J. Fish. Sci. Tech. 3(1), 44~48, 2000

JOURNAL OF
FISHERIES SCIENCE AND TECHNOLOGY

Property Changes of Salt-seasoned Salmon Roe during Fermentation

Sang Moo Kim
Faculty of Marine Bioscience & Technology Kangnung National University
Kangnung 210-702, Korea
(E-mail) smkim@knusun.kangnung.ac.kr

(Received January 2000, Accepted March 2000)

In order to utilize chum salmon returned in the east coast of Korea, the changes in the properties of *Yeonual-jeot* (salted salmon roe) fermented at different temperatures were measured for obtaining the basic data for its commercial production. Moisture content of salted salmon roe was significantly lower than raw salmon roe, while other proximate components were in the reverse. pH was constant for 56 days fermentation at 5℃, but decreased with fermentation period at 10 and 15℃. The contents of amino-nitrogen and VBN were almost in constant at 5℃ up to 28 days of fermentation, but increased very slowly at 10℃ and moderately at 15℃. TBA value, and the numbers of total viable cells and lactic acid bacteria increased over all fermentation periods, more at higher fermentation temperatures.

Key words: chum salmon, roe, fermentation, and *Yeonual-jeot*

Introduction

Fermented foods have played an important role in Korean dietary life in which they constituted the basis of the taste of Korean traditional meals and contributed significantly to the nutrition of the Korean people. The typical fermented fishery products are divided into three groups; *Jeotgal (jeot)* which is "salted-fermented fish", *Sikhae* which is "fermented fish with cooked cereals and subsidiary ingredients", and fish sauce which is "a liquid part of *Jeotgal*". *Jeotgal* is a fermented fish made by salting and mixing with subsidiary ingredients such as hot pepper, garlic, sesame, etc. (Lee et al., 1993)

The artificial propagation of salmon fry is one of the important projects in Korea. The returning rate of salmon is increasing every year; 349 in 1993, 398 in 1994, 419 in 1995, 479 in 1996, and 600 tons in 1997 (Maritime Administration Center, 1998). But the majority of salmon captured in Korea is chum salmon which is inferior for a raw material of food to other kinds of salmon. Most of them is discarded or used as animal feeds except small amount of chum salmon is utilized as foods in domestic market. Furthermore, the total amount of salmon captured in the eastern coastal ocean, Korea before delivery is not known exactly and estimated more than 100 tons. Salmon roe has been mainly used for topping of *Sushi*, one of the Japanese foods, and might be one of the raw materials for commercialization as a special product of east coastal region. Even though small amount of *Yeonual-jeot* (salted-fermented roe of salmon) is made as homemade level, it is not produced commercially and can not be displayed in the market.

In this study, fermented salmon roe was manufactured and its quality changes at different fermentation temperatures were measured for getting basic processing data.

Materials and Methods

Raw material

Roe of chum salmon (*Oncorhynchus keta*) captured in the lower point of Namdae river, Yangyang, Korea in November, 1997 was used as a raw material.

Manufacture of salt-fermented salmon roe (*Yeonual-jeot*)

Yeonual-jeot is manufactured by immersing fresh roe of salmon in seasoned brine. Therefore, salmon roe was firstly washed in 3% saline to remove blood, impurities, and foreign matters, etc., then sorted by its size, color, and freshness. Salmon roe dehydrated for 1 hr at room temperature was immersed in the seasoning solution consisted of 20% NaCl, 2% monosodiumglutamate (MSG), 1% sorbitol, and 1 % sugar per salmon roe for 24 hrs at room temperature. The immersing solution was changed once after 12 hrs. The immersed salmon roe was dehydrated again for 1 hr, packed in a plastic pot, and then fermented at 5, 10, and 15℃.

Proximate composition and pH

Proximate compositions of salmon roe during fermentation were determined according to AOAC (1990); moisture content by air oven method, crude lipid by Soxhlet method, protein by semimicro-Kjeldahl, ash by direct ashing method, and carbohydrate by difference method. pH of salmon roe during ripening was determined with a pH meter (Dongwoo Medical Center, Korea).

