CONTRIBUTION TO INVESTIGATION OF INDICES OF FRESH PORK QUALITY

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The literature offers a number of data on methods of proving the soundness of meat /7, 12, 13, 14, 18, 22, 23, 24, 25, 26, 27, 29/, but at the same time a number of controversies on the validity of particular methods may be found. Thus Požariskaja et al. /22/ attribute great importance to chemical and organoleptical findings. For the appreciation of the meat soundness, they propose the determinations of ammonia nitrogen, volatile acids and the reaction with copper sulphate. Cox and Pearson /6/ recommend the determination of volatile bases for the appreciation of the soundness of fish and lean meat. The same authors consider that the peroxide number and acid value may serve as indicators of meat spoilage. Klima /18/ offers the appreciation of the soundness of meat on the ground of ammonia content. Živković et al. /28/ having compared several methods of ammonia determination, have come to the conclusion that the meat spoilage cannot be evaluated in this way. The literature offers very little data on components which influence directly the taste and smell of meat. Nakano et al. /21/, using the paper chromatography, have determined the presence of acetic and butyric acids. In spoiled meat, the same authors have proved, beside the above acids, the presence of caproic, fumaric, valerianic and caprylic acids and by the size of spots, they stated that the acetic and caproic acids are prevailing.

Contrary to the quoted authors, Rubaskina /24/, Broumand et al. /3/ consider that there is a weak congruence between the organoleptical findings and physicochemical indices of pork quality.

In the literature there are chemical indices determining the quality of animal fats and their relation to the organoleptical examination /19, 26/, but the data relating to the appreciation of the soundness of the fatty tissue are very deficient.

Relevant to the significance of particular bacteria in giving rise to undesirable changes of refrigerated meat, there are abundant data in the literature. Haines /15/ considers that in the psychrophilic flora, the greatest part is taken by bacteria of Achromobacter group and next to them some species of Pseudomonas and Proteus. Jensen /16/, Ayres /1/, Wolin, Evans and Niven /28/ quote Pseudomonas as the most frequent species of bacteria. By Empey and Wichery /10/ the highest percentage of bacteria found in refrigerated meat cover the Achromobacter and significantly lower Pseudomonas and Micrococcus. Empey and Scott /9/ suppose that the four bacterial species are the most significant for the phenomenon of slimy meat and this in the following relation: Achromobacter - 90 per cent, Micrococcus 7 per cent, Flavobacter 3 per cent and Pseudomonas less than 1 per cent. Buttiaux, Catsaras /5/ refer that Achromobacter and Pseudomonas are the most frequent microorganisms in refrigerated meat while Athrobacter is less frequent.

The aim of our work has been to examine simultaneously several chemical indices of fresh pork quality and by comparison with the results of organoleptical examination to try to find marginal values for the wholesome, suspected or spoiled meat. By means of bacteriological investigation, we wished to examine whether the total number of bacteria, the number of lipolytic and proteolytic ones could be brought into correlation with the above said phases of meat spoilage.

METHODS

Choice of raw material and storage conditions.- Pork loin, boston butt and belly fatty tissue of white meat hogs /7 to 8 months old, weighing 90 kg to 110 kg/ were used for investigation. In the first case, warm meat cuts with adhering bones and fatty tissue were hanged in the cooling room at $4^{o}C$ and relative humidity of 86 - 88 per cent. In the second case, mentioned meat cuts were boned immediately after slaughter and cut into pieces weighing 500 g and kept in the refrigerator at 8 - $9^{o}C$ and relative humidity of 96 - 98 per cent.

Sampling. - In case of storage at 4°C, tests were undertaken after 2, 5, 8, 11, 14, 15, 16 and 17 days and in case of storage at 8 - 9°C after 2, 5, 7 and 8 days. Bacteriological sample of each meat cut weighed 10 to 15 grammes and it was taken from the same region as the sample for chemical and organoleptical examination.

Bacteriological tests. - Total bacteria count was examined by Koch method on 3% blood agar. Staphylococci were tested on Baird-Parker medium: Salmonellae - on tetrationate broth, on Brilliant dreen and desoxicholate agar; sulphite reducing Clostridia - on Wilson-Blair medium; coliform bacteria - on brilliant dreen agar; lactic acid bacteria - on De Man Rogosa and Sharpe medium and yeasts - on Sabourd medium. Lipolytic bacteria were examined on the tributyrin agar, and the isolated hemolytic bacteria from the blood agar were considered as proteolitic.

