

Examination of the Influence of Additives Mixtures From the Group of Weak Organic Acids with Common Salt on the Prolongation of Shelf Life of Ground Young beef

P.MODIĆ, LJUBICA BASTIĆ, RADMILA ŽIVANOVIĆ, V. MILOŠEVSKI

Yugoslav institute of meat technology - Beograd, Yugoslavia

Introduction

The prolongation of shelf life of portioned meat (ground and in pieces) can besides cooling be influenced also by the addition of common salt and certain additives, the significant ones among them being nitrites and weak organic acids, namely their salts. Common salt and nitrites are usually applied in the preparation of meat products whereas weak organic acids or their salts are less applied in practice. The majority of these additives act as buffers and by regulating the pH value they influence retardation or prevention of the growth of particular microorganisms. The Committee for Additives (1) classifies them as completely harmless constituents (GRAS), without any toxicological limitations. Yugoslav regulations(2) prescribe that ground packed meat, under defined conditions, can be stored in trade up to 72 hours. Our experimental and practical experiences indicate that spoilage of ground packed meat, dependent on the conditions of its storage in trade, usually appears already four days after production. This represents a special problem which prevents development of industrial production of ground meat and meat products being marketed in cooled state.

Having in mind such situation as well as the results of our previous examinations (3, 4), we set the task to examine the influence of adding the mixtures of certain additives belonging to the group of weak organic acids with common salt on the prolongation of shelf life of ground young beef.

Materials and methods

Cooled, namely thawed young beef, with different (lower or higher) initial bacterial contamination, was used as raw material for these examinations. Meat was comminuted in usual way in the grinder through 12 and 4 mm plates and then divided into experimental groups to which one of the mixtures, prepared from usual relations of common salt and one (M<sub>1</sub>), two (M<sub>2</sub>), namely three (M<sub>3</sub>) weak organic acids or their salts, were added. Control groups (K) consisted of ground young beef of the same origin to which the above mentioned mixtures were not added. Proportions of common salt and additives in the mixtures were determined on the basis of the results of our previous examinations in which the efficiency of each of the used components, regarding both the retardation of bacteria growth and the sensory properties of meat and products prepared thereof, was checked. After the addition of mixtures, meat from experimental and control groups was packed by being placed in polystyrene foodtainers and covered with thermoshrinkable polyethylene films. All experimental and control groups were then stored in the frigidaire at 5°C (+1°C) till the appearance of spoilage (odour change), namely for 10 days maximum.

The examinations performed each day covered determination of the total count of aerobic bacteria, specially those from Lactobacillus genus, then evaluation of sensory properties of meat (odour, taste, colour), measurement of pH value and measurement of mass losses by grilling meat on an electrical grill. The total aerobic bacteria count was determined according to our officially prescribed method (5) whereas the count of bacteria from Lactobacillus genus was determined by isolation on the Rogosa-agar selective medium (6). Sensory properties were determined in raw meat and in grilled meat whereas the pH value was determined by an pH-meter with glass electrode (Iskra - Kranj).

## Results and discussion

The results of the total aerobic bacteria count and of the count of bacteria from *Lactobacillus* genus, namely shelf life of experimental and control groups of ground young beef, are presented in Figures 1 and 2.

In control samples prepared from cooled meat, the number of aerobic bacteria increases suddenly already after 1 day, whereas in samples prepared from thawed meat the sudden increase appears at the beginning of refrigeration. Spoilage of control samples of cooled meat, along with a marked change of odour, appears on the fourth day, the samples being considered unsound already on the third day. In thawed meat samples, spoilage is observed on the third day and unsoundness (10) already on the second day of refrigeration. The increase of the number of bacteria from *Lactobacillus* genus is slight in relation to the increase of other aerobic bacteria.

In experimental samples in which mixtures of additives with common salt were used, reversed situation takes place. The increase of aerobic bacteria count is considerably retarded (practically stopped) till the fifth day in ground cooled meat, namely till the fourth day in thawed meat. Afterwards, a relatively sudden increase of total bacteria count occurs, whereby the increase of the count of bacteria from *Lactobacillus* genus is particularly expressed and already after 5 days they predominate. Dependent on the applied mixture, spoilage of meat along with a slight change of odour appears in cooled meat after 10 days and unsoundness (10) after 7 days of refrigeration. In thawed meat, spoilage is observed after 8 days and unsoundness (10) after 6 days of refrigeration.