Lactic acid

Lactic acid content of salt-fermented salmon roe was determined according to the method of Kim et al. (1994a).

Amino-nitrogen (NH_2-N)

The content of amino-nitrogen was determined according to the method of Spies and Chamber (1951).

Volatile Basic Nitrogen (VBN)

The concentration of VBN was determined according to micro diffusion method using Conway unit (1950).

Thiobarbituric acid (TBA) test

TBA test for determining lipid oxidation of *Yeonual-jeot* during fermentation at different temperatures was carried out according to the method of Tarladgis et al. (1962). TBA value is defined as the equivalent amount (milligram) of malonaldehyde per kilogram of sample.

Microflora

The viable cell count of the microorganism was determined by the Standard Plate Count method (1985). The number of lactic acid bacteria was determined using MRS agar (Difco Co., Michigan, USA)

Statistical analysis

Regression analysis was conducted by the method of Steel and Torrie (1980) for simple regression models.

Results and Discussion

Proximate compositions

Proximate compositions of raw and salted salmon roe are shown in Table 1. Moisture content of raw roe was 66.6%, while that of salted was 55.1% in which 11.5% was reduced. But the contents of crude protein, crude lipid, carbohydrate, and crude ash were increased from 19.7 to 24.7%, 10.0 to 15.0%, 0. 2 to 0.3%, and 3.5 to 5.0%, respectively. The content of crude lipid in salmon roe was higher but ash content was lower than those of *Alaska pollack* and cod roes. The carbohydrate content of salmon roe was a little higher than that of both *Alaska pollack* and cod roes but no significant difference in other components (National Fisheries Research & Development Agency, 1995). Salinity of salted salmon roe was 6.3% determined by Volhard method (AOAC International, 1995).

Table 1. Proximate compositions of raw and salted salmon roes (%)

Proximate composition	Raw salmon roe	Salted salmon roe
Moisture	66.6 ± 0.82[a]	55.1 ± 0.80
Crude protein	19.7 ± 0.72	24.7 ± 0.76
Crude lipid	10.0 ± 0.70	15.0 ± 0.81
Carbohydrate	0.2 ± 0.02	0.3 ± 0.02
Crude ash	3.5 ± 0.35	5.0 ± 0.41

[a] Standard deviation

pH and lactic acid

The changes of pH and lactic acid amount during fermentation of salmon roe are shown in Fig. 1 and 2, respectively. pH of salmon roe was almost in constant at 5℃ but decreased at 10 and 15℃ as fermentation progressed (Fig. 1). At 15℃, pH decreased rapidly up to 14 days of fermentation and then slowly. This is similar to the results of Kim and Lee (1997) in which pH of fermented *Alaska pollack* roe increased a little at 5℃ but decreased at higher temperatures during ripening.

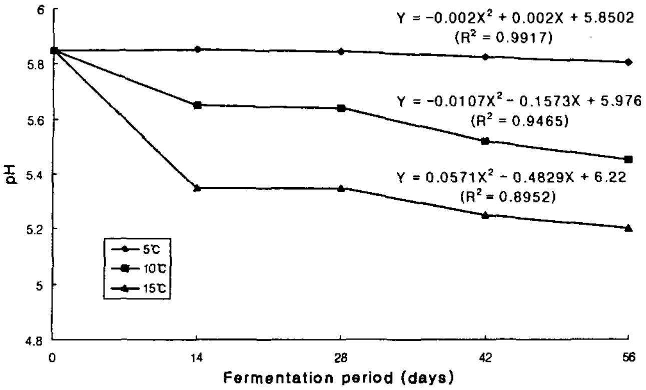

Fig. 1. Changes in the pH of salted salmon roe fermented at different temperatures.

