

전자선 조사된 원료육과 Starter Culture의 사용이 발효육의 숙성 중 품질에 미치는 영향

*

Effects of Starter Cultures on the Quality Traits of Electron Beam
Irradiated Fermented Meat during Aging

Dong-Gyun Lim, Kuk Hwan Seol, and Mooha Lee*

*Department of Animal Science and Biotechnology, Seoul National University, Seoul 151-742,
Korea*

Abstract

The microbiological and physicochemical properties of irradiated (2 kGy) or non-irradiated fermented meats processed with or without a commercial starter culture were evaluated during fermentation and aging. The pH of irradiated (2 kGy)

fermented meats with starter cultures dramatically decreased during fermentation and aging ($p < 0.05$), and the final pH was 4.25. The total aerobic counts and lactic acid bacteria counts reflected the addition of the starter culture. As the fermentation progressed, the total aerobic counts closely paralleled the lactic acid bacteria counts. The TBARS values of irradiated fermented meats increased regardless of the treatment during fermentation and aging. These results show that the irradiated (electron-beam) meat/fat resulted in the reduction of the total microbes and survives lactic acid bacteria. The use of starter cultures in meat batters post-irradiation may be useful for the production of fermented meats.

Key words : electron-beam irradiation, fermented meat, lactic acid bacteria, TBARS

가 (Leistner, 1995). 가 (Liepe, 1983). 가 (Samelis *et al.*, 1998). (Lee, 1990). 21-24 6-24 pH 4.6-5.1 (Kitchell and Shaw, 1975). 24 pH 5.2-5.6 (Lee, 1990). starter culture 가 (Bacus and Brown, 1981). Starter pH(4.6-5.9) pH

*Corresponding author : Mochha Lee, Department of Animal Science and Biotechnology, College of Agriculture and Life Sciences, Seoul National University, Seoul 151-742, Korea
 Tel: 82-2-880-4804, Fax: 82-2-873-4804, E-mail: mocha.lee@snu.ac.kr

(Smith and Palumbo, 1983). 40 (FAO/IAEA/WHO) 10 kGy 40 (Johnson and Marcott, 1999; Thayer and Rajkowski, 1999). 18 (FAO, WHO, 1988; Murano, 1995). FDA(1997) (fresh meat) 4.5 kGy, (frozen meat) 7.5 kGy 가

-27 ± 1 가 Slicer(HS-2N, , Korea) 1.5 cm 가 2 MeV(7 mm, 15mm) 10 mA, 27 ± 1 2 kGy

Stater Culture

4 ± 1 , 7 9 RH 87%, 20
 , , 0, 1, 3, 5,
 7, 9 .

가
 가
 silent cutter 1) pH
 (Meat chopper, MGB-32, , pH 10 g 90 mL
 Korea) . 10,000 rpm 1 pH
 (NaCl) 6%, glucose 5%, garlic extract meter(Model IQ 150, Lab Science,
 0.4%, coriander extract 0.1%, caraway USA)
 extract 0.1%
 (NaNO₂) 0.1% 2)
 가 . 10 g 90 mL
 가 pediococci, peptone (Difco Laboratories,
 lactobacilli micrococci Detroit, MI, USA) stomacher(In
 starter culture 0.5%(Rosellac™, terscience BagMixer , France) 2
 Abiasa, Canada) 10⁷ CFU/g 10
 가 . 1mL MRS agar(Difco)
 가 plate count agar (Difco)
 1:1 , 37 48
 colony colony
 4 ± 1 36 counter(Microcount 1008, IPI Inc., CA,
 USA)
 (Constant Temp & Humidity Chamber, 1g colony forming unit (CFU)
 HK-CTH150, , Korea) .
 cable tie Comi *et al.*(2005)
 Samelis *et al.* (2005)
 3 (RH) 93%,
 24 , 4 6 RH 90%, 22

