Gamma-Radiation of Lambs and its Effect on the Hydrophilic Properties of Meat

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SUMMARY: It has been studied the effect of gamma-radiation on the amount of free water, water-holding and salt-holding capacities by exposing lambs to 3.3 Gy. The method of Grau and Hamm has been used for the study. It has been established that gamma-radiation of lambs with doses of 3.3 Gy has caused lower hydrophilic properties of meat. The maximum level of free water has been registered at the 24th hour (20.64%) as compared to the same maximum for the control samples from nonradiated animals (17.55%) registered at the 36th hour. The results about the water-holding capacity of meat from radiated animals indicate that the minimum level has been reached earlier, i.e. at the 24th hour (4.43%) while in nonradiated meat it is 7.53% at the 36th hour. The results obtained make it reasonable to accept that 3.3 Gy gamma-radiation of lambs accelerates the postmortal processes in meat and the set-in of rigor mortis in comparison to the nonradiated controls.

INTRODUCTION: One of the main environmental factors of present-day life is radioactivity. The exposure of animals to ionizing radiation influences the human body in a certain way and causes unfavourable after-effects. (Paskevich et al. 1971). There are a great number of investigations on the influence of the ionizing radiation on the oxidizing of lipids (Lakritz et al. 1989).

The objective of the present work is to establish the effect of gamma-radiation on the hydrophilic properties of muscles from lambs radiated in live.

MATERIALS and METHODS: Four-month-old lambs with live weights of 10-18 kg were used in the study. They were divided into two groups, one of which was exposed to gamma-radiation with a dose of 3.3 Gy, and the other was a control group. The control animals were bred under the same conditions as the test animals except for the radiation exposure. Muscle samples were taken on the 20th day after the exposure, and the control and test carcasses were processed according to the technology common for our meat packing houses. The study was carried out on m. Longissimus dorsi and m. Semitendinosus at the 12th, 24th, 36th and 72nd h after slaughtering the animals. The muscle samples were stored at 0°-2°C.

The study was focused on the effect of gamma-radiation on the amount of free water and the water-holding and salt-holding capacities of the muscles. The amount of free water was determined by Grau and Hamm's (1964) combined press and filter-paper method. To determine the water-holding and salt-holding capacities, the preweighed muscle samples with sizes of 2.0 x 1.0 x 0.5 cm were placed in vessels containing 15cm^3 distilled water and 15 cm^3 physiological salt solution. The samples were left for 24 hours at 4°C. Later the solution was discarded, the sample surfaces were dried and the samples weighed. The water-holding and salt-holding capacities were determined as the difference between the sample weight (g) after 24 h storage in the solution and the weight before absorption (g), divided by the sample weight, and multiplied by 100.

The results obtained were analysed by the methods of mathematical statistics (Georgieva et al. 1987).

RESULTS and DISCUSSION: The experimental results about the amount of free water liberated by m. Longissimus dorsi from gamma-radiated and nonradiated lambs are given on Fig.1.

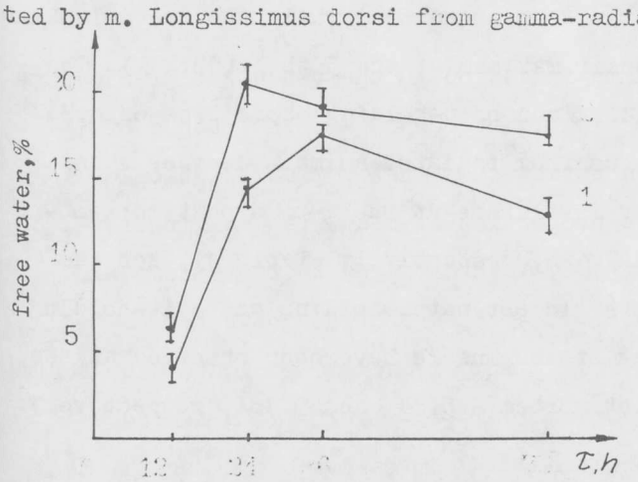

Fig.1. Changes in free water amount (%) during storage of m.Longissimus dorsi from: (1) nonradiated lambs; (2) 3.3 Gy gamma-radiated lambs.

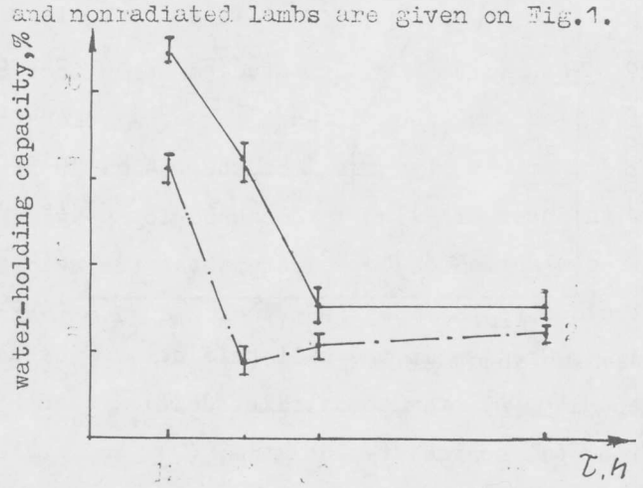

Fig.2. Changes in water-holding capacity (%) during storage of m.Longissimus dorsi from: (1) nonradiated lambs; (2) 3.3 Gy gamma-radiated lambs.

