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Lipid Components of the Cultured Pearl Oyster (*Pinctada fucata martensii*) in Korea

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Protein, lipid classes, and fatty acid composition, including n-3 highly unsaturated fatty acids (HUFAs), were analyzed in the soft parts, which we differentiated as the adductor muscles and "other portions," from the cultured pearl oyster after the pearl was harvested and before the nucleus was grafted to evaluate the nutritional qualities of the soft parts. Total lipid content was higher in the other portions of the soft parts (1.25-1.26%) than in the adductor muscles (0.58-0.65%) in both pearl oyster samples, whereas protein content was higher in the latter (15.5-18.7%) than in the former (11.2-13.9%; $P<0.05$). The percentage of total lipids (TLs) consisting of phospholipids (PLs) was higher in the adductor muscles (60.4-68.3%) than in the other portions (40.6-47.0%), but the percentage of nonpolar lipids (NLs) was higher in the other portions of the soft parts. The prominent lipid classes were free sterol (FS) and triglyceride (TG) in the NLs and phosphatidylcholine and phosphatidylethanolamine in the PLs. The adductor muscles contained high levels of FS and all PL classes, while the other portions contained high levels of all NL classes, especially TG (but not FS; $P<0.05$). The prominent fatty acids were 22:6n-3 (17.2-24.9%), 16:0 (8.35-15.8%), 20:5n-3 (7.95-14.9%), 18:0 dimethyl acetal (DMA, 4.79-13.5%), 18:0 (4.50-6.16%), and 20:4n-6 (4.36-5.43%). The percentages of 22:6n-3, 20:4n-6, and 18:0 DMA were higher in the adductor muscles than in the other portions of both pearl oyster samples, while those of 20:5n-3 and 16:0 were higher in the other portions ($P<0.05$). The levels of these food components were similar to those of other bivalves or were higher, especially the protein content, indicating that the soft parts of pearl oysters, which are currently wasted, have food value.

Keywords: *Pinctada fucata martensii,* Pearl oyster, Adductor muscles, Fatty acid, Lipid class

Introduction

In Korea, the pearl oyster *Pinctada fucata martensii* is cultured in the sea off the coast of Tongyeong. The pearl oyster that is usually cultured for 2 or 3 years on the pearl farm, are used for grafting a spherical nucleus of mussel shell. The nucleus with a piece of the mantle from another pearl oyster is inserted into the pearl oyster's gonad, and the oyster then is cultured for 1 or 2 years to create a pearl. Pearls are isolated from the shucked pearl oysters through a homogenization process with slaked lime (Kanoh et al., 2004).

Informal sources indicate that about 53 metric tons (M/T) of pearl oysters were produced in Korea in 2003, with 750 kg of pearls harvested (1,400,000 pearls). Pearl oysters consist of about 60% shell and 40% soft parts (7% adductor muscle and 33% gonad, mantle, etc.). The soft parts are usually discarded after the pearls are harvested. If useful nutraceuticals could be isolated from the waste, the pearl oyster culture industry would benefit from the added value, and environmental pollution caused by disposal of the soft parts would decrease.

Marine organisms are unique resources of n-3 highly unsaturated fatty acids (n-3 HUFAs) such as eicosapentaenoic acid (20:5n-3) and docosahexaenoic acid (22:6n-3), which have beneficial effects on cardiovascular diseases, some cancers, hypertension, and aging (Simopoulos, 1986; Lees, 1990). Some marine food scientists have described the n-3 HUFAs

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from marine organisms as marine vitamins. The pearl oyster is a bivalve and thus the composition of its soft parts would be expected to be similar to that of other bivalves. However, little is known about the nutrient composition, especially n-3 HUFA, of the soft parts of the cultured pearl oyster.

The purpose of this study was to examine the potential of the soft parts from pearl oysters as food. In this study, the adductor muscles and other soft parts of pearl oysters were analyzed for proximate composition, lipid classes, and fatty acid composition, including the n-3 HUFAs. Samples were obtained at two points in the production process: after harvesting the pearl and before grafting the nucleus.

Materials and Methods

Materials

Live specimens of cultured pearl oysters (*P. fucata martensii*), which had been cultured for about 2 years after hatching, were obtained from a pearl farm off the coast of Tongyeong in December 2004. The pearl oysters were transported to the laboratory of Gyeongsang National University in an ice box. Shell height (7.0±0.6 cm), shell length (6.6±0.5 cm), and body weight (45.6±7.1 g) were measured on 20 randomly chosen specimens. The adductor muscles (3.0±0.8 g) and the other portions (gonad, mantle, etc., 15.0±3.3 g) of the soft parts were isolated and kept at -70°C (before grafting the nucleus). Additional samples (both the adductor muscles and other portions) from oysters after the pearls were harvested were also obtained from the same pearl farm in December 2004 and kept at -70°C. The samples were mixed with a speed cutter, and their nutritional composition was analyzed.

