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Comparison of Body Fat Content and Lipid in Serum in Cultured Flounder in Korea and Japan

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The samples of cultured flounder (*Paralichtys olivaceus*) were collected from Tongyeong and Yosu in Korea and Nagasaki in Japan and processed to analyses of body and serum. Body size and weight were not significantly different between Korea and Japan produced. But the body weight of average size of flounder produced from Nagasaki was the highest from the samples. The average of fish body was not significantly different from the samples. The water content of fish body was lower in samples from Nagasaki and fat content was higher in the samples from Nagasaki and followed by Yosu and Tongyeong. The percentage of body water, fat and protein contents was Nagasaki, Yosu and Tongyeong in the order of high values. Japanese flounder showed relatively high content of body fat and muscle. The cholesterol of serum was highest in the samples of Yosu. The triglyceride of serum was highest in the samples of Nagasaki. Lipoprotein was highest in the samples of Nagasaki and enriched fat content in LDL fraction.

Key words : flounder, lipoprotein, disc electrophoresis profile

Introduction

Recently, to culture the flat fish is very prevalent both in Korea and Japan. In special, the culture of flat fish occupied an important position in Korea. Culture techniques between two countries are similar. But the yearly variation of water temperature and feed are a little different.

Therefore, as a cooperative study between two countries, influences of those differences on the fat content of body and on lipid in serum are experimented and discussed.

Materials and Methods

1. Sample fish

Flounders cultured in Yosu and Tongyeong, Korea and in Nagasaki, Japan are used as samples for experiments. Numbers of sample are nine from Yosu, and ten from Tongyeong and ten from Nagasaki. Body size, body composition, lipid and lipoprotein in serum of each sample were measured. In body size, body length, body weight, and body density were checked.

Fig. 1 shows a comparison of the seawater temperature between Korea and Japan. And Fig. 2 also shows general components of the feed for the flounder cultured in Korea and Japan.

2. General components

In body composition, body water content was measured with the method of heat drying at normal pressure after body including scales and internals was grinded down and homogenized, body fat content with the method of Folch (Folch and Sloane Stanly, 1957), body protein content with the method of Kieldahl, and other contents were also measured.

3. Triglyceride and total cholesterol contents in serum

In lipid in serum, triglyceride was measured

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with the method of GPO · MEHA (Bucolo and David, 1973) and cholesterol content with the method of MEHA (Allain *et al.*, 1974).

4. Disc electrophoresis profiles of serum lipoprotein

Disc electrophoresis for lipoprotein in serum was measured with the method of McDonald (McDonald and Ribeiro, 1959) and Narayan (Narayan *et al.*, 1966) and the method of Kelly (Kelly and Kruski, 1986) for density gradient ultracentrifugation.

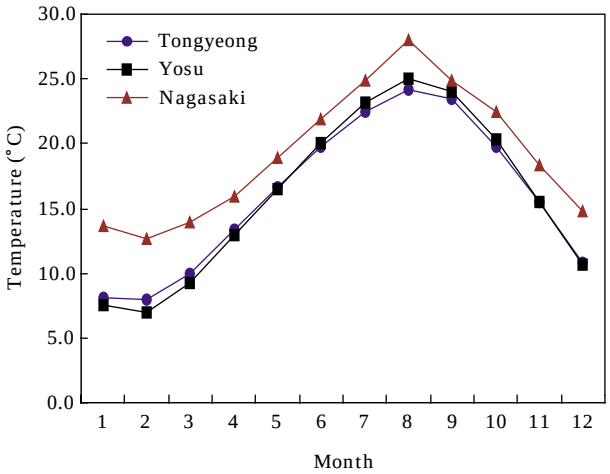

Fig. 1. Comparison of the seawater temperature between Korea and Japan.