Witte (1970) TBARS Blank sample 5 mL 5
 . 10 g sample 50 μ L mL TBA ,
 BHA, 2 M phosphoric acid (including 15
 20% TCA) 50 mL falcon tube spectrophotometer 530 nm
 homogenizing 15 mL .
 .
 50 mL
 , Watman No. 3
 1 . 5 mL , SAS (2005)
 test tube 5 mM TBA program Duncan
 (2-thiobarbituric acid) 5 mL 가 ($p<0.05$)

pH pH가 Park et
 Table 1 가 al.(1996)
 pH (pediococci, lactobacilli
 . 36 micrococci)
 , 0 pH 5.70-5.75 2-
 가 가 pH 3 가 108 CFU/g
 . 가
 5 5.72(0 kGy) 5.77(2
 kGy) 가
 pH 5 4.33(0
 kGy) 4.39(2kGy) 가 pH
 ($p<0.05$).
 culture 가

Starter Culture

(Leistner, 1995). 5 , 2 kGy 가
 가 pH가
 가 7 9 4.71 (p<0.05).
 4.88, 2kGy 가 Samelis (2005) Chouliara
 4.44 4.25 pH가 (2006)
 (p<0.05), 가 Greek salami
 pH
 commercial starter 가
 pH가 가 .
 Dickson and Maxcy (1985) 가 가 가
 pH 가가 nonprotein nitrogen(NPN) pH가 , 2kGy
 가 가 가 가 pH
 . 가 (p<0.05).
 가 .
 Lee (1990) 가
 pH .
 Table 2 . 36
 2 kGy 가 , 0
 pH 가 3.83(0 kGy) 0.23 Log

Table 1. Changes of pH in fermented meats during fermentation and aging

Irradiation dose (kGy)	Starter culture	Fermentation & Aging (days)					
		0	1	3	5	7	9
0 kGy	-	5.72±0.07 ^{bBC}	5.83±0.10 ^{ab}	5.83±0.07 ^{ab}	5.72±0.17 ^{abC}	6.23±0.52 ^{aA}	5.53±0.12 ^{dD}
0 kGy	+	5.75±0.11 ^{aA}	5.55±0.16 ^{bB}	4.48±0.14 ^{cE}	4.33±0.07 ^{fF}	4.71±0.22 ^{cD}	4.88±0.27 ^{cC}
2 kGy	-	5.70±0.09 ^{bCD}	5.68±0.09 ^{bD}	5.86±0.01 ^{aA}	5.77±0.04 ^{abC}	5.72±0.05 ^{bCD}	5.80±0.08 ^{aAB}
2 kGy	+	5.70±0.08 ^{bAB}	5.92±0.18 ^{aA}	4.75±0.18 ^{bC}	4.39±0.21 ^{bDE}	4.44±0.19 ^{dD}	4.25±0.04 ^{eE}

Each value is mean±SD of two replicate experiments with two samples analyzed per replicate (n=4).

^{A-F} Means in the same row with different superscripts differ significantly (p<0.05).

^{a-d} Means in the same column with different superscripts differ significantly (p<0.05).

CFU/g (2kGy), 가
 6.42(0 kGy) 6.00 Log CFU/g (2
 kGy) 2 kGy
 가 가
 (p<0.05). 가

7
 가 가 9 가
 가 (p<0.05).
 가

Table 3 . 36
 , 0
 가 (1 Log CFU/g)
 가 , 가
 5.99(0 kGy)
 3.72 Log CFU/g(2 kGy)
 (p<0.05). 9
 가 5.27(0
 kGy) 5.84 Log CFU/g(2 kGy),
 가
 8.38(0 kGy) 7.44 Log CFU/g(2 kGy)
 가
 (p<0.05).

가
 가
 pH가
 가 가 Dickson
 Maxcy(1985)

(Vignolo *et al.*, 1989;
 Coventry and Hickery, 1991),

Gram
 (Leistner *et al.*, 1981).

