A STUDY ON THE CHANGES OF PORK FATTY TISSUE CAUSED BY LOW DOSES IRRRADIATION AND ORGANOPHOSPHOROUS PESTICIDE POISONING

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BACKGROUND

Recently, the penetration of an increasingly greater number of organophosphrous compounds for utilization in agriculture has increased the risk of acuta toxaemia of animals and from their of man, as well. Organophosphrous compounds can cause various damages in degree of human organism. Unfortunately, as regards this widely used group of pesticides, profound investigations have not been carried out, studiyng their effect upon the qualitative characteristics of muscle and fatty tissue from the meat produced. It has been proved that these compounds can be deposited in the fatty tissue of swine and cattle mainly (Frank et al., 1983). On the other hand, irradiation is applied more and more frequently for meat products production (Thayer et al., 1993). The problem concerning the effect of combined influence of organophosphrous compounds and low doses gamma irradiation upon pork fatty tissue is very actual, as well.

OBJECTIVES

The objective of this study is to determine the changes of pork fatty tissue cuased by low doses irradiation and acute organophosphorous pesticide poisoning with phenitrotion.

MATERIALS AND METHODS

The experiment were carried out with 27 swine - crossbreed "Big White" by "Landras". The animals were weaned at one months' age and after a week period of adaptation they were divided into three groups - 9 animals each. The first and the second group were irradiated on the irradiator "Rokus-M" ^{60} Co, at power of dosage 0.005 Gy/s. The first group was acuta poisoned, one week after the irradiation, with organophosphorous pesticide phenitrothion, at dose of 150 mg/kg live weight and slaughtered at two months' age. The meat produced was used as an experimental sample P. The second group of animals was not treated by phenitrothion. It was slaughtered at two manths' age and the meat produced was utilized as an control only irradiated, sample Kgr. The third group of animals was grown up to two months' age with at any pesticides or irradiation treatment and slaughtered as a control sample Ko, obtained from clinical health pigs. Immediately, after the slaughtering of each group animals, the hypodermic fatty tissue from the carcasses was staffed up. It was minced on a grinder. The mean laboratory samples were prepared from this fatty tissue mix. The three mean laboratory samples were homogenized. The lipid faction was extracted immediately with a mixed solvent chlorophorm : menthol by the method of Bligh & Dayer. The chlorophorm fractions were collected and evaporated on a vacuum-rotational evaporatorator at - 0.95 kg/cm^2 and temperature 25^{o}C. The lipid fractions extracted in that way from the three samples were used in our further investigations. The acid value (AV), and peroxide value (POV) of lipids were determined by standard methods. The fat structure was determined by the infrared spectroscopy method. The investigations were carried out on a spectrophotometer "PYE UNICAM 8800" (Cambridge, England) at wavelengths 625 - 3800 cm^{-1}. The fatty acid methyl ester profiles (FAMEP) were determined gashromatographically on a gas chromatograph "FLOCTOVAT 2407 T" (Karlo Erba, Italy). The content of organophosphorous pesticids in fatty tissue was detrmined gaschromatographically using gas chomatograph apparatus PAY UNICAM (Cambrige, England) equipped with an electronicapture detector. The data obtained were statistically processed (Brandt, 1979).

RESULTS AND DISCUSION

The results obtained have shown that the highest is the AV of the sample Ko (0.6037 ±0.0124). The middle position is occupied by the AV of irradiated swines sample Kgr (0.4888 ± 0.0353), while the lowest one is that of the experimental sample P (0.2528 ± 0.0412). The results for POV have shown that in both samples Ko and Kgr that index is statistically indiscriminate, $p < 0.05$. The POV of sample Ko is 0.02774 ± 0.0107, while of the Kgr sample it is 0.0261 ± 0.0181. The POV level of the experimental sample P considerably higher can be observed (0.0486 ± 0.0156). The results show that low doses gamma irradiation does not accelerate the lipid peroxidation processes. In opposite, combination between acuta phenitrothion poisoning and low dosses irradiation accelerated lipid peroxidation. The results from the IRS analysis have shown follows: At wavelength of 1000 to 1240 cm^{-1} intensive absorbtion of C-O-C-groups can be observed that is due to deformation fluctuations of CH-groups in pork lipids. This effect is expectionaly well expressed experimental samples (P). The destruction in them is better expressed in comparison with the samples Ko and Kgr (Fig. 1, Fig. 2 and Fig. 3). At wavelength of 1400 to 1500 cm^{-1} we detected the presance of NH_2-groups. Their pick is better expresed in the experimental sample P (Fig. 3) and at a less degree - in samples Kgr (Fig. 2). These results are evidence about amino groups integration with hydrocarbon chain of lipids in third group animals (samples P). At wavelangth 1740 - 1750 cm^{-1} were determined the presence of non ionized COOH-groups in the phosphatidylserine region. There are also deformation fluctuations of H_2 and of CO-groups. At wavelength from 3000 to 2700 cm^{-1} we determined a strong absorbtion of CH_2-groups. It suggests a considerable accumulation of double bonds and formation of position isomers (dienes or trienes). That effect is the most strongly expressed in experimental samples P. In it the CH_2-groups being in a symmetrical as well as in asymmetrical shape. A normal picture can be observed with the control sample Ko again. The result obtained is an evidence about that combination of acuta poisoning with phenitrothion and low doses gamma irradiation causes processes of position isomerization of hydrocarbon chains of the lipids. The presence of the organophosphorous compounds with long hydrocarbon chans of fatty acid