Results

1. Body size of sample fish

Table 1 shows the body size of the flounder of Korea (Yosu and Tongyeong) and that of Japan (Nagasaki). Standard body length of total sample fishes was 28.5～34.6 cm with an average 29～30 cm and body weight was 464～732 g with an average 600 g. The two values together were a little high in the flounder of Yosu. Body density was also a bit high in the flounder of Yosu. But there is no significant difference.

A relationship between standard body length and body weight shown as the natural logarithm

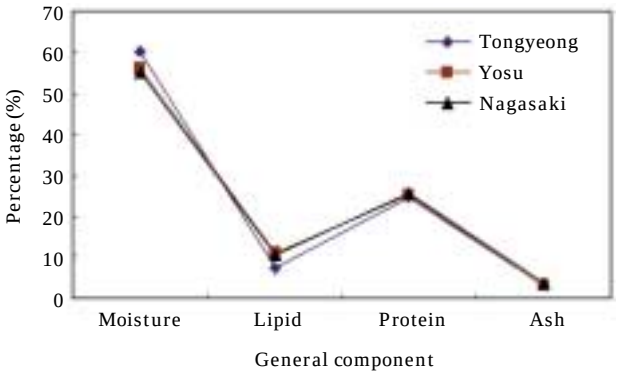

Fig. 2. General components of the feed for the flounder cultured in Korea and Japan.

Table 1. Physical characteristics of the flounder cultured in Korea and Japan

Group		Specimen number	Physique		
			Standard body length (cm)	Body weight (g)	Body density (g/cm^3)
Korea	Tongyeong	10	29.9±0.8	510.2±36.8	1.0744±0.0013
	Yosu	9	31.4±2.2	598.4±134.0	1.0764±0.0028
Japan	Nagasaki	10	30.3±1.1	566.3±54.9	1.0744±0.0031

Table 2. Mean values of body composition of the flounder in Korea and Japan

Group		Specimen number	Body composition			
			Water content (g/100 g)	Fat content (g/100 g)	Protein content (g/100 g)	Other content (g/100 g)
Korea	Tongyeong	10	72.59±0.72	5.93±0.52	18.67±0.49	2.81±0.29
	Yosu	9	72.64±0.99	5.13±0.90	19.12±0.65	3.12±0.45
Japan	Nagasaki	10	71.67±1.04	6.64±0.67	19.09±0.60	2.61±0.47

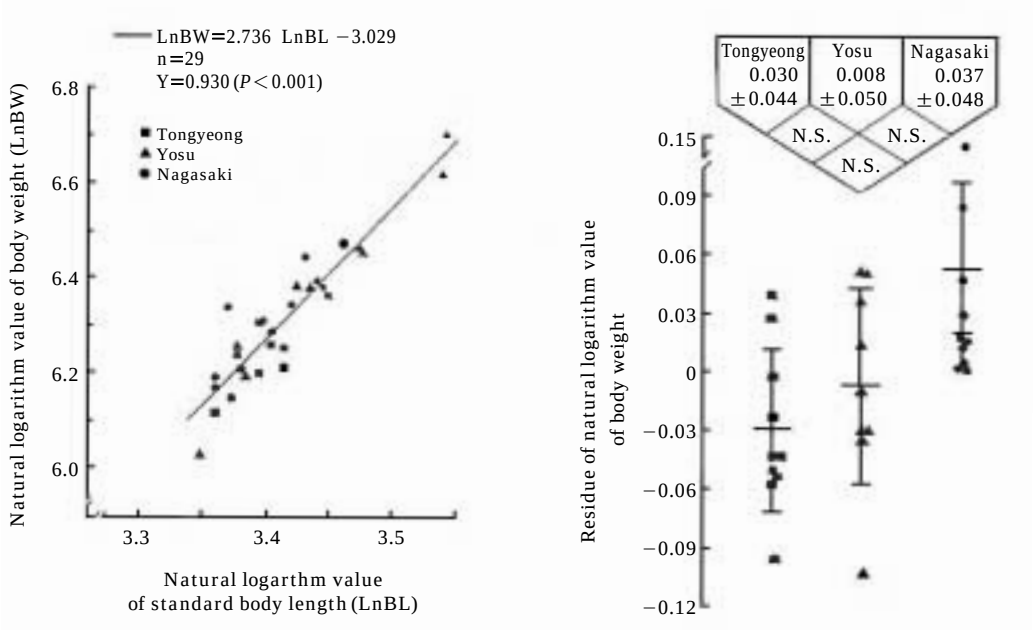

Fig. 3. Relationship between standard body length and body weight as the natural logarithm value of the flounder in Korea and Japan.