Analysis of proximate composition

The moisture and ash contents were determined by the atmospheric heat drying method at 105 and 550°C, respectively. The protein content was determined by the Kjeldahl method. The total lipids (TLs) were extracted and purified according to the method of Bligh and Dyer (1959), and the content was determined gravimetrically. The phospholipid (PL) content in the TLs was determined by the method of Bartlett (1959). The nonpolar lipid (NL) content in the TLs was calculated from the difference between the TL and PL values.

Analysis of lipid class and fatty acid composition

The lipid class compositions of PLs and NLs were determined as described in Jeong et al. (1990). The fatty acids were determined after methylation (AOCS 1990). The fatty acid composition of the TLs was analyzed using a gas-liquid chromatograph (Shimadzu GC 17A; Shimadzu Seisakusho, Co. Ltd., Japan) fitted with an Omegawax 320 fused silica capillary column (30 m × 0.32 mm; ID, Supelco, Bellefonte, USA). The injector and flame-ionization detector were held at 250°C; the column oven temperature was programmed from 180°C (initial time 8 min) to 230°C at 3°C/min; and the final temperature was held for 15 min. Helium was used as a carrier gas at the constant column inlet pressure of 1.0 kg/cm^2 with a split ratio of 1:50. Fatty acids were identified by comparison with authentic standards (Sigma Chemical Co., St. Louis, USA) and oyster fatty acids, which were analyzed by Koizumi et al. (1990). GC-Mass spectrometry (MS) was not used to confirm the structures. Therefore, the identification of fatty acids, especially the minor components, is only tentative. Methyl tricosanoate (99%; Aldrich Chemical Co., Milwaukee, WI, USA) was used as an internal standard.

Statistical analysis

Analyses were performed by SPSS (version 10.0). Significant differences between samples ($P < 0.05$) were identified by analysis of variance (ANOVA) and Duncan's multiple range test.

Results and Discussion

Proximate composition

Table 1 shows the proximate composition of the adductor muscles and the other portions of the soft parts of both samples before grafting the nucleus and after harvesting the pearl. The protein contents of the samples differed significantly. The protein content was higher in the adductor muscles (15.5-18.7%) than in the other portions (11.2-13.9%) of both samples. The adductor muscles in the sample obtained after the pearl was taken contained much more protein than the sample taken before grafting the nucleus, but the other portions of the latter contained much more protein than those in the former. Moisture contents also differed significantly, ranging from 76.3 to 84.2%. The other portions of the soft parts contained more moisture, lipids, and ash than did the adductor muscles in both samples. In particular, the lipid content of the other portions (1.25-1.26%) was about twofold higher than that of the adductor muscles (0.58-0.65%) in both samples. However, the lipid content did not differ significantly between the same portions of both samples. In general, the lipid con-

Table 1. Proximate composition (wt %) of the cultured pearl oyster[1]

	Before grafting the nucleus		After taking the pearl	
	Adductor muscle	Other portion	Adductor muscle	Other portion
Moisture	80.52 ± 0.30^{c}	82.38 ± 0.10^{b}	76.26 ± 0.23^{d}	84.23 ± 0.24^{a}
Protein	15.46 ± 0.71^{b}	13.87 ± 0.64^{c}	18.70 ± 0.25^{a}	11.17 ± 0.49^{d}
Lipid	0.65 ± 0.04^{b}	1.25 ± 0.11^{a}	0.58 ± 0.01^{b}	1.26 ± 0.02^{a}
Ash	0.98 ± 0.07^{c}	1.73 ± 0.03^{b}	2.02 ± 0.06^{b}	2.89 ± 0.01^{a}

[1]Data are expressed as mean ± SD of four determinations (two groups x two determinations), and different superscript letters indicate statistically significant difference (P<0.05).

tents of fish and shellfish are higher during the spawning season than during the growing season. Saito (2004) analyzed the lipid content of the total soft parts of the cultured pearl oyster in Japan and showed that it was higher (1.0-2.0%) during the spawning season (June and July) than during the growing season (0.4-0.7%; November and March). The comparatively high levels of lipids during the spawning season suggest that lipids may play a role in maturation (Saito, 2004). Although the pearl oysters were collected in a different habitat, the lipid contents, which were derived from samples taken during the growing season (December), were similar to those of Japanese pearl oysters during the growing season.