residues in the sample P (Fig. 3) at the wavelength from 700 to 780cm^{-1} was established. That results are in accordance with the experimental formulation where only the experimental group of pigs (from which was obtained sample P) have been acuta poisoned with 150 mg fenitrothion/kg live weight. The results obtained from the IRS analysis witness for considerable processes of destruction and isopolimerization of the lipids when both gamma rays and fenitrothion poisoning of the pigs have been combined (sample P - Fig. 5). There are differences between FAMEP of sample P, sample and sample Ko (Table 1). In the sample P statistically significant incresed $C_{18:0}$ and $C_{18:1}$ amounts and decresed quantity of $C_{18:2}$ in comperison with the FAMEP of sample Ko, can be observed. These results confirm the results obtained from the IRS analysis and results regarding the changes of the AV and POV. Statistically significant diffenences between FAMEP of samples P and Kgr were not established, exept the increasing of the amount of $C_{18:0}$ in sample P. FAMEP of the sample Ko characterizes with higher $C_{18:2}$ content and lower $C_{18:1}$ quantity then sample Kgr. The results from the gas chromatographic analysis carried out of the three investigated samples show that in sample Ko and Kgr did not detect organophosphorous compounds. While in sample P such can be noteced having levels of 1.8601 ± 0.0514 mg/kg fatty tissue. The evidently weaker expressed hydrolysis processes in the experimental sample P are probably due to the more considerable lower water concentration in fatty tissues caused probably by water radiolysis, as well as by the effect of acuta poisoning with the organophosphrous pesticide phenitrothion. The very low doses gamma irradiation, as 0.005 Gy/s could not accelerate the lipid peroxidation processes. In opposite, acute phenitrothion poisoning and low dosses irradiation causes accelerated lipid peroxidation. The chemical mechanism of this process is not well known yet, and needs of additional experiments to its understanding.

CONCLUSIONS

The obtained results and their analysis allow us to do the following conclusions: The combination gamma irradiation and phenitrothion poisoning of pigs causes inhibition of the lipid hydrolysis and acceleration of the fatty tissue peroxidation, chenges its structure and FAMEP. At that way the saturated fatty acids accumulate and decreases the unsaturated fatty acids. Both factors irradiation and phenitrothion poisoning have opposite effect on the chemical characteristics of the fatty tissue. The phenitrotion poisoning causes lipid peroxidation inreacing and dehydrataion of the tissue in higher degree than low doses irradiation of the animals.

REFERENCES

Brandt, S., 1979. Statistical and Computational Methods in Data Analysis. Elservier Publishing Co., New York, 59 pp. (GB).

Frank, R., H.E. Braun and G. Fleming, 1983. Organochlorine and organophosphorus residues in fat of bovine and porcine carcasses marketed in Ontario, Canada from 1969 - 1981. Journal of Food Protection, 46: 893 - 900 (USA).

Thayer, D.W., G. Boyd and R.K. Jenkins, 1993. Low-dose gamma irradiation and refrigerated storage in vacuo affect micribial flora of fresh pork. Journal of Food Science, 58: 717 - 718 (USA).

Table 1. FAMEP of pork fatty tissue subjected to a combained treatmend with organophosphoric combination - phenitrothion and gamma rays.

Fatty acids	Quantity, g / 100 g fatty tissue		
	Sample Ko	Sample Kgr	Sample P
$C_{14:0}$	1.11 ± 0.21	1.07 ± 0.18	0.97 ± 0.11
$C_{16:0}$	23.57 ± 0.43	23.38 ± 0.27	22.04 ± 0.48
$C_{16:1}$	4.51 ± 0.35	5.25 ± 0.33	3.97 ± 0.36
$C_{18:0}$	8.86 ± 0.41	8.56 ± 0.43	11.36 ± 0.58
$C_{18:1}$	45.70 ± 0.52	51.36 ± 0.49	50.63 ± 0.71
$C_{18:2}$	16.26 ± 0.47	10.45 ± 0.54	11.06 ± 0.37
$C_{18:3}$	traces	traces	traces

Figure 1. IRS of pork fatty tissue lipid obtaned from pigs, which are not treated with gamma rays or organophophorous pesticides (Samlpe Ko). I - C-O-C groups; II - NH_2 groups; III - COOH groups; IV - CH_2 groups.

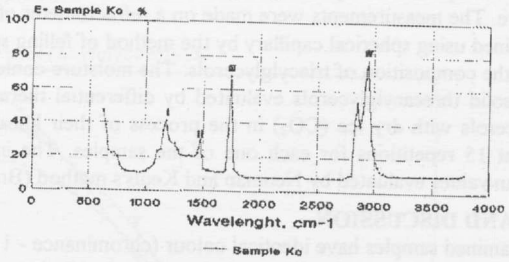

Figure 2. IRS of pork fatty tissue lipid obtaned from irradiated pigs at a dose 0.005 Gy/s (Sample Kgr). I - C-O-C groups; II - NH_2 groups; III - COOH groups; IV - CH_2 groups.

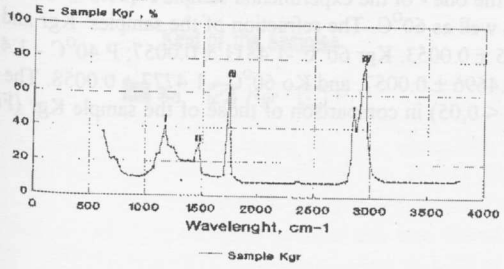

Figure 3. IRS of pork fatty tissue lipid obtaned from both irradiated at a dose 0.005 Gy/s and acute phenitrothion poisoned pigs (Sample P). I - C-O-C groups; II - NH_2 groups; III - COOH groups; IV - CH_2 groups; V - Organophosphorous compounds.