value of the flounder of Korea and those of Nagasaki is shown in Fig. 3. Standard body length has a great influence on body weight. The upper part of Fig. 1 shows a relationship between standard body length and body weight as the natural logarithm value. There is a positive correlation with a significance ($P<0.001$) and r=0.930 in values between both sides.

The lower part of Fig. 3 is a comparison of the residue of natural logarithm value of body weight of the flounder of Korea and those of Nagasaki. It shows residual differences. Differences were calculated from the regression line. It shows that the residue of natural logarithm value of body weight of the flounder of Nagasaki is higher than those of Yosu and Tongyeong. That is, in case of body length is same, it shows that weight of the flounder of Nagasaki is more heavier than those of Yosu and Tongyeong.

2. Body composition

Mean values of body composition of the flounder of Nagasaki and those of Yosu and Tongyeong is shown in Table 2. Water content was 71～72%, fat content 5～6%, protein content 18～19%, and other contents 2～3%. But here, too, there was no significant differences.

Fig. 4 shows a correlation between body fat content and body density of the flounder of Nagasaki and those of Yosu and Tongyeong. It shows the longer standard body length, the heavier body water content. Significance was high ($P<0.001$) and r=0.925. A high relationship was shown between them.

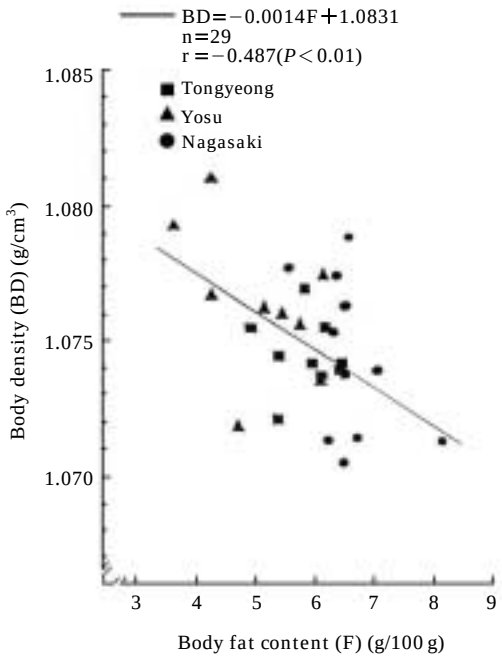

Fig. 4. Correlation between body fat content and body density of the flounder in Korea and Japan.