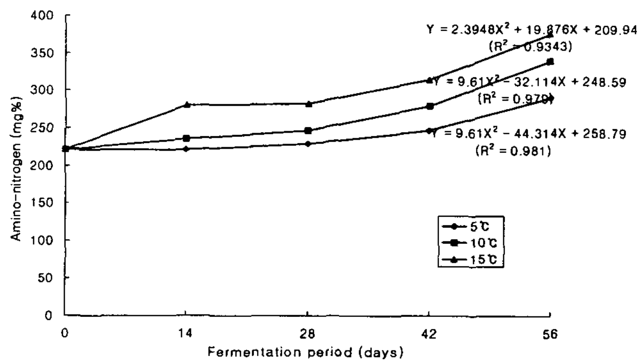

Fig. 3. Changes in the amino-nitrogen content of salted salmon roe fermented at different tempera-tures.

But, according to Park et al. (1998), pH of low salted *Pollack* tripe fermented at freezing point temperatures decreased a little as fermentation progressed, which is supposed considered to be due to more microbial acid production in *Pollack* tripe than *Pollack* roe.

The contents of lactic acid increased during fermentation, more at higher temperatures (Fig. 2), similar to the results of Kim and Lee (1997). Therefore, pH of salted salmon roe during fermentation might be changed mainly by lactic acid production.

Amino-nitrogen

Changes of the amino-nitrogen content during the fermentation of salted salmon roe are shown in Fig. 3. The contents of amino-nitrogen at 5 and 10℃ were in constant or increased slowly up to 28 days of fermentation and then increased somewhat rapidly. At 15℃, the content of amino-nitrogen increased rapidly on 14 days of fermentation and then constant up to 28 days, and then increased rapidly after that. Park et al. (1998) reported that amino-nitrogen content of low salt fermented *Pollack* tripe increased constantly up to 50 days of fermentation at freezing point temperature and then decreased slowly. Kim and Lee (1997) reported that the amino-nitrogen content of low salted *Alaska pollack* roe increased rapidly up to 5 days of fermentation and then slowly after that. Souane et al. (1987) also reported that the amino-nitrogen content of flatfish *Sikhae*, a traditional fermented fishery product in Korea, increased up to 15 days of fermentation and then decreased slowly, in which the most favorite and tasteful *Sikhae* by sensory evaluation was the fermented for 15 days with the highest amino-nitrogen content. In this study, the content of amino-nitrogen showed a similar trend to the results of Kim and Lee (1997).

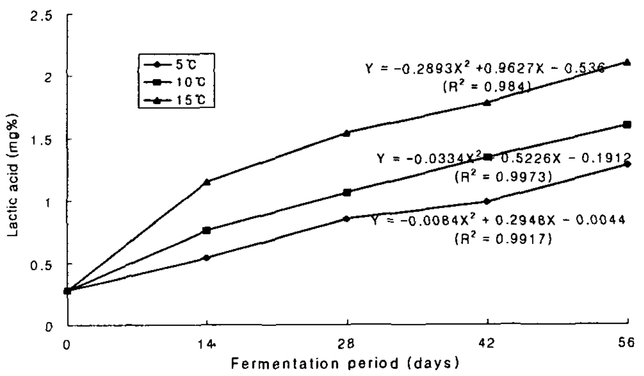

Fig. 2. Changes in the lactic acid content of salted salmon roe fermented at different tempera-tures.

Volatile basic nitrogen (VBN)

The volatile basic nitrogen (VBN) contents of fermented salmon roe are shown in Fig. 4. The VBN content at 5 and 10℃ showed almost in cons-tant or increased a little up to 28 days of fermentation and then increased rapidly, but that at 15℃ increased rapidly over all fermentation periods. The VBN content of fermented squid with 8% NaCl increased slowly up to 35 days of fermentation and did rapidly after that (Kim et al., 1993). However, VBN content of low salted *Alaska pollack* roe fermented at 10℃ increased very slowly up to 15 days of fermentation and since then increased very rapidly (Kim and Lee, 1997), which was similar to this study. But, according to Park et al. (1998), VBN

