FECT OF IRRADIATION AND PACKAGING ON THE SURVIVAL OF CAMPYLOBACTER JEJUNI CHILLED POULTRY MEAT

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e current study was designed to determine the effect of low-dose irradiation and modified mosphere packaging on the survival of Campylobacter jejuni on inoculated poultry meat ored under refrigeration temperature. The results obtained show that vacuum- and CO_2 - ckaging enhance the survival of C.jejuni. D_{10} - values for this Campylobacter strain ry from 0,16 kGy (air) and 0,18 kGy (vacuum) to 0,21 kGy (CO_2). Slightly higher are the 0-values for the same Campylobacter strain during refrigeration storage of the irradiated oultry meat due to less expressed post-irradiation effect. During refrigeration storage decrease in Campylobacter count is observed. Low-dose irradiation (0,5 - 1,0 kGy) is ffective in inactivation of surface population of Campylobacter on chilled poultry meat.

ntroduction

oultry meat is considered to be food with high level of Campylobacter contamination. nder the conditions prevailing now in poultry-processing plants it is not possible to roduce a pathogen-free chicken meat. Attempts to eliminate Campylobacter contamination f poultry also have not been successful until now (Stern et al.,1989)
t was demonstrated, however, that irradiation treatment can solve the problem (Kampel - acher, 1983; Klinger, 1989). Few studies carried out on the effect of irradiation on ampylobacter demonstrated that this organism is quite sensitive to ionizing radiation Lambert & Maxcy, 1984; Tarjan, 1985) and generally less resistant than has been reported for most Salmonella strains. The evidences presented indicate that the application of ow-dose gamma radiation would drastically reduce the possibility of transmission of .jejuni and thereby decrease the public health hazards associated with this organism Lambert & Maxcy, 1984).
ommercial availability of vacuum-packed, CO_2 -flushed poultry and red meats in the arketplace has increased. For poultry meat, packaging under high CO_2-atmosphere has been eported to extend the storage life approximately threefold over the attained for similar roduct stored in air (Hotchkiss et al.,1985).
o data exist in the literature on the effects of combined treatment - low-dose irradiation nd modified atmosphere packaging on the survival of Campylobacter. Investigations on hese effects seem warranted.

Materials and Methods

Organism. Campylobacter jejuni 85Y242, used as test-strain in the experiments, was ob - tained from the Agricultural University, Wageningen, The Netherlands. During the course of experiments the strain was subcultured 48h before inoculation on Blood Agar No1 (Oxoid CM331) plus 5% lysed horsed blood and Campylobacter growth supplement F.B.P.(Oxoid SR84) at 42,5°C in a microserophillic atmosphere (5% O_2, 10% CO_2, 85% N_2) (Anaerocult C, Merck 16275).
Source, inoculation and preparation of samples. As sample material were used chicken wings, purchased from local supermarkets.
For the preparation of the inoculum C.jejuni 85Y242 was grown in Brucella Broth with F.B.P - supplement under oscillatory conditions (100 rpm) for 24h at 42,5°C, in anaerobic jars in a controlled microserophillic atmosphere. Before inoculation the enriched broth culture was diluted (1:1) with 1% peptone water. In order to ensure sterility of chicken wings, before inoculation, they were packed and irradiated at a dose 10 kGy. Under asep- tic conditions, chicken samples were placed in a sterilised pot with the diluted broth

culture of the test-strain. For uniform spreading of the organism on the surface of the chicken parts, they were held for 20 min. after which dripping for 5-10 min.was applied.

Packaging and storage. Inoculated chicken wings were packed individually or 3 in packs. Vacuum-packaging was performed in O_2-impermeable bags on "Henovac"-packaging machine (evacuation for 30 sec. and sealing time 2 sec.)CO_2-packaging was performed in double-layer polyethelene O_2-impermeable bags on "Multivac A 306/42" . Vacuum drawn to -1000 mbar was applied, followed by filling with 100% CO_2 and sealing. Packed samples were stored at refrigeration temperature (0-5°C) before being analyzed.