However, the protein contents in the soft parts of the pearl oysters (mean value, 14.8%) were high compared with those (mean value, 11.8%) of 13 bivalve species among 35 marine invertebrate species (Jeong et al., 1999). This suggests that the soft parts of pearl oysters could be good sources of protein compared to other bivalves. However, the lipid, moisture, and ash contents in the soft parts of the pearl oysters were similar to those of the edible parts of the 13 bivalve species reported by Jeong et al. (1999).

NL and PL contents and lipid class composition

NL and PL contents and lipid class composition are shown in Table 2. The NL contents were 0.18-0.26 g/100 g sample (31.8-39.6% of TL content) in the adductor muscles and 0.66-0.75 g/100 g sample (53.0-59.4% of TL content) in the other portions of both samples. The PL contents were also higher in the other portions (0.51-0.59 g/100 g) than in the adductor muscles (0.39-0.40 g/100 g) of both samples, but the proportion of TLs consisting of PLs in the latter, 60.4-68.3%, was higher than that in the former, 40.6-47.0%. In general, the proportions of PLs in tissue TL are almost constant in most animals because they are important as cell membrane lipids, whereas the levels of depot lipids vary (Morris and Culkin, 1989). The mean PL levels in most marine organisms are less than 1% (Takama et al., 1994; Medina et al., 1995; Moon et al., 2000).

The prominent NL classes were free sterols (FSs) and triglycerides (TGs) in all samples except in the adductor muscles of the sample after taking the pearl (1.84%), and the proportions of FSs and TGs showed significant differences among all samples. The proportion of FSs was much higher in the adductor muscles (24.7-26.9%) compared to those in the other portions (16.6-19.1%), but the proportion of TGs was about one-fourth to one-tenth in the former (1.84-6.18%) compared to the latter (20.0-25.6%) in both samples. However, the other portions of the sample after harvesting the pearl contained a large amount of free fatty acids (FFAs; 14.8% of the TL content), which may have been hydrolyzed from lipids (Saito, 2004). This may have been particularly true for PLs such as phosphatidylcholine (PC) and phosphatidylethanolamine (PE), during the process of harvesting the pearl and/or creating the pearl in the pearl oyster. In fact, as described later, the proportions of PL classes, especially PC in the other portions of the sample after taking the pearl, were low (P < 0.05) compared to those of the sample before grafting the nucleus.

In both samples, the prominent PL classes were PC and PE. The proportions of PC and PE differed significantly among all samples, and those of PC and PE differed significantly in the adductor muscles (24.2-26.2 and 13.6-16.8%, respectively), where levels were high compared to those in the other portions (14.8-19.1 and 8.83-9.48%, respectively) in both samples. Therefore, with respect to these prominent PL classes, there were clear differences between two portions of the soft parts but few differences between the same portions in both samples before grafting the nucleus and after taking the pearl. Furthermore, the proportions of all PL classes, including PC and PE, were also higher in the adductor muscles than in the other portions of both samples. The adductor muscles had higher pro-portions of PLs in the TL than the other portions in both samples.

Table 2. Lipid contents and lipid class compositions of the cultured pearl oyster[1]