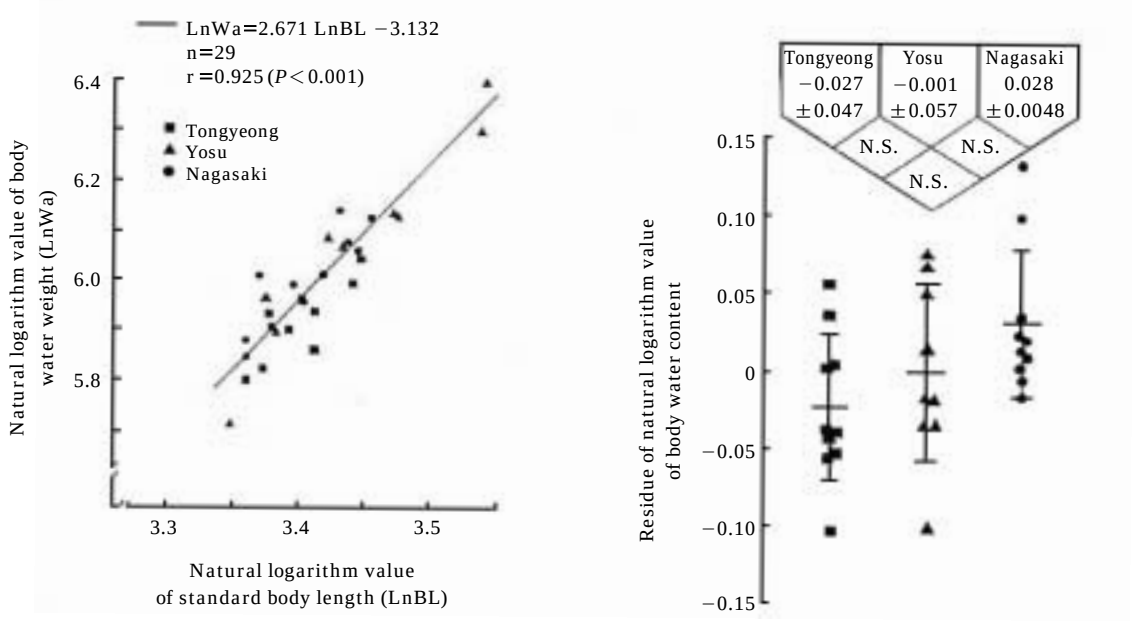

Fig. 5. Correlation between standard body length and body water content as the natural logarithm value of the flounder in Korea and Japan.

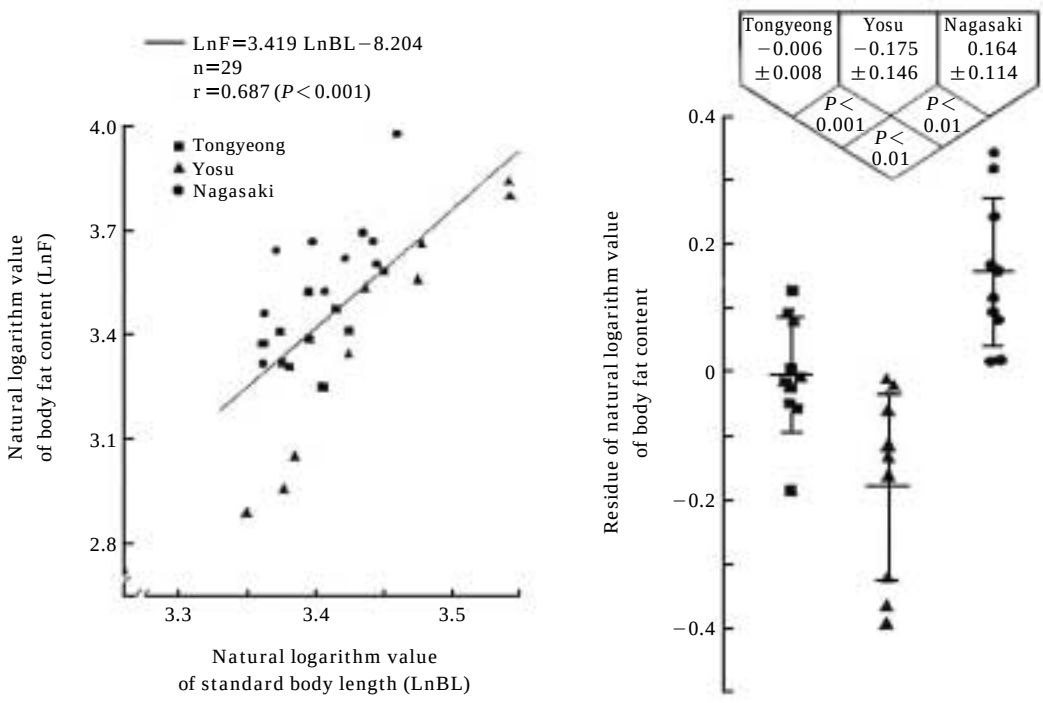

Fig. 6. Correlation between standard body length and body fat content as the natural logarithm value of the flounder in Korea and Japan.