Irradiation treatment.Irradiation of inoculated and packed chicken parts was performed at Co-60 irradiation facility , doses absorbed - 0,2; 0,4 and 0,6 kGy.

Enumeration procedures.Before being analyzed the chicken skin was cut in small pieces, measured (10-20 g) and homogenized with the respective quantity (dilution 10^{-1}) with PFS in a Stomacher 400 lab blender for 1,5 min. The number of survivors in each pack was determined by direct plating of 0,1 ml of the initial homogenized suspension and dilutions on modified CCDA (Oxoid CM739) with an addition of cefoperazone 32 mg/l (Oxoid SR 125E) and cyclohexamide 0,1 g/l (Hutchinson & Bolton,1983). All studies involved three or more repetitions with triplicate plating of each replication. The logarithm of the bacterial count was plotted against radiation dose to determine the death rate of the organism. Regression lines were calculated for each atmosphere and D_{10}-values were calculated as the reciprocal of the slope of the lines (Ley,1983).

Results and Discussion

The results of this comparative study are presented on Fig. 1 and 2.

After the irradiation of inoculated chicken wings under air-packaging (O_2-permeable bags) reduction of the initial viable population of Campylobacter jejuni 85Y242 is observed - by 2 log cycles (dose absorbed 0,2 kGy), by 2,8 log cycles (dose 0,4 kGy) and 3,6 log cycles (dose 0,6 kGy). During refrigeration storage of chicken samples(7 days) a slight decline in Campylobacter count is observed.

Vacuum-packaging has a protective effect on survival of Campylobacter during refrigeration storage of irradiated chicken parts (Fig.1). On the first day after the irradiation treatment the dose absorbed 0,2 kGy causes a reduction of the initial viable population of Campylobacter (approx. 10^6 cfu/g) by 1 log.cycle, dose 0,4 kGy - by 2,4 log cycles and 0,6 kGy - by 3,3 log cycles.

CO_2-packaging has a more expressed protective effect on C.jejuni 85Y242 (Fig.2).The doses absorbed reduce the initial population (approx. 10^6cfu/g) - by 1 log cycle (0,2 kGy), by 2,3 log cycles (0,4 kGy) and 2,8 log cycles (0,6 kGy). The protective effect of CO_2-packaging on the survival of Campylobacter during the refrigeration storage of irradiated chicken parts is observed too.

The observed phenomena are better illustrated by the survival curves of C.jejuni 85Y242 irradiated on chicken wings, packed under various atmospheres (Fig.3). The D_{10}-values for this Campylobacter strain irradiated under various atmospheres and the changes in these values during refrigeration storage of chicken wings are presented in Table 1. The slightly higher D_{10}-values for C.jejuni on the 7th and 14th day of the refrigeration storage of irradiated chicken wings can be explained by the less expressed post-irradiation effect.

TABLE 1. D_{10}-values (kGy) of Campylobacter jejuni 85Y242 irradiated on chicken wings under various atmospheres and during refrigeration storage.

Atmosphere	Refrigeration storage (days)		
	1	7	14
Air	0,16	0,20	-
Vacuum	0,18	0,21	0,22
CO_2	0,21	0,22	0,24

Our results confirm those from other studies showing that CO_2 enhances the survival of C. jejuni on refrigerated chicken meat (Blankenship et al.,1982; Beuchat,1985). The D_{10}-values for C.jejuni determined in our experiments are comparable with those reported by other authors - 0,16 kGy for C.jejuni irradiated in ground turkey (Lambert & Maxcy,1984) and 0,08 - 0,15 kGy for two strains of C.fetus subsp.jejuni in irradiated "Filet american"(Tarkowski et al.,1984)

