Short Paper

Microbial Flora of Jack Mackerel *Trachurus japonicus* Fillets Stored in Retail Packages Containing Different Gas Atmospheres at 5°C

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(Received August 31, 1990)

In recent years, partial freezing (-3°C) storage¹⁾ is increasing in common use in Japan during the transportation of fish. Bacterial growth is, if not at all, severely inhibited under this temperature.²⁾ In practice however, it is extremely difficult to strictly control the storage conditions under this sensitive temperature throughout distributions. Exposition to higher ambient temperatures can often occur during distribution, which may cause microbial growth, especially during the summer season.

One method that could potentially improve the practical deficiencies mentioned above is the combination of low temperature and modified atmosphere (MA) packaging. Studies³⁻⁶⁾ have shown that fish stored in a CO_2 atmosphere have a longer shelf life when compared to similar samples stored under air.

In our previous study,⁶⁾ we investigated the bacterial count of several marine fish fillets stored in MA packages and demonstrated a longer shelf life with CO_2 storage. In this paper, we report on the microbial flora during the MA storage. Jack Mackerel (*Trachurus japonicus*) fillets were stored in retail packages containing air, N_2 (nitrogen 100%), and CO_2 (CO_2 40%/N₂ 60%) atmosphere at 5°C following the procedure previously described.⁶⁾ Triplicate bags (containing one fillet each) on each sample were taken after 0, 3, 6 days of storage and microbial counts were determined. About 150 isolates from each sample (50 isolates from each fillet) were identified to the generic level according to the scheme of Cowan and Steel.⁷⁾

The results were shown in Table 1.

The microbial growth was decreased in the order, CO_2 , N_2 , and air storage. After 6 days, the air samples already smelled putrid and were covered with slime, whereas the CO_2 and N_2 samples were not.

The dominant microbial flora of fresh fillets were *Moraxella*, *Vibrio-Aeromonas* group, *Pseudomonas*, coryneforms, *Acinetobacter*, and *Micrococcus*. After

the period of storage, in both N_2 and CO_2 storage, several common features were noted: the growth of *Pseudomonas* was inhibited, whereas the growth of *Vibrio-Aeromonas* group was promoted. Small numbers of *Lactobacillus* was detected and the increased degree of ratio was noted during the course of storage (7-10% of the final microflora). Other studies^{3,4)} of CO_2 -stored fish have demonstrated the predominance of *Lactobacillus*. On the other hand, Fujii *et al.*⁵⁾ noted the absence of this genus on CO_2 -stored sardine. The degree of ratio of this genus on MA-stored fish is possibly dependent on the stages of the spoilage process, as suggested by Fujii *et al.*⁵⁾ Among three package treatments, the CO_2 samples appeared to preserve the versatility of initial microflora most intact. This may reflect the fact that the increase in microbial number in CO_2 samples was significantly lower than that in air and N_2 samples during the storage period.

From the data of the present as well as our previous study,⁶⁾ it was suggested that CO_2 atmosphere reduce the spoilage microbial growth and is likely to preserve the initial microbial flora.

We thank Showa Tansan Co., Ltd. for providing us with the gas packaging facilities and helpful advice.

References

- 1) H. Uchiyama and N. Kato: *Nippon Suisan Gakkaishi*, **40**, 1145-1154 (1974).
- 2) M. Okuzumi, T. Shimidu, and A. Matsumoto: *Nippon Suisan Gakkaishi*, **47**, 239-242 (1981).
- 3) G. Molin, I. Sternstrom, and A. Ternstrom: *J. Appl. Bacteriol.*, **55**, 49-54 (1983).
- 4) K. Mokhele, A. R. Johnson, E. Barrett, and D. M. Ogrydziak: *Appl. Environ. Microbiol.*, **45**, 878-883 (1983).
- 5) T. Fujii, M. Hirayama, M. Okuzumi, M. Yasuda, H. Nishino, and M. Yokoyama: *Nippon Suisan Gakkaishi*, **55**, 1971-1975 (1989).
- 6) B. Kimura, M. Murakami, and H. Fujisawa: *J. Shimonoseki Univ. Fish.*, **37**, 129-136 (1989).
- 7) S. T. Cowan and K. J. Steel: *Manual for the Identification of Medical Bacteria*, Cambridge University Press, London, 1966.
- 8) T. Fujii, M. Hirayama, M. Okuzumi, M. Yasuda, H. Nishino, and M. Yokoyama: *Nippon Suisan Gakkaishi*, **56**, 837 (1990).

Table 1. Microbial flora of jack mackerel fillets stored at 5°C under different gas packaging treatments*

Microorganism	Air			N ₂		CO ₂	
	Day0 (190)*†	Day3 (148)	Day6 (163)	Day6 (152)	Day6 (133)	Day3 (142)	Day6 (140)
<i>Vibrio-Aeromonas</i>	15.8**	44.6	50.9	60.0	57.9	24.6	43.6
<i>Pseudomonas</i>	11.1	27.0	18.4	9.7	5.3	9.9	2.1
<i>Alcaligenes</i>	2.1	2.7	1.8	5.3	1.5	3.5	2.1
<i>Moraxella</i>	26.3	18.9	22.1	5.9	6.0	14.8	9.3
<i>Flavobacterium</i>	0.5	—	—	—	—	0.7	—
<i>Acinetobacter</i>	10.5	—	0.6	—	5.3	9.9	16.4
Enterobacteriaceae	1.6	0.7	—	10.5	5.3	9.2	6.4
<i>Bacillus</i>	5.3	0.7	—	1.3	1.5	1.4	0.7
Coryneforms	11.6	2.0	6.1	2.6	0.8	14.1	2.9
<i>Staphylococcus</i>	1.1	0.7	—	3.3	0.8	0.7	—
<i>Micrococcus</i>	9.5	1.4	—	—	—	2.8	1.4
<i>Streptococcus</i>	—	0.7	—	—	—	0.7	1.4
<i>Lactobacillus</i>	—	—	—	0.7	9.8	0.7	7.1
Unidentified	4.7	0.7	—	0.7	5.3	7.0	6.4
Total aerobic count (log n/cm ² skin)*†	5.0±0.3	7.5±0.4	8.9±0.3	6.7±0.5	7.7±0.3	5.5±0.5	6.6±0.6

* N_2 , 100%; CO_2 , 40%; CO_2 /60% N_2 .

** % total tested.

** Number of isolates tested (3 fillets).

** Mean value on 3 fillets ± standard deviation.

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