Lipid	Before grafting the nucleus		After taking the pearl	
	Adductor muscle	Other portion	Adductor muscle	Other portion
TL (g/100g muscle)	0.65	1.25	0.58	1.26
NL (g/100g muscle)	0.26 (39.6)[2]	0.66 (53.0)	0.18 (31.8)	0.75 (59.4)
PL (g/100g muscle)	0.39 (60.4)	0.59 (47.0)	0.40 (68.3)	0.51 (40.6)
NL class[3]				
FS	26.87 ± 0.32^{a}	16.65 ± 0.22^{d}	24.65 ± 0.80^{b}	19.10 ± 0.65^{c}
FFA	2.69 ± 0.01^{c}	4.98 ± 0.54^{b}	2.73 ± 0.39^{c}	14.75 ± 0.35^{a}
TG	6.18 ± 0.11^{c}	25.60 ± 1.74^{a}	1.84 ± 0.79^{d}	20.01 ± 0.37^{b}
GE	2.59 ± 0.18^{a}	3.86 ± 0.95^{a}	1.09 ± 0.44^{b}	3.36 ± 0.01^{a}
SE				
PL class[3]	1.27 ± 0.61	1.92 ± 0.48	1.49 ± 0.76	2.15 ± 0.62
SPM	6.10 ± 0.41^{b}	5.20 ± 0.36^{b,c}	8.46 ± 1.11^{a}	6.56 ± 0.22^{b}
PC	24.21 ± 0.67^{b}	19.06 ± 1.20^{c}	26.24 ± 1.50^{a}	14.78 ± 0.14^{d}
PS	6.49 ± 0.49^{a}	4.37 ± 0.60^{b}	6.78 ± 0.41^{a}	4.13 ± 0.23^{b}
PI	6.05 ± 0.31^{a,b}	5.58 ± 0.55^{b}	6.21 ± 0.24^{a}	3.89 ± 0.26^{c}
PE	13.60 ± 0.46^{b}	9.48 ± 0.56^{c}	16.84 ± 0.67^{a}	8.83 ± 0.25^{c}
UK	3.96 ± 0.18^{a}	3.31 ± 0.38^{b}	3.78 ± 0.42^{a,b}	2.41 ± 0.10^{c}

[1]Data are expressed as mean ± SD of four determinations (two groups x two determinations) and different superscript letters indicate statistically siginificant difference ($P<0.05$). TL, total lipid; NL, non-polar lipid; FS, free sterol; FFA, free fatty acid; TG, triglyceride; GE, glycerylether; SE, sterol ester; PL, phospholipid; SPM, sphingomyelin; PC, phosphatidylcholine; PS, phosphatidylserine; PI, phosphatidylinositol; PE, phosphatidylethanolamine; UK, unknown. [2]Figures in parentheses are presented as weight percent of TL content. [3]Results are expressed as weigh percent of TL content.

However, a lipid class was shown on thin layer chromatography that could not be identified as a PL, but was not the glycolipid galactosyl cerebroside (standard). In the present study, this lipid class thus was treated as an unknown (UK) lipid class, but it may have been ceramide aminoethyl phosphate, which was found in the soft parts of the pearl oyster in Japan (Saito, 2004). Furthermore, sphingomyelin (SPM), phosphatidylserine (PS), and phosphatidylinositol (PI) were found at 4-9% levels in all samples, which were high compared to those of a bivalve (*Crassostrea gigas*; Jeong et al., 1999), and a lean fish (*Pararlichthys olivaceus*; Jeong et al., 2000).

Fatty acid compositions of the TL

Table 3 shows the fatty acid compositions (>0.5% of the total fatty acids) of the TL in the adductor muscles and other portions of both samples. These fatty acid profiles of the TLs were similar to those of other bivalves (Jeong et al., 1998). The prominent fatty acids that accounted for more than 3% of the total fatty acids were 16:0 and 18:0 in saturates, 16:1n-7, 18:1n-9, 18:1n-7, and 20:1n-11(+9) in monoenes, 20:4n-6, 20:5n-3, 22:2 non-methylene interrupted diene (NMID; $\Delta^{7,15}$), 22:5n-3, and 22:6n-3 in polyenes, and 18:0 dimethyl acetal (DMA) and 16:0 DMA from ether lipids such as plasmalogen. In saturates including DMA, the proportions of 16:0 were significantly different between the samples and slightly higher in the sample before grafting the nucleus compared with the sample after taking the pearl. The proportion of 16:0 was about 1.5-fold higher in the other portions compared with the adductor muscles in both samples. In contrast, the proportion of 18:0 DMA was significantly different between the adductor muscles (12.6-13.5%) and the other portions (4.79-6.25%) of both samples, but not significantly different between the same portions of the two samples. The proportion of 18:0 was 4.50-6.16% in all samples but not significantly different in all samples. In monoenes, the proportion of 16:1n-7 was significantly different between the adductor muscles (3.53-3.90%) and the other portions (1.21-1.93%) of both samples. The proportion of 18:1n-7 was slightly higher in the other portions of both samples, but that of 20:1n-11(+9) was slightly higher in the adductor muscles; these differences between the two fatty acids barely reached statistical significance. In polyenes, the proportions of 20:4n-6, 22:2NMID($\Delta^{7,15}$), and 22:6n-3 were higher in the adductor muscles compared with those in the other portions of both samples; in particular, the proportion of 22:6n-3 was about 5-7% higher in the adductor muscles ($P<0.05$). In contrast, the proportions of 20:5n-3 were 4-7% higher in the other portions compared with those in the adductor muscles ($P<0.05$).