Conclusions

Modified atmosphere packaging (vacuum and CO_2) enhances the survival of C.jejuni on chilled poultry meat. D_{10}-values for C.jejuni 85Y242 irradiated on chicken wings under various atmospheres are the following: 0,16 kGy(air), 0,18 kGy(vacuum) and 0,21 kGy(CO_2). During refrigeration storage of poultry the population of Campylobacter gradually declines but is able to survive under these conditions at least three weeks. Low-dose irradiation (0,5-1,0 kGy) will be effective in inactivation of Campylobacter on poultry meat, having in mind that the surface contamination of poultry with Campylobacter is considered to ammount to 10^2-10^3cfu/g

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References:

BEUCHAT,L.1985.Efficacy of media and methods for detecting and enumerating Campylobacter jejuni in refrigerated chicken meat.Appl.and Environ.Microb.,50,4,934-939
BLANKENSHIP,L.C.,CRAVEN,S.E.,1982.Campylobacter jejuni in chicken meat as a function of temperature.Appl.and Environ.Microb.,44,88-92
HOTCHKISS,I.H. et al.1985. Elevated CO_2-atmospheres for packaging poultry,Poult.Sci.64,333
HUTCHINSON,D.N.,BOLTON,F.1983.Is enrichment culture necessary for the isolation of Campylobacter jejuni from feaces? Journal of Clinical Pathology,36,1350-1352
KAMPELMACHER,E.H.1983.Irradiation for control of Salmonella and other pathogens in poultry and fresh meats. Food Technol.,37, 117-119
KLINGER,I.1989. Decontamination of chicken meat by ionizing radiation.9th Eur.WPSA Symp.
LAMBERT,J.& MAXCY,R.1984.Effect of gamma radiation on C.jejuni.J.Fd Sci,49(3),665-667,674
LEY,F.1983. Food Irradiation.In"Food Microb.",The Soc.Appl.Bacter.Symp.,Series No11
STERN,J.,MEINERSMAN,R.1989.Potentials for colonization of C.jejuni in chicken,J.Fd Prot, 52(6), 427-430
TARKOWSKI,J.et al.1984. Low-dose gamma irradiation of raw meat.Int.J.Fd Microb.,1. 13-23
TARJAN,V. 1985. Investigations into radiosensitivity of Campylobacter fetus subsp.jejuni in ground chicken meat. Int.Journal of Food Microbiology, 1, 321-326

