INVESTIGATION OF LISTERIA MONOCYTOGENES RADIORESISTANCE IN POULTRY MEAT

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Conclusions

1. Depending on the applied ionising radiation dose of frozen samples the effect of radurization is noticeable:

- applying 2 kGy dose and subsequent storage till 150 days in aerobically packed samples, and in vacuum packed samples the same effect is not established.
- applying 3 kGy dose and subsequent storage till 90 days in aerobically packed samples, and in vacuum packed samples the same effect was noticeable still subsequent storage till 150 days
- applying 4 kGy dose and subsequent storage till 60 days in aerobically packed samples, and in vacuum packed samples the same effect was noticeable still subsequent storage till 120 days .

2. Better bactericidal effect can be achieved either by higher doses of ionising radiation of by radiation with lower doses and subsequent storage at freezing temperatures.

3. The advantage of combined methods of frozen poultry meat radiation is the hygienic soundness of treated samples and health safety on the other hand.

4. The lowest ionising radiation dose, which can eliminate the *L. monocytogenes* cells, is 3 kGy on condition that *L. monocytogenes* cells are present in potential 10^4 cfu/g.

5. This means that before the radiation process, it is necessary to determine the initial quality e.g. the contamination level of poultry meat with this microorganism before the use of combined preservation methods of poultry meat.

OBJECTIVES

Having in mind the mentioned facts, the scope of this work was to find the lowest dose of ionizing irradiation which could eliminate the pathogenic *L. monocytogenes* 4b and, in the same time, provide hygienically safe poultry meat.

Background

The ubiquitous spread and saprofitic life of *Listeria monocytogenes* is presented in a number of papers.Different domestic animals can be hosts for this microorganism. *Listeria sp.* is mainly connected with the intestinal tract of domestic animals (Skovgaard, Morgen, 1988) or with latent infection of humans, while birds are responsible for silage contamination (Fenlon, 1985, Brackett, 1988). Lowet and Twedt report in 1988 that only two kinds of this genus are patogenic: *Listeria monocytogenes (L. monocytogenes)* and *Listeria ivanovii (L. ivanovii)*, though there are some different oppinions, too.

Poultry meat can be contaminated by *L.monocytogenes 4b* in a significant degree even at good hygienic condition during production and processing(Mollins,Motarajemi, 1997). The contamination can originate from every stage of slaughter or processing of carcasses(Kampelmacher, 1987).

Food irradiation is not a new technology. The investigations connected with the application of radiation technologies in the food preservation processes are intensifying. The literature statements point out the chance of radiation technology to become the most spread industry in the world. Two factors are important for such movements in the development of radiation technology. The first is the efficiency of ionizing radiation as the antimicrobial agens and the second, that the mentioned process combined with other physical food preservation methods causes insignificant chemical changes without any harmfull effect on quality of treated food (Thayer et al., 1996, Loaharany, 1996).

The bactericidal action of ionizing irradiation is limited by the dose, which can be changed depending on the kind of treated food as well as on the initial bacteriologic quality. Efficient decontamination could be achieved by combined methods of frozen meat radiation. This procedure would result in less expressed deviation of sensory characteristics compared to the ones after the application of ionizing radiation only (Thayer, 1995).

METHODS

Experiments were carried out on samples of frozen chicken meat, purposely contaminated with pathogenic *L. monocytogenes 4b* at concentration $5x10^7$ cfu·g^{-1}.Chunks of frozen (-18°C) meat, of low initial spontaneous contamination with saprophytic microflora, were artificially contaminated with afore cited *Listeria sp.* The contamination was carried out 24 hours post mortem by submerging frozen samples into 24 hours old culture suspensions of *L. monocytogenes*. The frozen and contaminated samples were then packed in plastic bags (in aerobic conditions- **I**), and in vacuum conditins (**II**) and subjected to ionising radiation - 2, 3 and 4 kGy doses. The irradiation operation was carried out in the laboratory of the Institute for Nuclear Sciences, Vinèa. A group of frozen, nonradiated samples was the control group during the following of ionising radiation efficiency.

After the irradiation, the frozen samples were transported to the microbiological laboratory, Department of Food technology, for the determination of cells surviving irradiation of chosen doses. Cell counts were performed by cultivation on solid selective substrate (LSA-Merck, 10985 + 5% defibrinated sheep blood). The control of irradiated samples was done during 6 month, every 30 days.

RESULTS AND DISCUSSION

The results are shown in Table 1 and 2.