3. Body composition and natural logarithm value

The upper part of Fig. 5 shows a correlation between standard body length and body water content as the natural logarithm value of the flounder of Nagasaki and those of Yosu and Tongyeong. It is also highly correlated with a signif-

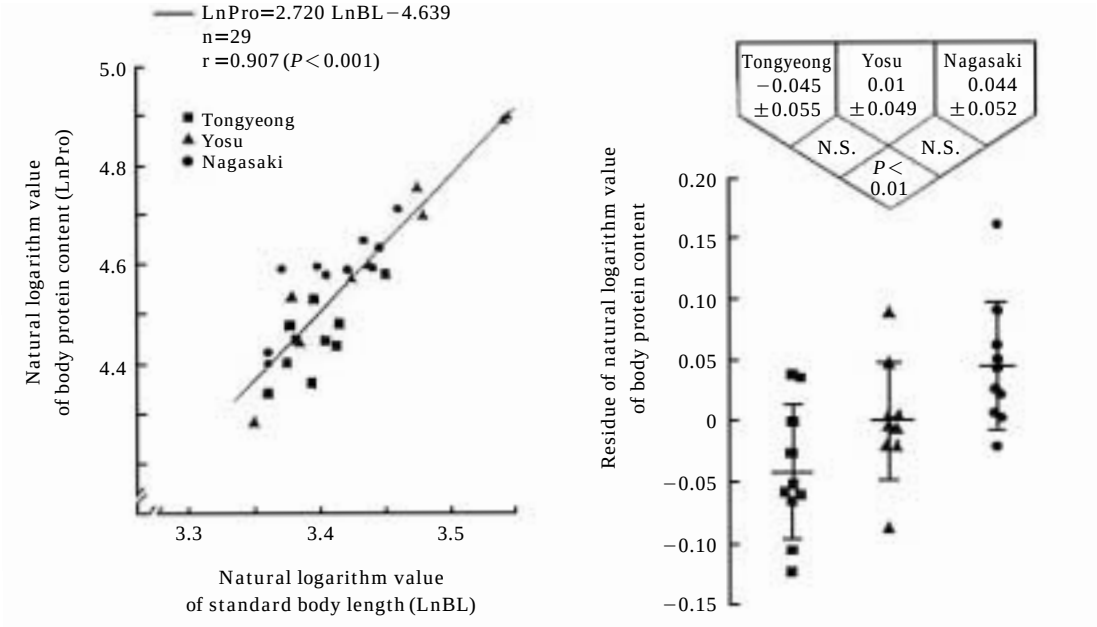

Fig. 7. Correlation between standard body length and body protein content of the flounder in Korea and Japan.