Plated nutritive media were held at 15°C for 24, 48 and 72 hours and Sabourd agar at room temperature for 5 days.

Chemical tests. - Meat cuts for determination of nitrogen components were good trimmed.

Free ammonia was detected by dye reaction with thymol and bromine at 475 and 682 mmk / 4 /; amino nitroden - ninhydrine reaction at 520 mmk /143 ; amino ammonia nitrogen - formol titration /22/; total volatile ammonia - vacuum distallation from weak basic medium, at 60° C /2/; volatile bases - water vapour distillation /6/; asid value and peroxide number - titration of cold chloroform extract; TBA - dye reaction at 535 mmk; iodine value - Hanush method; pH - in water exctract /1:4/ with glass and calomel electrode; glycogen - anthrone dye reaction at 620 mmk /19/. Volatile fatty acids were detected by distillation in presence of sulphuric acid /22/. Sodium salts of fatty acids, after evaporation, were treated with the excels of the trichloroacetic acid in acetone. Separated fatty acids were injected into the gas chromatograph; stationary phase was 3,15% PEGA on chromosorb /60 - 80 mesh/. Column length was 5" and diameter 1/4". Gas velosity was 30 ml/min /16/.

Organoleptic evaluation.- Appearance and odour of fresh meat, odour of vapors as well as odour and taste of the sample prepared by cooking.

EXAMINATION RESULTS AND DISCUSSION

The results of chemical and physicochemical examinations are shown in the Figures 1, 2 and 3 and Table and of the bacteriological ones in the Figures 4 and 5.

Chemical examinations

It is imortant to point out that results of organoleptic examinations are in relation to contents of free and volatile ammonia, volatile bases and volatile acids.

Observing the quantity of the free ammonia at both examined temperatures, it was stated /Fig. 1 and 2/ that no udesirable organoleptic changes of pork loin and boston butt were registered in presence of free ammonia up to 5 mg%. In cases of free ammonia content from 5 to 6 mg%, the meat did not show any conspicious signs of spoilage, that is it was suspected, while in all cases where the quantity of free ammonia was higher than 6 mg%, both in the boston butt and pork loin, characteristic spoilage was recorded.

It is interesting to mention that after the second day at 4°C, respectively on the fifth day at 8 to 9°C a lowering of the ammonia content was noticed, as it can be seen from the figure. The explanation can be found according to Golovkin et al. /13/ that during the rigor mortis significant structural changes take place in the contractile proteins which provoke the lowering of side groups of aminoacids.

The results of the examination of the content of volatile ammonia /Fig. 1 and 2/ show that with the content of this component up to 25 mg%, no undesirable organoleptic changes were recorded. These quantities are a little greater in the literature of the above quoted /18/. With the content of volatile ammonia between 25 and 35 mg%, the samples were evaluated as suspected, while in all cases of organoleptically stated spoilage, its content was higher than 35 mg%. That is in accordance with the data in the literature /18/.

On the basis of the given Figure of the changes of the volatile bases content /Fig. 1 and 2/, up to 30 mg%, no changes

were recorded organoleptically. When the value of this index varied between 30 to 37 mg%, the meat was of suspected quality, while in the case of organoleptically stated spoilage the quantities were higher than 37 mg%.

Changes in volatile fatty acid content, demonstrated in the same figures, show good concordance with the organoleptical examination. The content of these acids is expressed in the quantity of the acetic acid, because the results of the chromatographyc examination showed that its participation was the greatest. Up to the quantity of 28 mg% of these acids, the samples were organoleptically wholesome, and in the interval of 28 to 40 mg%, suspect was expressed; in the cases of sample spoilage, the quantities of these acids were higher than 40 mg%.

On purpose to determine the volatile fatty acids which participate in the aroma of suspected and spoiled meat, the gas chromatographic analysis was carried out. In the suspected meat, acetic acid and traces of butyric acid were identified and in the spoiled meat - acetic, propionic and butyric acids. In the case, the component being in the highest quantity was acetic acid.

The results of the examination of the amino nitrogen and aminoammonia nitrogen in comparison with organoleptic findings were fairly variable. However, it can still be stated that in the wholesome meat, the quantity of amino nitrogen amounts up to 70 mg%, and the quantity of amino ammonia nitrogen up to 85mg%; in organoleptically suspected meat the content of amino nitrogen varied between 70 and 150 mg%, and of amino ammonia nitrogen between 85 and 110%. The samples, in which the spoilage was recorded organoleptically, had more than 150 mg% of amino nitrogen, respectively 110 mg% of amino ammonia nitrogen.

