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A STUDY OF THE STRUCTURAL-MECHANICAL PROPERTIES OF PORK TREATED WITH GAMMA RAYS AND PHOSPHORORGANIC PESTICIDES

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SUMMARY

We have studied the changes of the structural-mechanical properties (elasticity, structural strength and plastic strength) of pork from animals which have been exposed to combined treatment with 1 Gy radiation and acute poisoning with 250 mg of the phosphororganic pesticide AGRIA 1050 per 1 kg live weight. Comparisons are made with the structural-mechanical properties of meat from healthy animals, and from animals radiated only with 1 Gy.
Two muscles were studied: *m. Longissimus dorsi* and *m. Quadriceps femoris*. The studies included a period of 120 hours of cold storage of the meat at $+4\ ^{o}C$ post mortem.
Increased elasticity was established in the meat from the experimental animal group throughout the whole period of observation. Higher structural and plastic strengths were found in the meat from the animals radiated with 1 Gy within the 6 - 120 hour period compared to the meat from healthy animals. Lower values for these two characteristics were observed in the meat from the swines exposed to combined treatment with 1 Gy and phosphororganic pesticide "AGRIA 1050".
The conclusion drawn is that the combined treatment of swines with 1Gy and phosphororganic pesticide causes increased hardness in pork meat expressed in higher elasticity and reduced structural and plastic strength.

BACKGROUND

Compared to other meats from warm-blooded abattoir animals, pork meat is distinguished for its specific structural-mechanical properties like better delicacy and tenderness, higher elasticity and lower structural and plastic strength. Because of these structural-mechanical characteristics pork is widely preferred by the consumer and is used to produce a range of meat products.
Until now, very little has been done to study the effect of some toxicological factors like acute poisoning with phosphororganic substances (POS) and radiation of animals with gamma-rays on the quality of meat. In most of these cases the meat does not contain radionuclides and POS, and from sanitary point of view is fit for consumption. The question that needs an answer is how to change meat's technological properties and what method of processing would be most appropriate for its utilization.

OBJECTIVE

The objective of the present work was to study the changes in the structural-mechanical properties of pork meat from animals exposed to the combined effect of 1 Gy radiation and acute poisoning with 250 mg of the POS AGRIA 1050 per 1 kg live weight.

MATERIALS AND METHODS

The swines used in our study were of a Big White-Landras cross-breed. The animals were weaned on the 30^{-th} day after birth and distributed into 3 groups, with 10 animals in each group. Group 1 was bred for another 30 days and the ahimals were then slaughtered. Their weat was used as a control sample Ko. Group 2 was radiated with 1 Gy on the 53^{-rd} day, on a gamma installation "ROKUS-M" (^{60}Co) with emissive power of 0.5 rad /s , and the animals were slaughtered on the 60^{-th} day. The meat from this group was used as a test sample radiated with gamma rays (Kgr). Group 3 was radiated with 1 Gy, like Group 2. On the 57^{-th} day of the experiment, the animals were poisoned with 250 mg/kg live weight of POS AGRIA 1050. The poison was administered into the animals stomachs by means of a stomach-tube. The animals were slaughtered on the 60^{-th} day of the experimental period, their meat was used as a test sample (P). Following the meat production from the carcasses of all groups, were prepared *m. Longissimus dorsi* and *m. Quadriceps femoris*. Each sample was cooled to $+4^{o}C$ and stored in paper /bags until 120h past mortem/.
At the 6^{-th}, 48^{-th}, 72^{-nd} and 120^{-th} hour the samples were temperated to $+20^{o}C$ and the structural-mechanical properties were determined by measuring the elasticity, the structural strenght and plastic strenght using the method of penetration (Ribender et al.,1949). The penetrometer used was OB-204 (Hungary). The data obtained were processed by mathematical and statistical metods (Georgieva at al., 1989).

RESULTS AND DISCUSION

Gamma rays and POS influenced the elasticity of pork (Fig. 1). The elasticity of the test sample P in the both tested muscles (*m. L.dorsi* and *m. Q.femoris*) was higher in the period 6 - 120 h post mortem compared to samples Kgr and Ko. By contrast, the samples Ko had the lowest elasticity while the medium position was taken by the samples Kgr. These results testify to possible changes in the muscle structure and more specifically to its hardening resulting from the radiation with 1 Gy and the poissoning with POS "AGRIA 1050".
The chenges thus estabiched for the elasticity of meat from gamma radiated and poissoned swines different from the changes observed in the structural-mechanical properties of lamb, produced under analogous experimental conditions (Dragoev et al., 1993). Therefore, we can infer that the specificity of animal speacies a significant impactt on meat elasticity.
The obtained results show that the changes in the structural (fig.2) and plastic strenght (Fig.3) of the pork samples are of similar pattern. All 6 samples showed certain increase in the levels of these parametes up to 24 h post mortem, followed by a tendency of steady decrease by 120 h. Our results are in unison with the data found for the changes in the structural and plastic strenght of lamb (Dragoev et al., 1993) and can be explained by the begining of the rigor mortis process.
Of greater interest is the fact that test samples P possess lower structurul and plastic strenght that both the control samples Ko and samples Kgr. The highest values for these two characteristics are found with the *m. L.dorsi* Kgr sample.
We established greater pressure shear resistance (expressed in terms of structural and plastic strenght) for the three *m. L.dorsi* samples as compared to the *m. Q.femoris*.
We can, therefore, draw the conclusion that the comained effect of 1 Gy radiation and POS poisoning of swines leads to hardening of meat, while gamma radiation alone reduced the strenght of the muscular struture.
These changes are probably due to sarcoplasm concentration in the cells of the test animals (group P) and the radiolytic process of water in progress in the muscular tissue of the radiated animals.