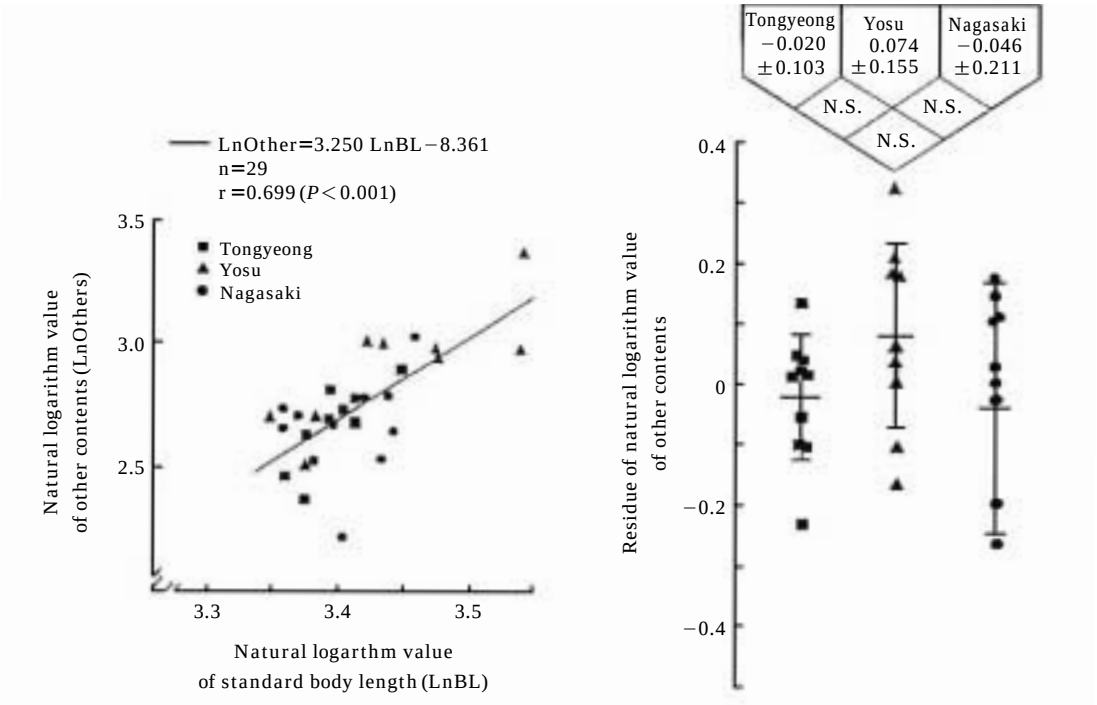

Fig. 8. Correlation between standard body length and the other contents of the flounder in Korea and Japan.

icance ($P < 0.001$) as r=0.925. The lower part of Fig. 5 is a comparison on the residue of natural logarithm value of body water content. In case of body length was same, the flounder of Nagasaki was a little higher in body water content than those of Yosu and Tongyeong. This shows the opposite result from the Table 2 in where the water content of the flounder of Nagasaki is lower than those of Yosu and Tongyeong.

The upper part of Fig. 6 shows a correlation between standard body length and body fat content as the natural logarithm value of the floun-

der of Nagasaki and those of Yosu and Tongyeong. It is also highly correlated with a significance ($P<0.001$) as r=0.687. The lower part of Fig. 6 is a comparison on residue of natural logarithm value of body fat content of the flounder of Nagasaki and those of Yosu and Tong-yeong. Body fat content of the flounder of Nagasaki shows a high significance ($P<0.001$) than those of Yosu and Tongyeong. Between the Korean flounder, that of Yosu is significantly ($P=0.01$) low.

The upper part of Fig. 7 shows a correlation between standard body length and body protein content of the flounder of Nagasaki and those of Yosu and Tongyeong. It also showed a high correlation with a significance ($P<0.001$) as r= 0.907. The lower part of Fig. 7 is a comparison on residue of natural logarithm value of body protein content of the flounder of Nagasaki and those of Yosu and Tongyeong. Body protein content of the flounder of Nagasaki was higher than those of Yosu and Tongyeong. There was significant difference ($P<0.01$) between those of Nagasaki and Tongyeong.

The upper part of Fig. 8 shows a correlation between standard body length and the others contents. It was also highly correlated with a significance ($P<0.001$) as r=0.699. The lower part of Fig. 8 is the comparison on residue of the flounder of Nagasaki, Yosu and Tongyeong. There was no significant differences.