Table 1 illustrates the effect of applied ionising radiation treatments with different doses in aerobically packed samples. The 2 kGy dose caused a decrease of vital *L. monocytogenes 4b* cells and during subsequent storage no presence of vital cells of *L.monocytogenes* on the 150 th day.

From the same figure it is obvious that the application of 3kGy doses reduced the initial contamination for 3,845 log.cycles. During subsequent storage the number of vital cells of *L.monocytogenes 4b* was reduced so on the 90 th day of subsequent storage at –18° C vital cells were not found.

Applaying the 4kGy doses the highest percentage of vital cells of *L.monocytogenes 4b* was eliminated immediately after irradiation. Further reduction was continued during storage, so that on the 60th day the presenece of tested microorganisms was not confirmed.

The dose of 3kGy enables the complete elimination of cells between 120th and 150th day of storage in vacuum packed

sampkes. In the same group of samples the applied dose of 4 kGy enables the reduction of cells of L.monocytogenes 4b on the 0^{th} day for 4,85 log. cycle and in the time interval between 90-120 days all present vital cells of L.monocytogenes 4b are completely eliminated.

It can bee observe that the *L.monocytogenes 4b* cells are more resistant to all applied doses of ionizing irradiation, if they are presence in vacuum packed samples. It is obvious that after the applied dose of 2 kGy and after 180 days of storage (-18°C) the vital cells in potencial of $1x10^2$ still can bee detected (Tab. 2).

The freezing, compared to the combined methods of frozen samples radiation, does not eliminate the vital cells of *L. monocytogenes* 4b.

Different ionising radiation doses are cited in literature as efficient for *L. monocytogenes* elimination.Huhtanen et al. (1989) cite that 2 kGy is an efficent ionising radiation dose for the elimination of *L. monocytogenes*. The authors claim further that this dose is sufficient to eliminate the *L. monocytogenes* cells if initially present in potential $1x10^4$. The same results are given from the other authors(Paterson, 1989, Gaze et al. 1989, Lewis, Corry, 1991, Bulatoviæ,Todoroviæ, 1992).

In this work, investigating the 3 kGy dose, we achieved the complete elimination of *L. monocytogenes* cells between the 60th and 90th day of storage. However, an extremely high initial concentration was investigated ($5x10^7$ cfu/g), which is exceptionally rear during the production and processing processes. This investigated initial contamination is near to the one stated by Urbain (1986) as the indicator of meat spoilage.

Faster e.g. more efficient reduction of *L. monocytogenes* cell numbers can be achieved by use of higher doses of ionising radiation (for example 4 kGy) or subsequent storage for a certain period of time after application of lower doses of ionising radiation.

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Table 1. The influence of ionising irradiation (2, 3, and 4 kGy) on the number of vital cells of *L. monocytogenes* 4b durring storage till 180^{th} day (initial contamination log. N° 7,698) in aerobic condition

days of storage / type of ambalage		0	30	60	90	120	150	180
Aerobic (2kGy)	cfu/g	$5,5x10^4$	$1,5x10^4$	$2x10^2$	$1,8x10^2$	3	0	0
	log N°	4,740	4,176	2,302	2,255	0,477	0	0
Aerobic (3kGy)	cfu/g	$7x10^3$	$6x10^2$	80	0	0	0	0
	log N°	3,845	2,778	1,903	0	0	0	0
Aerobic (4kGy)	cfu/g	$5x10^2$	80	0	0	0	0	0
	log N°	2,698	1,903	0	0	0	0	0

Table 2. The influencce of ionising irradiation (2, 3 and 4 kGy) on the number of vital cells of *L. monocytogenes* 4b durring storage till 180^{th} day (initial contamination log. N° 7,698) in vacuum condition

days of storage / type of ambalage		0	30	60	90	120	150	180
Vacuum (2kGy)	cfu/g	$8,4x10^4$	$4,3x10^4$	$7x10^3$	$5,8x10^3$	$4,9x10^3$	$3x10^2$	100
	log N°	4,924	4,634	3,845	3,763	3,690	2,477	2,000
Vacuum (3kGy)	cfu/g	$8x10^3$	$4,210^3$	$20x10^2$	$5x10^2$	70	0	0
	log N°	3,903	3,623	3,301	2,698	1,845	0	0
Vacuum (4kGy)	cfu/g	$7x10^2$	180	60	10	0	0	0
	log N°	2,845	2,255	1,778	1	0	0	0