
16:1
18:0
18:1
18:2
with-preparation
-out
with preparation