4. Triglyceride and total cholesterol contents in serum

A comparison of triglyceride contents in serum of the flounder of Nagasaki and those of Yosu

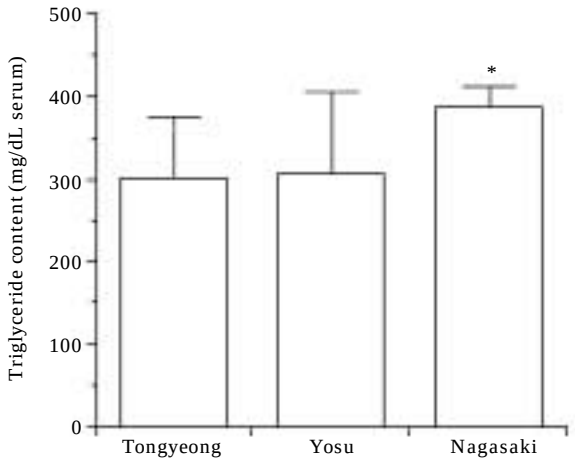

Fig. 9. Comparison of triglyceride content in serum of the flounder in Korea and Japan. *$P<0.01$ compared with flounder in Tongyeong

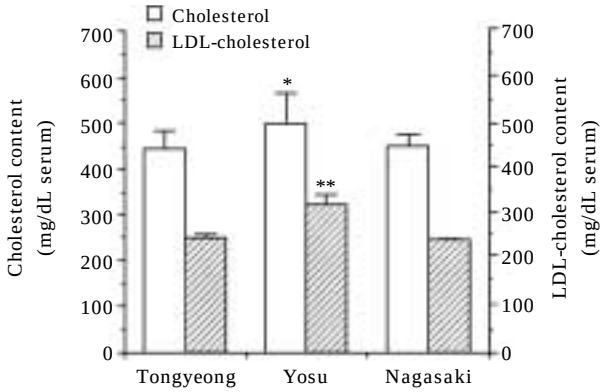

Fig. 10. Comparison between total cholesterol content and LDL-cholesterol in serum of the flounder in Korea and Japan. *$P<0.05$; **$P<0.001$ compared with flounder in Tongyeong.

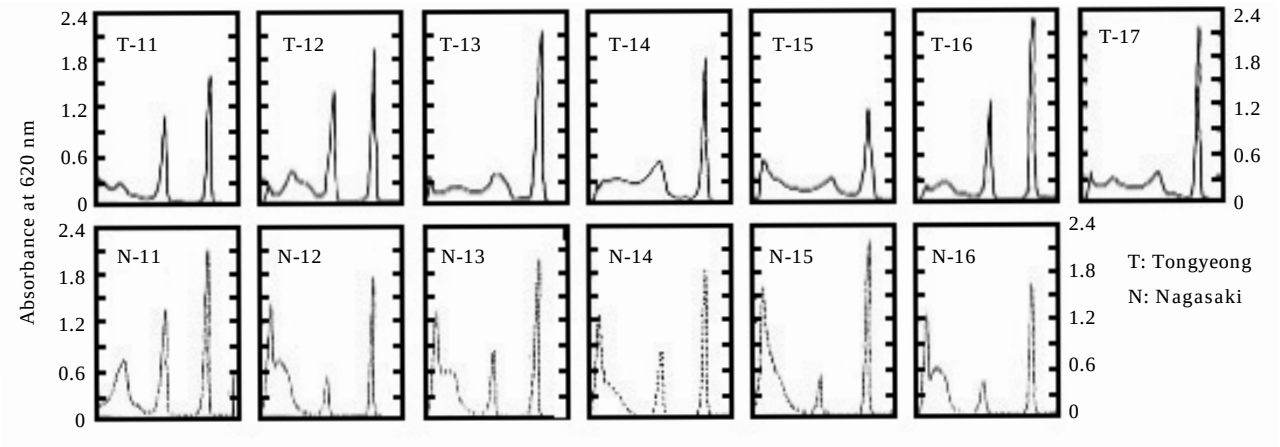

Fig. 11. Disc electrophoretic profiles of lipoprotein in serum of the flounder in Tongyeong and Nagasaki.

and Tongyeong is shown in Fig. 9. The tryglyceride content of the flounder of Nagasaki was higher than those of Yosu and Tongyeong. It showed an significance ($P<0.01$) between that of Nagasaki and Tongyeong.

