EFFECT OF MICROCOCCI AND LACTOBACILI ON THE PRODUCTION OF DRY SAUSAGES

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INTRODUCTION

The role of starter cultures in processing of fermented sausages is reflected in acceleration of the processes which normally develop under the influence of "natural" microflora. In addition, there are no departures as to the quality of the products, and the health of the consumers is not endgangered. So for instance, the starter cultures (mainly lactobacilli), producing the lactic acid, increase the shelf life of the sausages through direct prevention of the development of unwanted microflora. Indirectly, they influence faster smoking of meat, because it is well known that about pH 5 values this processes are accelerated. On the other hand cultures from the Micrococcaceae family rapidly decrease the nitrate and nitrite contents and contribute to improvement of colour and taste in addition, so that catalase activity is rather significant as well.

The objective of this work is to investigate the effect of lactobacili (Lactobacillus plantarum, Lactobacillus sake) which are mostly represented in the meat products (Schillinger and Lücke, 1987), together with micrococci, on the microbiological, organoleptic and physicochemical properties of ripened dry sausages which are mostly produced in Yugoslavia.

MATERIALS AND METHODS

The primary make-up of the sausages included: beef, category A - 40%; pork, category A - 30%; and bacon - 30%. In 100 kg sausage mix were added 2,8 kg of nitrite salts for curing, 0,15 kg of black pepper and 0,05 kg of garlic. In sausages without the starter there was added 0,8% mix of glucono-delta-lactone, ascorbic acid and dextrose. In the sausages produced with starter cultures 1% dextrose has been added.

Three different strains were used for production of sausages. These were: Lactobacillus plantarum Lb. 1000 (isolated from long ripened dry meat products), Lactobacillus sake Lb. 972 (from the collection of the Federal Meat Research Centre, Kulmbach), and Micrococcus M-104 which was used for investigation purposes before (Šutić and Joksimović, 1973). The lactobacilli were maintaned in MRS broth (De Man et al., 1960), while the micrococcus was maintaned in YDB broth (Naylor and Sharpe, 1958).

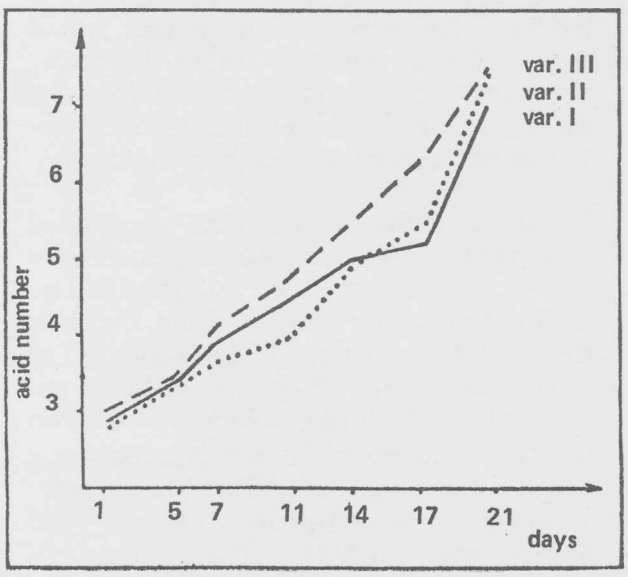
The sausages were produced in three different variants: the I standard variant with GDL additive, the II with Micrococcus M-104 and Lactobacillus sake Lb. 972 (1:2) variant, and the III with Micrococcus M-104 and Lactobacillus plantarum Lb. 100 (1:2) variant.

The plate count agar (PCA) was used to determine total aerobic bacterial count, while PCA with 10% NaCl was used for determination of micrococci. For determination of lactobacilli the MRS agar was anaerobically incubated 48 hours at 30° C.