Saito (2004) studied the fatty acids in the soft parts of pearl oysters in Japan during the growing season

Table 3. Fatty acid compositions (wt %) of the cultured pearl oyster[1]

Fatty acid	Before grafting the nucleus		After taking the pearl	
	Adductor muscle	Other portion	Adductor muscle	Other portion
14:0	0.56 ± 0.04^{b}	2.09 ± 0.29^{a}	0.23 ± 0.04^{c}	1.98 ± 0.11^{a}
Pristanic	0.65 ± 0.04^{b}	0.12 ± 0.03^{c}	0.89 ± 0.05^{a}	0.16 ± 0.02^{c}
16:0 DMA	1.51 ± 0.58^{b}	0.77 ± 0.29^{b}	3.12 ± 0.69^{a}	1.41 ± 1.25^{b}
16:0	10.07 ± 0.16^{c}	15.77 ± 0.41^{a}	8.35 ± 0.31^{d}	14.18 ± 0.76^{b}
17:0 anteiso	0.63 ± 0.02^{a}	0.29 ± 0.04^{c}	0.66 ± 0.06^{a}	0.42 ± 0.08^{b}
17:0	0.82 ± 0.02^{c}	1.21 ± 0.12^{a}	0.62 ± 0.03^{d}	1.11 ± 0.05^{b}
18:0 DMA	13.46 ± 1.16^{a}	4.79 ± 1.95^{b}	12.60 ± 1.21^{a}	6.25 ± 4.24^{b}
18:0	5.15 ± 0.05	6.16 ± 0.60	4.50 ± 0.08	4.66 ± 3.11
Others[2]	0.60	1.00	0.85	0.92
ΣSaturates	33.45	32.20	31.82	31.09
16:1n-7	1.21 ± 0.03^{c}	3.90 ± 0.41^{a}	1.93 ± 0.47^{b}	3.53 ± 0.46^{a}
17:1n-8	0.13 ± 0.01	1.46 ± 1.38	0.18 ± 0.02	2.30 ± 3.75
18:1n-9	2.15 ± 0.05	3.19 ± 0.82	2.13 ± 0.07	1.18 ± 0.81
18:1n-7	3.22 ± 0.14	3.59 ± 0.21	2.92 ± 0.07	4.26 ± 1.85
20:1n-11+9	3.62 ± 0.11^{a,b}	3.23 ± 0.15^{a,b}	4.31 ± 0.06^{a}	2.48 ± 1.60^{b}
20:1n-7	1.04 ± 0.05	1.14 ± 0.11	1.01 ± 0.04	1.73 ± 0.93
22:1n-9	1.91 ± 0.06^{a}	1.09 ± 1.02^{b}	0.07 ± 0.01^{d}	0.44 ± 0.19^{c}
Others[3]	0.38	0.63	0.30	0.53
ΣMonoenes	13.66	18.23	12.85	16.45
16:3n-4	0.61 ± 0.04	0.24 ± 0.06	0.62 ± 0.04	0.30 ± 0.21
18:2n-6	1.23 ± 0.06^{a}	1.22 ± 0.20^{a}	1.34 ± 0.03^{a}	0.89 ± 0.05^{b}
18:3n-3	0.51 ± 0.05^{b}	0.71 ± 0.05^{a}	0.43 ± 0.01^{c}	0.73 ± 0.07^{a}
18:4n-3	0.54 ± 0.03^{c}	0.95 ± 0.11^{a}	0.57 ± 0.01^{c}	0.87 ± 0.02^{b}
20:2n-6	0.39 ± 0.03	0.63 ± 0.36	0.38 ± 0.02	0.56 ± 0.45
20:4n-6	5.25 ± 0.07^{a,b}	4.36 ± 0.64^{b,c}	5.43 ± 0.10^{a}	4.86 ± 0.21^{b}
20:4n-3	0.23 ± 0.03^{b}	0.65 ± 0.39^{a,b}	0.28 ± 0.03^{b}	0.75 ± 0.41^{a}
20:5n-3	9.98 ± 0.19^{c}	13.69 ± 0.69^{b}	7.95 ± 0.16^{d}	14.92 ± 0.55^{a}
22:2NMID(△7,13)	0.31 ± 0.08	1.49 ± 0.09	2.39 ± 0.09	2.19 ± 0.14
22:2NMID(△7,15)	3.39 ± 0.12^{a,b}	3.01 ± 0.88^{b}	3.83 ± 0.10^{a}	3.11 ± 0.04^{b}
22:3n-6	1.12 ± 0.06^{b}	0.68 ± 0.05^{c}	1.56 ± 0.28^{a}	0.96 ± 0.12^{b}
22:4n-6	1.44 ± 0.50	0.83 ± 0.08	1.57 ± 0.30	0.97 ± 0.09
22:5n-6	1.40 ± 0.57^{a}	0.66 ± 0.05^{b}	1.07 ± 0.19^{a}	0.75 ± 0.19^{a,b}
22:5n-3	3.05 ± 0.21^{a}	2.22 ± 0.27^{b}	2.72 ± 0.18^{a,b}	2.73 ± 0.82^{a,b}
22:6n-3	23.00 ± 0.39^{b}	17.51 ± 0.57^{c}	24.94 ± 0.37^{a}	17.15 ± 1.26^{c}
Others[4]	0.44	0.72	0.46	0.70
ΣPolyenes	52.89	49.57	55.54	52.44