가
 가

(Dickson and Maxcy, 1985).
 Samelis *et al.*(2005) Chouliara *et al.*(2006)
 Greek salami

가 가 가
 가 가

Thiobarbituric acid value (TBARS)
 가

Stater Culture

(TBARS) Table 4 . 1994; Formanek *et al.*, 2003),
 36 ,
 가 가 (Koh and Whang,
 ($p < 0.05$). 9 2002).
 TBARS 2 kGy TBARS
 가 0.10 mg MDA/kg ,
 가 ($p < 0.05$). 가
 (Thayer *et al.*, .

Table 2. Growth of total aerobic bacteria of fermented meats during fermentation and aging (log10 CFU/g)

Irradiation dose (kGy)	Starter culture	Fermentation & Aging (days)					
		0	1	3	5	7	9
0 kGy	-	3.83±0.97 ^{DE}	4.45±0.72 ^{CD}	6.34±0.32 ^{CC}	6.78±0.69 ^{CB}	7.26±0.46 ^{BA}	7.54±0.90 ^{BA}
0 kGy	+	6.42±0.22 ^{AD}	7.80±0.64 ^{BC}	8.71±0.65 ^{BA}	8.36±0.66 ^{AB}	8.16±0.32 ^{AB}	8.24±0.24 ^{AB}
2 kGy	-	0.23±0.52 ^{DE}	3.60±0.92 ^{BD}	4.83±0.80 ^{CC}	6.26±0.14 ^{CB}	6.73±0.36 ^{CA}	6.59±0.82 ^{CAB}
2 kGy	+	6.00±0.21 ^{BD}	6.78±0.40 ^{BC}	7.70±0.58 ^{BAB}	7.80±0.57 ^{AB}	8.02±0.27 ^{BA}	7.48±0.47 ^{AB}

Each value is mean ± SD of two replicate experiments with two samples analyzed per replicate (n = 4).

^{A-E} Means in the same row with different superscripts differ significantly (p < 0.05).

^{a-d} Means in the same column with different superscripts differ significantly (p < 0.05).

Table 3. Growth of lactic acid bacteria of fermented meats during fermentation and aging (log10 CFU/g)

Irradiation dose (kGy)	Starter culture	Fermentation & Aging (days)					
		0	1	3	5	7	9
0 kGy	-	ND ¹⁾	3.23±0.46 ^{CD}	4.6±1.48 ^{CC}	5.95±0.74 ^{BA}	6.29±0.60 ^{BA}	5.27±0.63 ^{AB}
0 kGy	+	5.99±0.31 ^D	7.85±0.83 ^{BC}	8.86±0.59 ^{BA}	8.20±0.50 ^{AB}	8.08±0.27 ^{ABC}	8.38±0.36 ^{AB}
2 kGy	-	ND ¹⁾	3.58±1.12 ^{CC}	4.54±0.92 ^{CB}	5.92±0.27 ^{BA}	6.17±0.24 ^{BA}	5.84±0.75 ^{CA}
2 kGy	+	3.72±2.83 ^C	6.88±0.50 ^{BB}	7.66±0.69 ^{BAB}	7.93±0.58 ^{BA}	8.12±0.35 ^{BA}	7.44±0.45 ^{BAB}

Each value is mean ± SD of two replicate experiments with two samples analyzed per replicate (n = 4).

^{A-E} Means in the same row with different superscripts differ significantly (p < 0.05).

^{a-d} Means in the same column with different superscripts differ significantly (p < 0.05).

¹⁾ ND: not detected with the detection limit < 1 log CFU/g.

392.