With respect to the concordance of the results of organoleptic findings and hydrolitic changes of the fatty tissue of the examined samples of the pork loin and the boston butt, conspicious variations were observed. The acid value of the samples, stored at both temperature conditions and organoleptically evaluated as spoiled, was found to be as high as 7 to 8. Oxidative changes were insignificant in these samples.

In samples of the fatty tissue of the belly, which were stored only at 4°C up to 40 days, although no expressive regularity was observed between organoleptic findings and chemical indices, limits for organoleptically wholesome, suspected and spoiled meat can still be drawn /Table/.

Chemical Indices for the Quality of the Fatty Tissue of the Belly

Organoleptically	Peroxide number	Acid value	TBA
Wholesome	up to 2.5	up to o.8	up to o.4
Suspected	2.5 - 4.o	o.8 - 4.o	o.4 - 1.1
Spoiled	over 4	over 4	over 1.1

The iodine number was shown to be a weak objective index in the examination both of the pork loin and the boston butt because of the lack of any regularity between its values and organoleptic findings.

P h y s i c o c h e m i c a l e x a m i n a t i o n s

Fig. 3 shows the changes in pH and glycogen content in the boston butt and pork loin during the storage at 8 to 9°C. As it can be seen in the Figure, the pH is constantly higher in the boston butt than in the pork loin. The glycogen content is higher in the pork loin samples. This is fully in concordance with organoleptical findings - the spoilage appeared in the boston butt samples always earlier than in those of the pork loin.

In the examination of the free and volatile ammonia, volatile bases and acids, the pork loin samples showed always lower values in relation to those of the boston butt, because, as we have seen, the pork loin - in relation to the boston butt - had lower pH and greater quantity of glycogen.

B a c t e r i o l o g i c a l e x a m i n a t i o n s

In tested samples, no Staphylococci, Salmonellae and Clostridia were found. It is in concordance with the literature

data /8/. Coli bacteria, lactic acid bacteria and yeasts were present all over the examinations but in the changable count. Strains of lipolytic and proteolytic flora of examined cooled meat were not determined because attention was paid to their biochemical activity in meat.

As it is shown in Figure 4, total bacteria count was in constant increase all over the examination. The increase of the total bacteria count is followed by increase of lipolytic and proteolytic species which curves are almost parallel with the total bacteria curve. At the beginning, both in the pork loin and boston butt, lipolytic bacteria count was somewhat higher than the proteolytic bacteria one. In the boston butt, such relation was maintained at the end of the examination as well but in the pork loin that relation was changed on behalf of proteolytic species.

Fig. 5. show that initial contamination of the raw material was somewhat higher in samples stored at 8 to 9°C. The total number of bacteria in these samples is increasing much faster, as it might hade been expected. Proteolytic bacteria grow rapidly simultanously with the total number of bacteria in pork loin samples, while the number of lipolytic bacteria are in gradual increase.

By comparison of results shown in Figures 4 and 5, the difference in the rate of the bacteria growth in the same time intervals is observed. Those changes stress the importance of temperature conditions during storage what confirm results from the literature. Only the increase of the bacteria count in the samples kept at 8 - 9°C was initiated too rapidly in comparison with literature data /1, 11, 26/. In the samples kept at 4°C, sliminess was detected after 14 days - total bacteria count being 10^{11}; the same changes were registered in the samples stored at 8°C after 5 days - total bacteria count being 10^{14}.

x

x x

Based on experimental results the following conclusions may be drawn cut:

1. The most reliable indices of fresh meat quality were free and volatile ammonia contents and contents of volatile bases and acids.

2.The volatile fatty acids play important part in evaluation of fresh meat quality. The spoiled meat is characterised by higher contents of acetic, propionic and byturic acids.

3.There is interdependance of total bacteria count, counts of lypolitic and proteolytic bacteria and the incidence of spoilage. The determination of bacteria would surely bring more light into the clarification of these problems.