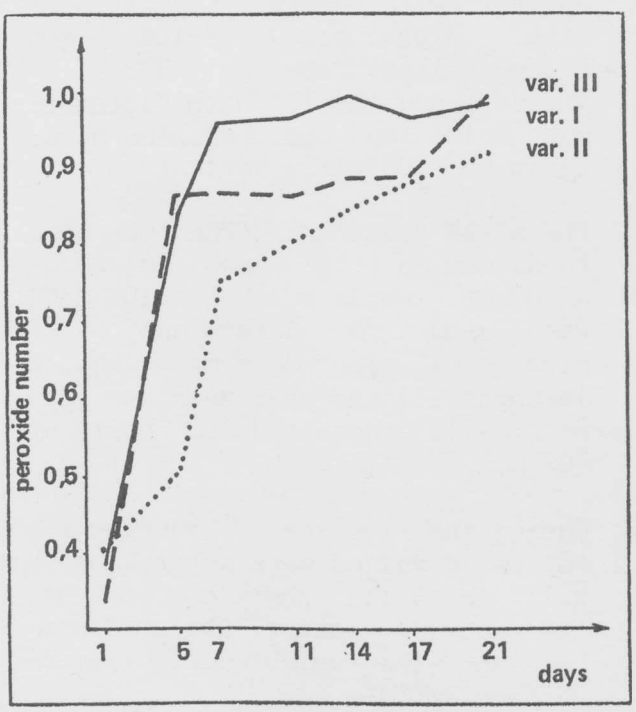
During the ripening of sausages the following values were determined as well: pH value, the water content, the peroxide number, the acid number and the weight loss (Karan-Đurđić, 1988).

The dry sausage samples of the bacteriological and chemical

variants (graph 7). During the ripening of sausage the peroxide number increased very slowly, and no significant differences between the sausage variants were noticed.



Graph 6: Changes of acid number during the ripening of sausages



Graph 7: Changes of peroxide number during the ripening of sausages

On the basis of the analysis of the average weight losses of sausages at the end of the ripening period, considerable differences between the examined sausage variants (table 1) can be noticed. Namely, the smallest weight loss was found with the variant III, and the biggest with the variant I. It appears that significant differences in the weight loss between the sausage variants were at the level of $p < 0.01$.

Table 1: Average weight losses of sausages at the end of the ripening in percents

Variants	Mean value	Standard deviation	Variation coefficient
I	40,44	1,56	3,85
II	36,60	1,70	4,64
III	38,06	4,08	10,72

The organoleptic evaluation data (Table 2) show that variant II sausages have been rated best.

Table 2: Average values of organoleptic evaluation test (point)

	Variants		
	I	II	III
Appearance	4,05	4,16	3,61
Appearance of composition and colour at the cut surface area	3,97	4,05	3,58
Taste	3,50	4,05	3,94
Aroma	3,89	4,16	4,00
Consistency	3,67	3,94	3,78

Namely, all the organoleptic properties of this variant have been rated higher than the sausages of the remaining two. Between the

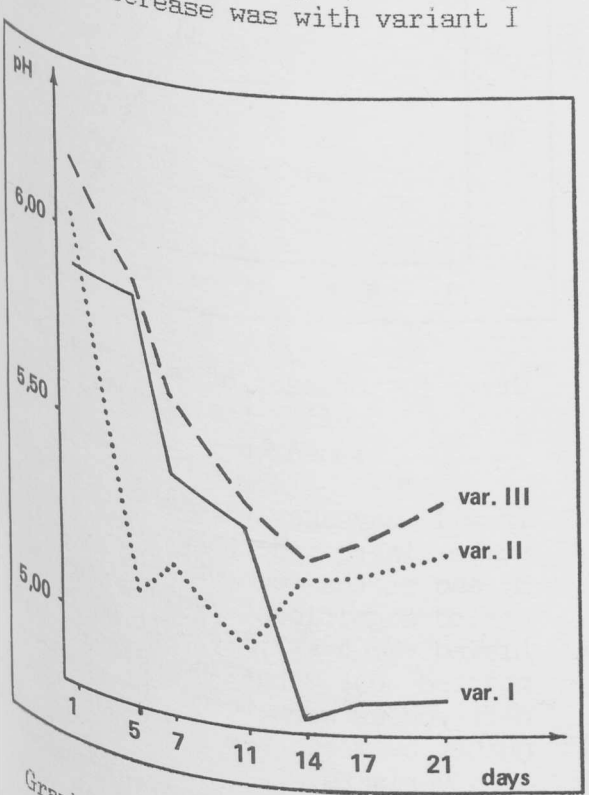
analyses were taken 5th, 7th, 11th, 14th, 18th and 21th day of the ripening process.
For all variants at the end of the ripening the weight losses mean values were determined, and also the standard deviation and the coefficient of variation. The significance of differences in the mean values were determined using student t-test.

The organoleptic evaluation of the finished products was conducted by a nine-member board. The point rating system ranging from 1 to 5 points was applied. This evaluation included the appearance, appearance of composition and colour at the cut surface area, taste, aroma and consistency.