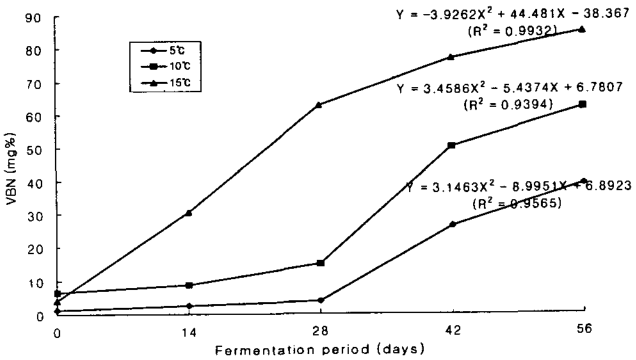

Fig. 4. Changes in the VBN content of salted salmon roe fermented at different temperatures.

content of low salted *Pollack* tripe fermented at freezing point temperature increased constantly as fermentation progressed up to 60 days of fermentation.

Thiobarbituric acid value (TBAV)

The changes in the thiobarbituricacid values (TBAV) of salted-fermented salmon roe are shown in Figure 5. TBAV increased during fermentation, more at higher temperatures. TBAV of low salted *Alaska pollack* roe fermented at 10℃ increased greatly up to 10 days of fermentation and then decreased slowly (Kim and Lee, 1997). The production of malonaldehyde was enhanced at high NaCl concentration, and KCl was more effective to inhibit malonaldehyde production than NaCl (Terrel, 1983). In this study, the low temperatures (5 and 10℃) might be effective to prevent malonaldahyde production, especially up to 28 days of fermentation.

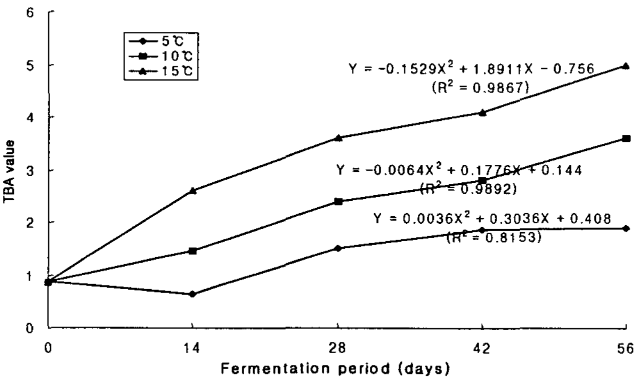

Fig. 5. Changes in the TBA value of salted salmon roe fermented at different temperatures.

Microflora

The changes of microflora during the fermentation of salmon roe are shown in Table 2 and 3.

Table 2. Changes in the total viable cell count of salted salmon roe fermented at different temperatures (CFU/g)

Temperatures	Fermentation periods (days)				
(℃)	0	14	28	42	56
5	3.0×10^{2}	3.5×10^{2}	1.2×10^{3}	6.0×10^{3}	5.2×10^{4}
10	3.0×10^{2}	3.2×10^{4}	5.3×10^{4}	5.8×10^{4}	9.8×10^{5}
15	3.0×10^{2}	6.8×10^{4}	6.0×10^{4}	1.6×10^{5}	2.9×10^{6}

Table 3. Changes in the number of lactic acid bacteria of salted salmon roe fermented at different temperatures (CFU/g)

Temperatures	Fermentation periods (days)				
(℃)	0	14	28	42	56
5	3.0×10^{2}	3.5×10^{2}	4.0×10^{2}	1.5×10^{3}	2.1×10^{4}
10	3.0×10^{2}	4.9×10^{3}	2.2×10^{4}	3.0×10^{4}	3.4×10^{4}
15	3.0×10^{2}	6.2×10^{4}	8.8×10^{4}	4.6×10^{4}	5.2×10^{5}

The numbers of total viable cells and lactic acid bacteria increased as fermentation progressed, more at higher temperatures. The numbers of total viable cells and lactic acid increased up to 15 and 16 days of fermented squid *Sikhae* (Kim et al., 1994b) and flatfish *Sikhae* (Souane et al., 1987), and then decreased slowly after that, due to the lactic acid accumulation. But, the numbers of microflora of salted *Alaska pollack* roe with 3% NaCl at 10℃ fermentation increased in which the numbers of total viable cell and lactic acid bacteria were 5.8×10^{8} and 4.0×10^{7} CFU/g, respectively on 20 days of fermentation (Kim and Lee, 1997), which was a little higher than in this study.