Comparing the obtained results, it can be said that the established differences in shelf life between experimental and control samples are very high, more than doubled. In addition, considerable differences were established in the intensity of unpleasant odour of raw meat, whereas in experimental samples prepared from cooled meat it was not expressive even after 10-day refrigeration. Among the used mixtures, the best results were shown by the mixture  $M_3$  prepared with definite quantities of NaCl, sodium acetate, citric acid and ascorbic acid.

The examination results of total aerobic bacteria count, namely shelf life of experimental (with the mixture  $M_3$ ) and control groups of cooled young beef, are presented in Figure 3. Obviously, the initial bacteria count plays a very significant role in the shelf life of ground young beef, regardless of whether the additive mixture  $M_3$  was used or not. However, differences in shelf life between experimental and control groups of the same initial contamination are also very high. Without regard to the initial contamination, the addition of the additive mixture prolonged by more than twice the shelf life of ground young beef. The change of odour in experimental groups was slight (changed to sourish), whereas in control groups it was very intensive (stench).

Changes of pH value and average mass losses of experimental and control groups of cooled and thawed meat, after grilling, are presented in Table 1.

In control samples, pH value increased considerably from day to day, whereas in some experimental samples certain decrease of pH was observed already 2 hours after the addition of the mixture, remaining practically unchanged in the course of further refrigeration. Average losses of liquid (meat juice) and fat, after grilling were higher in experimental groups in relation to control ones, what is the result of somewhat lower pH value of meat.

The results of sensory evaluation (odour, taste, colour) show that expressive change of odour and taste in control samples, along with the change of meat colour, appeared after refrigeration for 3 days (thawed), namely for 4 days (cooled). Contrary to that experimental samples even after 9, namely 10 days, did not show unpleasant but sourish taste and odour with a

slight change of fatty tissue taste. Products prepared from cooled meat of control groups, with usual addition of common salt and spices, had after grilling conditionally acceptable odour and taste which were not evaluated as unpleasant ones.

All the obtained results showed very favourable activity of the mixtures of additives with common salt on the prolongation of shelf life of ground young beef as well as on sensory properties of meat. Specially favourable effects were obtained by the application of the mixture M<sub>3</sub> to cooled meat, whereby shelf life was also dependent on the initial bacterial contamination. According to the results of our previous examinations (3, 4), there are considerable differences in the activity among individual components of the mixture, whereby some of them (e.g. citrates) showed expressively selective inhibitory activity on the growth of individual bacteria kinds and the others lower or slight activity. However, the activity of additives and common salt associated in the mixture is considerably stronger than the activity of each individual component, what is also confirmed by the literature data (7,8). The mentioned organic acids act as buffers in foodstuffs, regulating the pH value during production and storage of finished products, along with an expressive effect on the colour stability.

In our opinion, the application of the mentioned mixtures of additives with common salt is justifiable in the production of ground meat as well as in the production of ground formed meat products, being put into trade in cooled state. The results indicate that shelf life of such meat and meat products will depend primarily on hygienic conditions of production, but regardless of the initial bacterial contamination it will be prolonged at least by twice. As additives used in the mixtures belong to completely harmless components, their application is justifiable from technological point of view as well as from the aspect of the protection of human health.

#### References

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5. Regulations on the Methods of Microbiological Analyses and Superanalyses of Foodstuffs, "Službeni list SFRJ" No.25/80;
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7. Handbook of Additives, CRC Press, 1972;
8. Science of Food, Pergamon Press, 1978;
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Comparative Review of Total Aerobic Bacteria Count in 1 g. of Cooled Ground Young Beef Samples with Different Initial Contamination, with and without the Addition of the Mixture M<sub>3</sub>, at 5°C.

Log. of bacteria count in 1 g

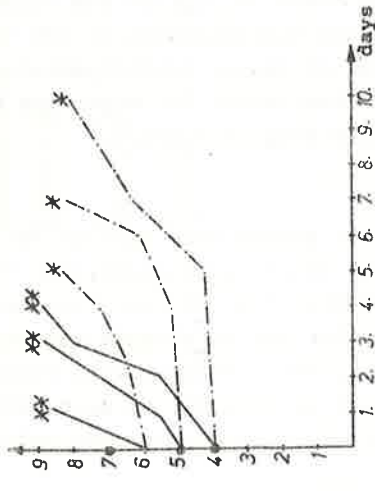


Fig. 3.