[1]Data are expressed as mean ± SD of four determinations (two groups x two determinations), fatty acid components present at <0.5% in all the values of each lane were removed and different superscript letters indicate statistically siginificant difference (P<0.05). DMA, dimethyl acetals; NMID, non-methylene interrupted dienes. [2]Includes 15:0, phytanic, 18:0 iso, 19:0, 20:0 and 22:0. [3]Includes 16:1n-5 and 18:1n-5. [4]Includes 18:2n-4, 20:3n-6 and 20:3n-3.

and demonstrated that the major fatty acids of TG were 16:0 (12.4-15.3%), 18:0 (6.4-10.1%), 22:2 NMID($\Delta^{7,15}$; 2.0-4.0%), 20:4n-6 (2.1-5.3%), 20:5n-3 (8.5-12.3%), and 22:6n-3 (9.0-13.0%); those of PE were 18:0DMA (13.8-17.0%), 18:0 (4.4-4.5%), 22:2NMID($\Delta^{9,15}$; 6.5-10.1%), 22:2NMID($\Delta^{7,15}$; 2.1-6.4%), 20:4n-6 (6.9-9.4%), 22:3($\Delta^{6,9,15}$; 3.6-4.2%), 20:5n-3 (7.0-10.4%), and 22:6n-3 (19.6-27.3%); and those of PC were 16:0 (14.9-20.0%), 18:0 (4.2-4.3%), 18:1n-7 (1.4-3.1%), 20:1n-11 (2.3-3.3%), 22:2 NMID ($\Delta^{7,15}$; 3.4-3.5%), 20:4n-6 (4.5-6.1%), 20:5n-3 (7.6-8.4%), and 22:6n-3 (29.6-32.3%).

In the present study, the proportions of prominent fatty acids in the adductor muscles of the soft parts in both samples were similar to those of PE or PC of the pearl oysters in Japan because the adductor muscles of the pearl oysters in Korea contained high levels of PLs such as PC or PE compared to the other portions. However, the proportions of prominent fatty acids of the other portions of the soft parts in both samples were similar to those of TG in the pearl oysters in Japan because the other portions of the pearl oysters in Korea contained high levels of TG compared to the adductor muscles. In particular, 22:6n-3, 18:0DMA, and 20:4n-6 seemed to be the characteristic fatty acids in adductor muscles rich in PL such as PE and

PC, whereas 20:5n-3 and 16:0 seemed to be the characteristic fatty acids in the other portions, which were rich in TG.

Jeong et al. (1998) studied the fatty acids of 35 marine invertebrate species, including 13 bivalves, and demonstrated the proportions of some characteristic fatty acids; 22:6n-3 ranged from 9.34 to 24.3% (mean value, 16.0%), 20:5n-3 ranged from 7.32 to 26.6% (mean value, 17.6%), and 20:4n-6 ranged from 1.41 to 4.34% (mean value, 2.98%). Therefore, the mean values of 22:6n-3 and 20:4n-6 in 13 species of bivalves were low compared to those of the soft parts (mean values, 20.7 and 4.98%, respectively) of the pearl oysters, whereas that of 20:5n-3 was higher (mean value, 11.6%) than in the pearl oysters. The differences in these fatty acid compositions may have been due to their prey or their species-specificity, even though they belong to the same taxonomic group.

The soft parts of the pearl oyster that are currently discarded have food components including n-3 HUFA similar to those of other edible bivalves, with particularly high 22:6n-3 and protein contents. Therefore, the soft parts of the pearl oyster have nutritional food value.

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