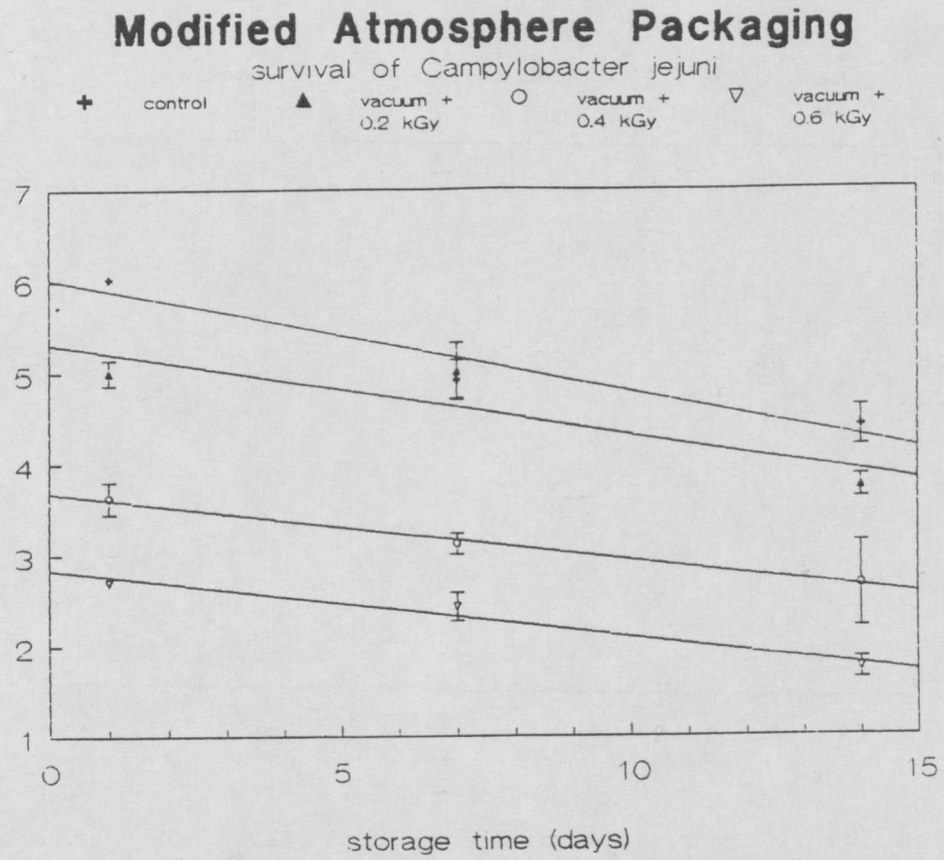


FIG.1. Effect of irradiation and vacuum-packaging on survival of C.jejuni 85Y242 on inoculated chicken wings during refrigeration storage.

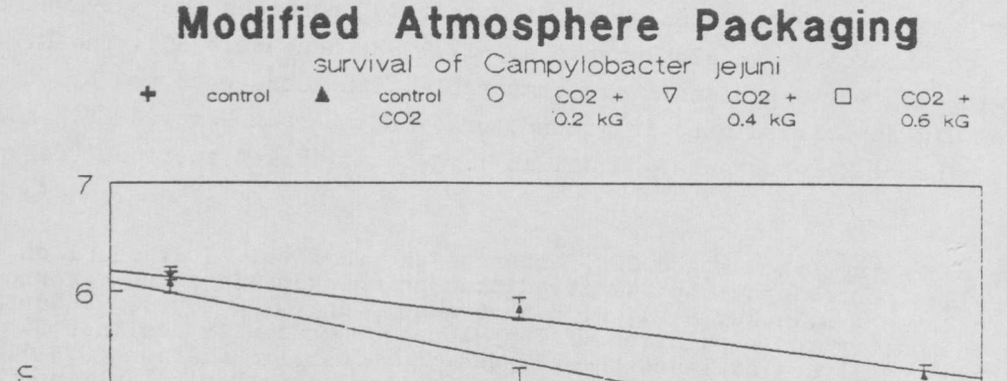
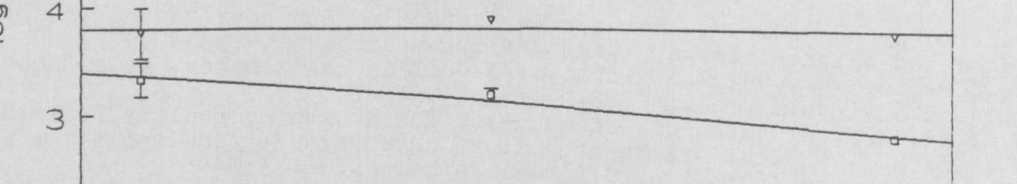


FIG.2. Effect of irradiation and CO_2 - packaging on survival of C.jejuni 85Y242 on inoculated chicken wings during refrigeration storage.



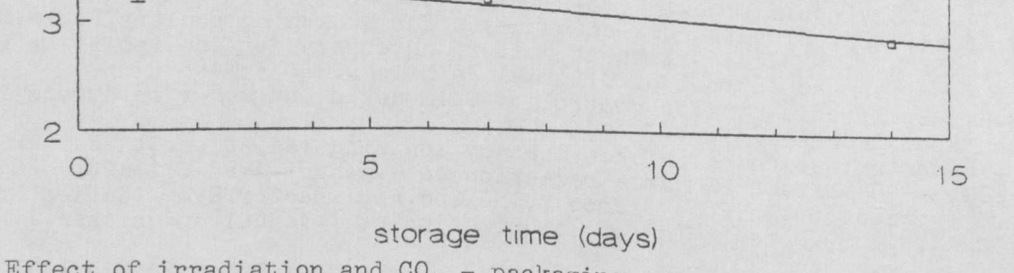


FIG.3. Effect of irradiation on population of C.jejuni 85Y242 under various atmospheres /1st day after applied treatment/