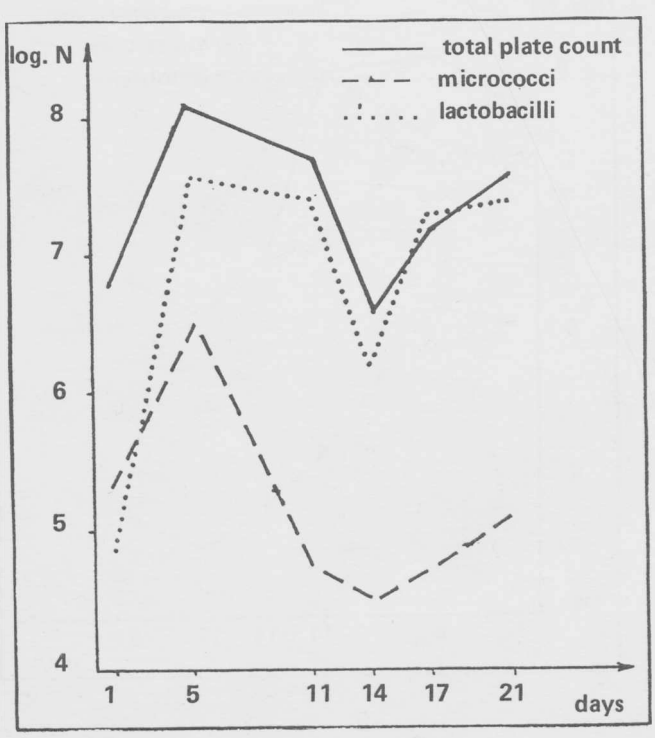
RESULTS

On the basis of the data on changes of pH values (Graph 1) some differences between the examined sausages are noticed. Namely, the fastest decrease of pH value appeared with the variant II sausages, somewhat slower decrease was with variant I (without added starter cultures), while the slowest decrease occurred with variant III.

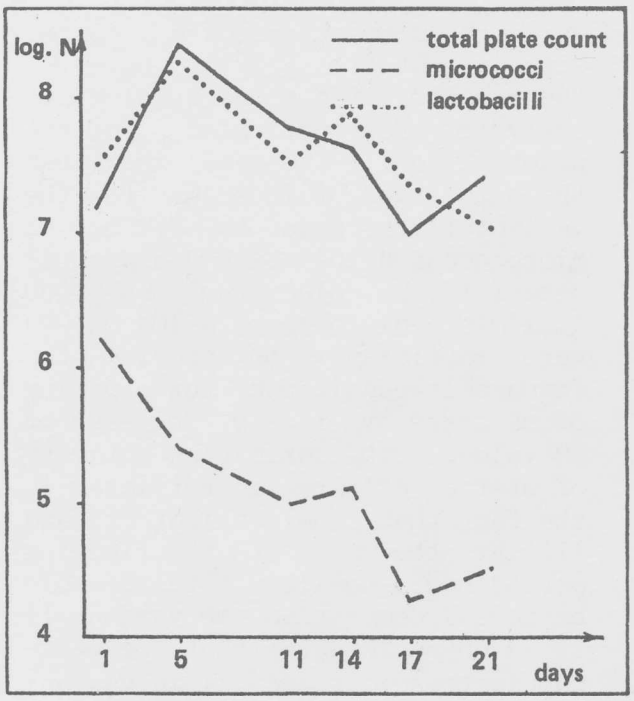
The results of the bacteriological analyses are presented on the graphs 2 to 4. The data show that the quantities of inoculum for the variant II (L. sake Lb. 972 $5x10^9$, Micrococcus M-104 $6x10^8$) and variant III (L. plantarum Lb. 1000 $1,2x10^{10}$, Micrococcus M-104 $6x10^8$) were sufficiant to provide the favourable conditions for ripening of sausages by timely decrease of pH values. The inhibiting activity of starter cultures is reflected in the fact that the variant II and III at the end of the ripening period had a smaller total aerobic bacterial count than the variant I. It is characteristic that the maximum lactobacilli count in variant II was achieved on the fifth day, and in variant III on the eleventh day. Also the biggest micrococci count in variant II was achieved