They indicate that the amount of free water in the controls is 4.71% at the 12th h post mortem while in the test samples it is 6.20%. It has been established that the water liberated by m.Longissimus dorsi from gamma-radiated animals has increased significantly and the maximum levels have been reached at the 24th h (20.64%) followed by a slight decrease (Fig.1). In the muscles from nonradiated lambs the maximum free water level has been reached at the 36th h post mortem (17.55%).

The results for the water-holding capacity of m. Longissimus dorsi stored in distilled water are given in Fig.2. They show that the water capacity of muscles from 3.3 Gy radiated lambs stays lower than the water-holding capacity of muscles from nonradiated animals. Furthermore, there has been observed a faster decrease of the water-holding capacity in m.Longissimus dorsi samples from radiated animals. In these samples, the minimum levels have been reached earlier, at the 24th h post mortem, (4.43%) (Fig.2). With further storage, the muscle water-holding capacity has increased. The results for m.Longissimus dorsi from nonradiated lambs indicate that after the 12th h the water-holding capacity has decreased reaching its minimum level at the 36th h (7.53%) followed by a relative stabilization (Fig.2)

The results for the salt-holding capacity of m.Longissimus dorsi indicate that that factor is higher during the whole test period in the nonradiated samples when compared to the 3.3 Gy gamma-radiated samples (Fig.3). The minimum levels for the controls have been observed at the 36th h post mortem (11.73%). For radiated samples there are significant changes (Fig.3). The salt-holding capacity decreases faster and the minimum levels have been observed at the 24th h post mortem (8.05%). After 24 hours this level stays relatively unchanged.

The experimental results about the effect of gamma-radiation on the hydrophilic properties

of m.Semitendinosus are given in Table 1. It has been established that the amount of free water is higher during the whole test period in radiated muscle samples. It has reached its maximum level at the 24th h (21.83%) while the controls have reached their maximum at the 36th h (19.26%). The water-holding and salt-holding capacities of m.Semitendinosus from radiated animals decreases and the lowest levels are at the 24th h post mortem - 3.62% and 7.41%, respectively (Table 1). For the controls the lowest water-holding and salt-holding capacities of the muscle have been observed at the 36th h post mortem - 5.34% and 9.18%, respectively.

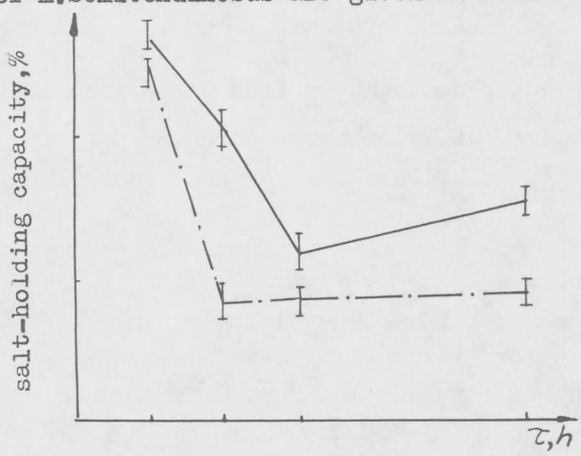

Fig.3. Changes in the salt-holding capacity (%) of m.Longissimus dorsi from: (1) nonradiated animals; (2) 3.3 Gy gamma-radiated animals.

CONCLUSIONS: The results obtained indicate that gamma-radiation with 3.3 Gy leads to a fast drop of the hydrophilic properties of m. Longissimus dorsi and m. Semitendinosus from radiated lambs. The minimum levels of the characteristics studied are observed earlier, at the 24th hour, in comparison to the muscles from the nonradiated animals.

We conclude that the ionizing radiation treatment of lambs accelerates the postmortal processes and the set-in of rigor mortis which results in lower hydrophilic properties of the muscle. We accept that radiation of lambs with a dose of 3.3 Gy does not cause significant deviations in the muscles that may encumber their technological processing.

Table 1. Changes in the free water amount (%), water-holding and salt-holding capacities (%) during storage of m. Semitendinosus from nonradiated (control) and 3.3 Gy gamma-radiated (test) lambs.

Time (h)	Free water amount,%		Water-holding capacity,%		Salt-holding capacity,%	
	Control	Test	Control	Test	Control	Test
12	4.93±0.19	7.28±0.26	20.47±1.12	15.00±0.51	24.80±1.10	22.03±1.09
24	15.10±0.37	21.83±0.95	14.86±0.60	3.62±0.20	20.36±1.05	7.47±0.32
36	19.26±0.69	20.45±0.98	5.34±0.27	5.14±0.29	9.18±0.37	7.86±0.40
72	13.87±0.48	17.06±0.54	6.11±0.32	5.79±0.34	11.40±0.50	8.57±0.46

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