— control samples  
 - - - experimental samples with the mixture M<sub>3</sub>  
 \* slight (\*) and expressive (\*\*) changes of odour

Changes of pH Value and Average Mass Losses in Ground Young Beef of Experimental and Control Samples Kept at 5°C (±1°C)

Table 1

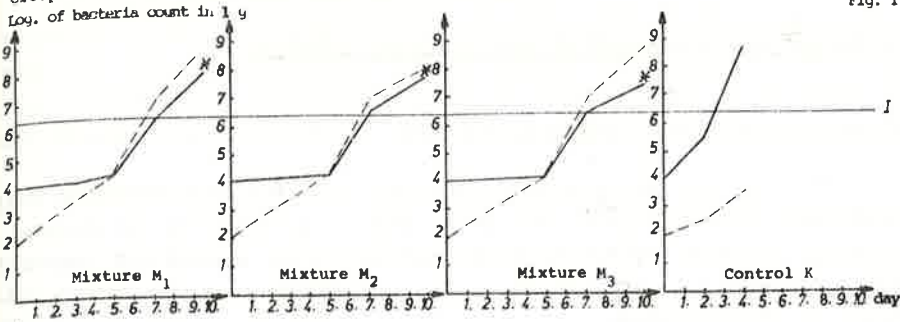
Series examined	pH value of meat after (days)									Mass losses(%)
	In.	1	3	5	7	9	9	9	9	
<b>Cooled meat</b>										
K	5.60	5.70	5.00	6.20*	-	-	-	-	-	36.82
M <sub>1</sub>	5.60	5.60	5.80	5.90	5.90	5.95	5.95	5.95	5.95	37.56
M <sub>2</sub>	5.60	5.60	5.80	5.85	5.90	5.95	5.95	5.95	5.95	37.39
M <sub>3</sub>	5.60	5.55	5.75	5.80	5.80	5.85	5.85	5.85	5.85	37.88
<b>Thawed meat</b>										
K	5.95	6.10	6.30*	-	-	-	-	-	-	38.07
M <sub>1</sub>	5.95	5.85	6.0	6.0	6.10	-	-	-	-	38.71
M <sub>2</sub>	5.95	5.85	6.0	6.0	6.10	-	-	-	-	39.36
M <sub>3</sub>	5.95	5.80	5.95	6.0	6.0	6.10	6.10	6.10	6.10	39.83

\*spillage of meat with intensive odour change

- not examined

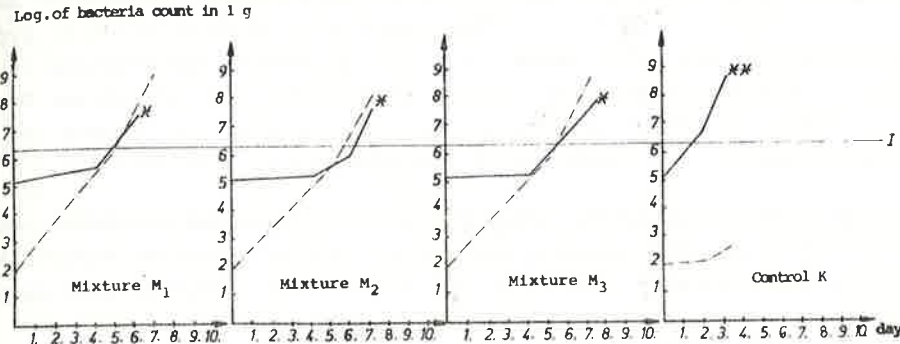
Results of Bacteriological Examination of Experimental and Control Groups of Cooled Ground Young Beef kept at 5°C (±1°C)

Fig. 1



Results of Bacteriological Examination of Experimental and Control Groups of Thawed Ground Young Beef kept at 5°C (±1°C)

Fig. 2



— bacteria from Lactobacillus genus  
 - - - other aerobic bacteria groups  
 I — According to Yugoslav Regulations (11), ground meat with higher contamination than the stated one is considered unound and shall not be put into trade.