5. Dickson, J. S. and Maxcy, R. B. (1985) Irradiation of meat for the production of fermented sausage. *J. Food Sci.* 50, 1007-1009.
 6. FAO, WHO (1988) Food irradiation. a technique for preserving and improving the safety of food. WHO, Geneva, pp. 23.
 7. FDA (1997) Irradiation in the production, processing and handling of food: Final rule. Fed. Register. 62, 64107-64121.
 8. Formanek, Z., Lynch, A., Galvin, K., Farkas, J., and Kerry, J. P. (2003) Combined effects of irradiation and the use of natural antioxidants on the shelf life stability of overwrapped minced beef. *Meat Sci.* 63, 443-440.
 9. Johnson, J. and Marcott, M. (1999) Irradiation control of insect pests of dried fruits and walnuts. *Food Technol.* 53, 46-51.
 10. Kitchell, A. G. and Shaw, B. G. (1975) Lactic acid bacteria in fresh and cured meat. In: *Lactic acid bacteria in beverage and foods.* Carr, J. G., Cutting, C. V., and Whiting, C. C. (eds), Academic Press, London, pp. 209-220.
 11. Koh, K. H. and Whang, K. (2003). Effect of electron beam irradiation on the oxidative and microbiological storage. *Korean J. Food Sci. Ani. Resour.* 22, 316-321.
 12. Liepe, H. U. (1983) Starter cultures in meat production. *Biotechnology* 5, 400-424.
 13. Leistner, L., Del, R. W., and Kripson, K. (1981) Microbiology of meat and products in high- and intermediaterange. In: *Water activity; Influence of Food Quality.* Academic Press, New York. pp. 885.
 14. Leistner, L. (1995). Stable and safe fermented sausages world-wide. In: *Fermented Meats.* Campbell-Platt, G. and Cook, P. E. (eds.), Blackie Academic & Professional, pp. 160-175.
 15. Lee, S. K. (1990) Ripening and development of fermented meat products. *Korean J. Food Sci. Ani. Resour.* 10, 59-74.
 16. Murano, E. A. (1995) Irradiation of fresh meats. *Food Technol.* 49, 52-54.
 17. Park, W. M., Choi, W. H., and Yoo, I. J. (1995) A role and utilization of microorganisms in fermented meat product. *Korean J. Food Sci. Ani. Resour.* 15, 244-251.
 18. Park, W. M., Choi, W. H., Yoo, I. J., Kim, Y. S. and Kim, C. H. (1996) Effects of mixed starter cultures on the bacteriological safety of fermented sausage. *Korean J. Food Sci. Ani. Resour.* 16, 9-13.
 19. Samelis, J., Metaxopoulos, J., Vlassi, M., and Pappa, A. (1998). Stability and safety of traditional Greek salamia microbiological ecology study. *Int. J. Food Microbiol.* 44, 69-82.
 20. Samelis, J., Kakouri, A., Savvaidis I. N., Riganakos, K., and Kontominas, M. G. (2005). Use of ionizing radiation doses of 2 and 4 kGy to control *Listeria* spp. and *Escherichia coli* O157:H7 on frozen meat trimmings used for dry fermented sausage production. *Meat Sci.* 70, 189-195.
 21. SAS (2005) SAS/STAT user's guide. SAS Institute Inc. Cary NC USA.
 22. Smith, J. L. and Palumbo, S. A. (1983) Use of starter cultures in meats. *J. Food Prot.* 46, 997.
 23. Thayer, D. W., Boyd, G., Fox, J. B., Lakritz, L., and Hampson, J. W. (1994) Variations in irradiation sensitivity of foodborne pathogens associated with the suspending meat. *J. Food Sci.* 60, 63-67.
 24. Thayer, D. W. and Rajkowski, K. T. (1999) Developments in irradiation of fresh fruits and vegetables. *Food Technol.* 53, 44-50.
 25. Vignolo, G. M., de Ruiz Holgado, A. P. and Oliver, G. (1989) Use of bacterial cultures in the ripening of fermented sausages. *J. Food Prot.* 52, 787.
 26. Witte, V. C., Krause, G. F., and Bailey, M. E. (1970) A new extraction method for determining 2-thiobarbituric acid values of pork and beef during storage. *J. Food Sci.* 41, 1433-1442.
- (2007. 6. 23. /2007. 8. 23.)