Since in most cases the structural and plastic strenght of one and the same muscle sample for group P and Ko are statistically insignificant ($p < 0.05$), we can allow for the statement that the acute POS poisoning the swines has an inversely proportional effect on the changes in the structural-mechanical properties of meat compared to the 1 Gy gamma radiation. As a result there is an effect of mutual comparision of the effect of both factors as far as structural and plastic strenght of meat samples is concerneal. Consequently, we can conclude that radiating swines with 1 Gy results in considerably greater changes in the structural-mechanical properties of the produced meat compared to the combined effect of 1 Gy radiation and poisoning with POS "AGRIA 1050".

CONCLUSIONS

The results obtained and their analysis allow us to make the following major conclusions:

1. The combined treatment of swines with 1 Gy and 250 mg/kg life weight makes pork meat harder expressed by greater elasticity and reduced structural and plastic strenght.
2. The change in the structural-mecanical properties of pork meat caused by gamma radiation of the animals is more significant that by the combined treatment with gamma rays and POS.

PERTINENT LITERATURE

1. Dragoev,S., S.Danchev, T.Zlatev, N.Nikolova, B.Tododrov (1993). Study of the combined effect of organophosphoric pesticide "AGRIA 1050" and gamma rays on the structural-mechanical properties of lamb meat, Jubiley Science Sesion "40-th years HIFFI", 11-12.XI.1993, HIFFI, Plovdiv, Bulgaria, v.I, 173.
2. Georgieva, P., S.Todorinov, St.Tanchev (1989). Mathematical and statistical methods in the technological investigations, Agric. sci., 25, 1, 100 - 109.
3. Rebinder, P.A., N.V.Sosonenko (1949). On the conus used method for characterising structural-mechanical properties plastic-liquid bodys, Tesysis of the Academic of Science of USSR, 14, 6, 12 - 18.

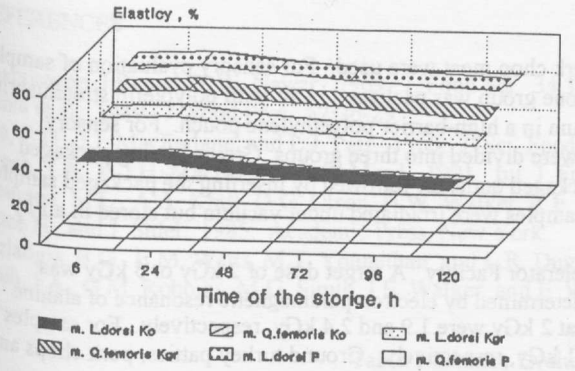

Figure 1. Changes of the elastiicty of pork, from animals combined teated with gamma rays and POS.

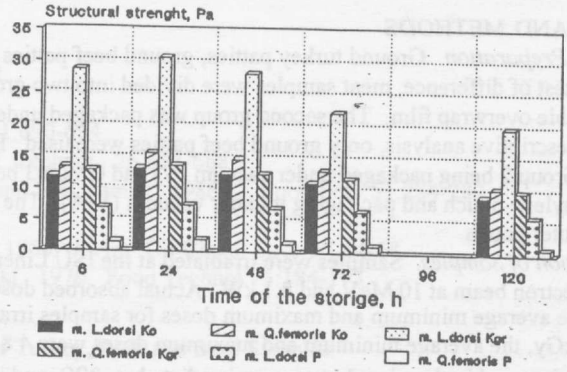

Figure 2. Changes of the structural strenght of pork, from animals combined treated with gamma rays and POS.

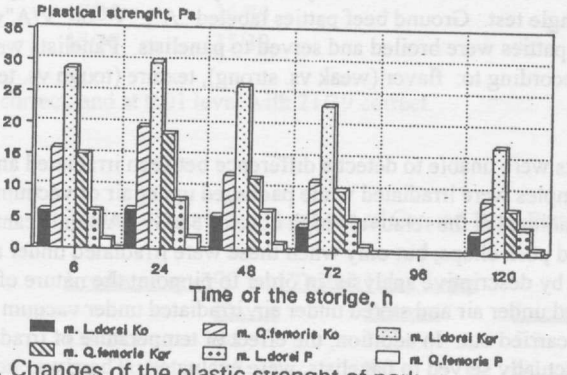

Figure 3. Changes of the plastic strenght of pork, from animals combined treated with gamma rays and POS.