References

AOAC. 1990. *Official Methods of Analysis.* Association of Official Analytical Chemists, Washington, D.C., USA. p. 36.

AOAC. 1995. *Official Methods of Analysis.* 16th ed. AOAC International. Gaithersburg, MD.

Conway, E.J. 1950. *Microdiffusion Analysis and Volumetric Error.* Crosby Lockwood and Son Ltd., London, England.

Kim, D.S., Kim, Y.M., Koo, J.G. and Lee, Y.C. 1993. A study on shelf-life of seasoned and fermented squid. Bull. Korean Fish. Soc., 26, 13~20 (in Korean).

Kim, S.M., Cho, Y.J. and Lee, K.T. 1994b. The development of squid (*Todarodes pacificus*) sik-hae in Kangnung district. 2. The effects of fermentation temperatures and periods on chemical and microbial changes, and the partial purification of protease. Bull. Korean Fish. Soc., 27, 223~231 (in Korean).

Kim, S.M., Jeong, I.H. and Cho, Y.J. 1994a. The development of squid (*Todarodes pacificus*) sik-hae in Kangnung district. 1. The effects of fermentation temperaturs and periods on the properties of squid sikhae. Bull. Korean Fish. Soc., 27, 215~222 (in Korean).

Kim, S.M. and Lee, K.T. 1997. The shelf-life extension of low-salted *Myungran-jeot.* 1. The effects of pH on the shelf-life of low-salted *Myungran-jeot.* J. Korean Soc. Food Sci. Nutr., 26, 456~461 (in Korean).

Lee, C.H., K.H. Steinkraus and P.J. Alan Reilly. 1993 In *Fish Fermentation Technology.* United Nations University Press, New York, pp. 33~43, 187~202.

Maritime Administration Center. 1998. In *Fisheries Production in Kangwon Provincial Government,* Kangwondo, Korea. p. 96 [in Korean].

National Fisheries Research & Development Agency. 1995. In *Chemical Composition of Marine Products in Korea.* pp. 30~31 (in Korean).

Park, S.M., Park, C.K., Lee, K.T. and Kim, S.M. 1998. Changes in taste compound of low salt fermented pollack tripe during controlled freezing point aging. Korean J. Food Sci. Technol., 30, 49~53 (in Korean).

Richardson, G.H. 1985. In *Standard Methods for the Examination of Dairy Products.* 15th ed. American Public Health Assn., Washington, D.C., USA. pp. 25~39.

Souane, M., Kim, Y.B. and Lee, C.H. 1987. Microbial characterization of Gajami sik-hae fermentation. Korean. J. Appl. Microbiol. Bioeng., 15, 150~157.

Spies, T.R. and Chamber, D.C. 1951. Spectrophotometric analysis of amino acids and peptides with their copper salt. J. Biol. Chem., 191, 780~797.

Steel, R.G.D. and Torrie, J.H. 1980. *Principles and Procedures of Statistics,* 2nd ed. McGraw-Hill Book Co. Inc., New York.

Tarladgis, B.G., Pearson, A.M. and Dugan, L.R. 1962. The chemistry of the 2-thiobarbituric acid test for the determination of oxidative rancidity in foods. I. some important side reactants. J. Am. Oil Chem. Soc., 39, 34~39.

Terrel, R.N. 1983. Reducing the sodium content of processed meat. Food Rech., 37, 66~72.