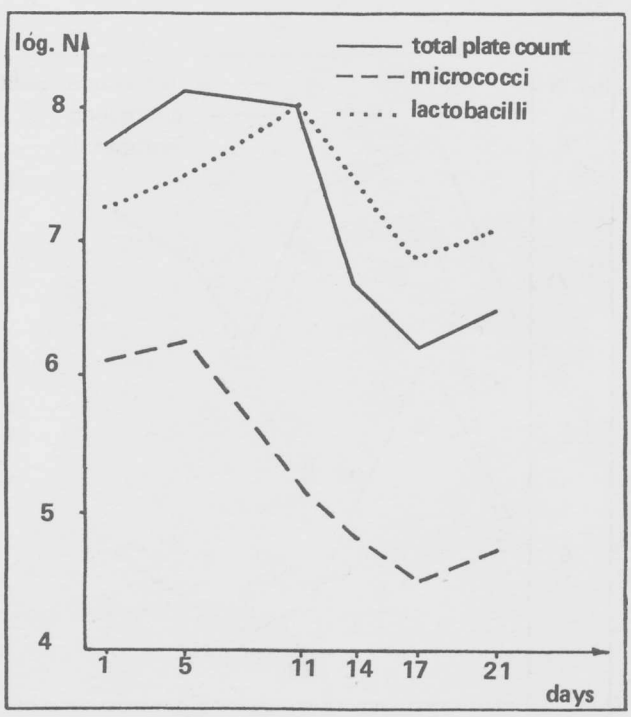
Graph. 1: Changes of pH during the ripening of sausages



Graph 2: Dynamics of total plate count, lactobacilli and micrococci during the ripening of var. I sausages

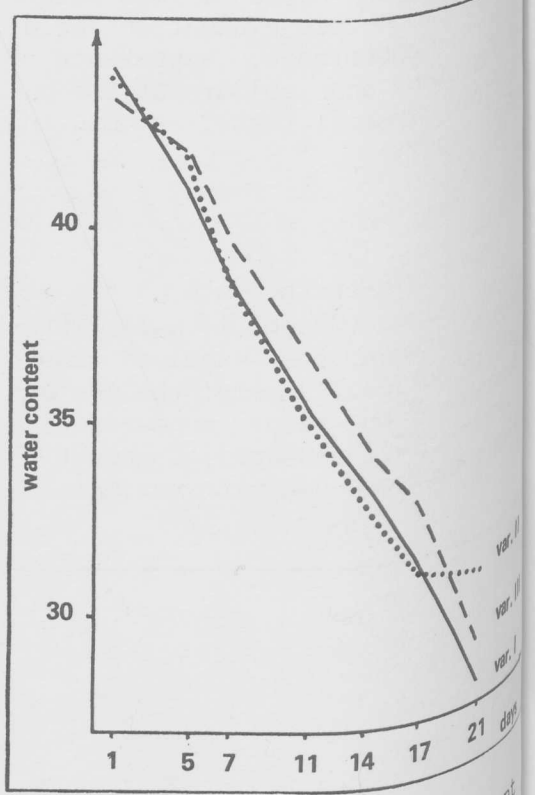


Graph 3: Dynamics of total plate count, lactobacilli and micrococci during the ripening of var. II sausages



Graph 4: Dynamics of total plate count, lactobacilli and micrococci during the ripening of var. III sausages

on the first ripening day, and i
variant III on the fifth day. This
can be explained by rapid decrease
of pH value by L. sake Lb. 6
strain.
The results obtained after the ana
lysis of the water content (graph
5) showed that the variant II sau
sages had the biggest water conten
at the end of the ripening period
that it was somewhat lower with
variant III and the lowest with the
variant I.



Graph 5: Changes of water content during the ripening of sausages

In all sausage variants the acid
number increased rather fast (graph
6) and at the end of the ripening
period significant values were ac
hieved (7,05 - 7,57). It should be
pointed out that no significant
differences were found in the acid
number between the individual sau
sage variants.
The values of the peroxide number
were approximately same and very
small at the begining of the inve
stigation with all the sausage

variants I and III certain differences in organoleptic properties have been found. To be precise, the taste, aroma and consistency of the variant III have received higher points, while the appearance and the appearance of composition and colour at the cut surface area have received lower points.

CONCLUSION

From the following results it can be concluded that the use of mixed culture (lactobacilli and micrococci) can be successfully applied for the production of dry sausages most widely produced in Yugoslavia. In this way better organoleptic properties are obtained in sausages with starter cultures, and the weight loss of sausages is somewhat lower than with sausages without the starter culture added.

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