LITERATURE

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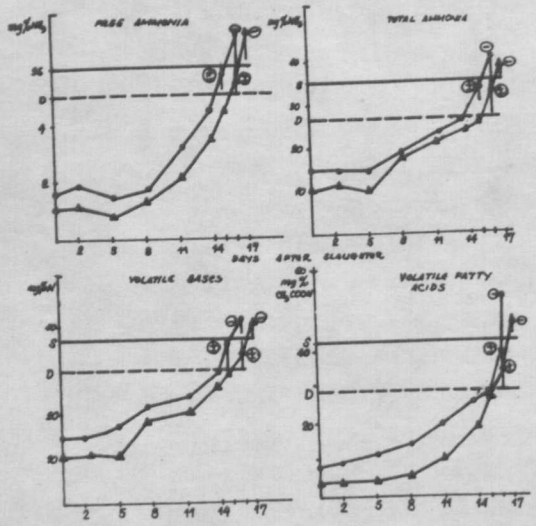
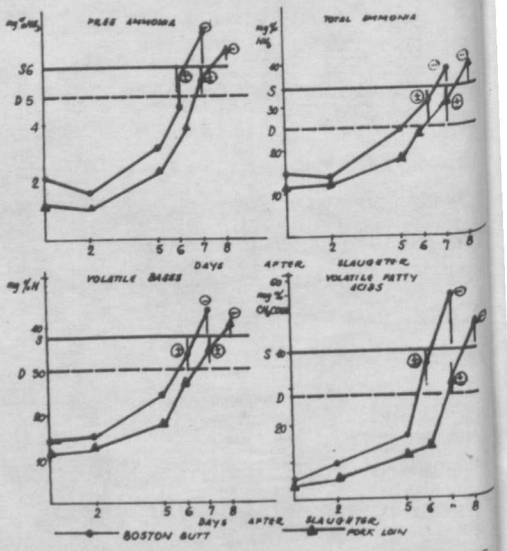


D ± SUSPECTED MEAT | MAXIMUM DEVIATION FROM MEAN VALUE
S, –, SPOILED MEAT

FIG. 1. CHANGES OF SOME CHEMICAL COMPONENTS IN PORK DURING STORAGE AT 4°C.



D ± SUSPECTED MEAT | MAXIMUM DEVIATION FROM MEAN VALUE
S, –, SPOILED MEAT

FIG. 2. CHANGES OF SOME CHEMICAL COMPONENTS IN PORK DURING STORAGE AT 8÷9 °C

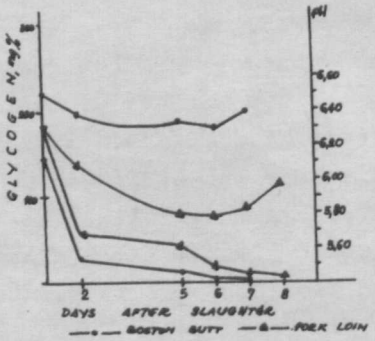


FIG. 3. CHANGES OF GLYCOGEN AND pH IN PORK CUTS AT 8÷9 °C.

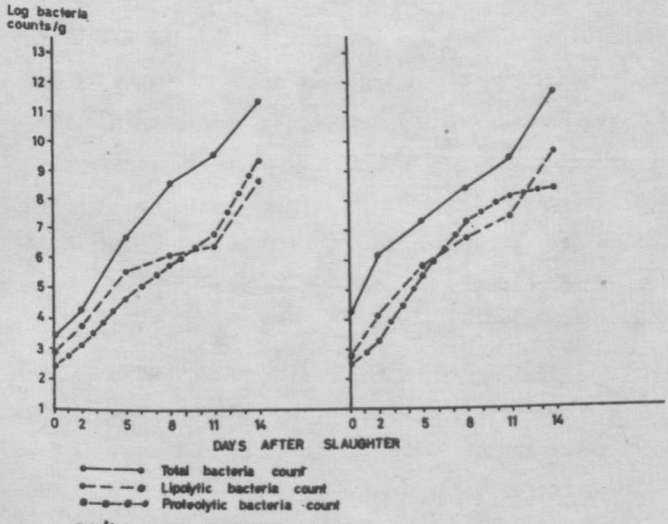


FIG. 4: CHANGES OF BACTERIA COUNT IN SAMPLES AT + 4 °C

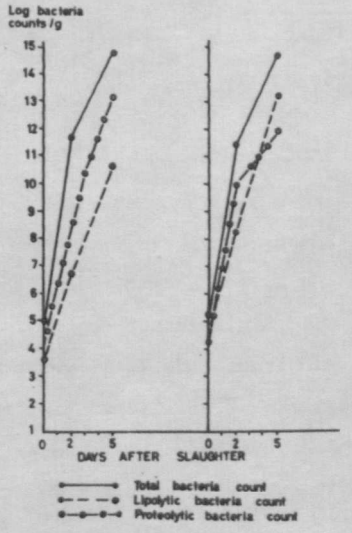


FIG. 5. CHANGES OF BACTERIA COUNT IN SAMPLES AT + 8 °C