Fig. 10 is the comparison between total cholesterol content and LDL-cholesterol content of the flounder of Yosu and that of Nagasaki. It showed a high significance, that is, $P<0.05$, $P<0.001$ respectively.

5. Disc electrophoresis profiles of serum lipoprotein

Disc electrophoresis profiles of lipoprotein in serum of the flounder of Nagasaki and Tongyeong are shown in Fig. 11. The electrophoretic patterns are measured at 620 nm with a densitometer. In disc electrophoresis profiles, VLDL and LDL in the flounder of Nagasaki was higher than those of Tongyeong.

Discussion

General components of fish muscle fluctuates largely in accordance with a part, sex, season, habitat, nutritive conditions, even in same species, and alterations of lipid among general components are remarkable. Mean values of body composition of the flounder of Nagasaki and those of Yosu and Tongyeong is shown in Table 2. But there was no significant differences. Fig. 4 shows a correlation between body fat content and body density of the flounder of Nagasaki and those of Yosu and Tongyeong. There was a negative correlation with a high significance ($P<0.01$) and $r=-0.487$. In the flounder like the sea bream (Tsuchimoto *et al.*, 1992) it will be possible that the body fat content can be estimated from body density. The upper part of Fig. 6 shows a correlation between standard body length and body fat content as the natural logarithm value. It was also highly correlated with a significance ($P<0.001$) as $r=0.687$. The lower part of Fig. 6 is a comparison on residue of natural logarithm value of body fat content. Body fat content of the flounder of Nagasaki shows a high significance ($P<0.001$) than those of Yosu and Tongyeong. Between the Korean flounder, that of Yosu was significantly ($P<0.01$) low. It is able to ratiocinate like the following. The reason why the flounder of Nagasaki was heavier in body weight than those of Yosu and Tongyeong is conceivable that plentiful muscle is due to abundances of body water, fat and protein.

A comparison of tryglyceride content in serum of the flounder is shown in Fig. 9. The content of the flounder of Nagasaki is higher than those of Yosu and Tongyeong, and there shows a significance ($P<0.01$) between that of Nagasaki and Tongyeong. Fig. 10 is a comparison between total cholesterol content and LDL-cholesterol content in serum of the flounder. Total cholesterol and LDL-cholesterol content of the flounder of Yosu show a high significance, that is, $P<0.05$, $P<0.001$ respectively. This result shows the differences of the lipoprotein content in serum of the flounder. Fig. 11 is the result of disc electrophoresis profiles of lipoprotein in serum of the flounder of Tongyeong and Nagasaki. From this result, we could see that the position of the fraction was the same as the red sea bream (Park *et al.*, 1999). The reason why the flounder of Nagasaki has more LDL and VLDL of lipoprotein in serum than those of Yosu and Tongyeong is thinkable that it is relevant to the abundance of body fat content as referred to above.

Fig. 1 shows a comparison of the seawater temperature between Korea and Japan. And Fig. 2 also shows general components of the feed for the flounder cultured in Korea and Japan.

But it is not clear that such differences are owing to water temperature or feed in the farm between two areas, Korea and Japan.

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한국산과 일본산 넙치의 체지방량 및 혈청지질 비교

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한국산(통영, 여수)과 일본산(나가사키) 넙치(*Paralichthys olivaceus*)의 체지방량 및 혈청지질을 분석한 결과, 표준체장과 체중의 평균치는 각각 유의한 차이가 없었다. 체장을 제외한 상대적인 체중에서는 나가사키산＞여수산＞통영산 넙치의 순위로, 일본산・넙치가 한국산・넙치에 비해 체중이 많았으며, 어체 밀도의 평균치에서는 국가간, 지역간에 유의한 차이가 없었다. 각 체구성 성분은 일본 나가사키산의 넙치가 한국의 여수, 통영산 넙치에 비해 체수분량이 적었고, 체지방량과 체단백질량은 많았다. 그러나 체장의 요인을 제외하고 비교하면, 체수분량, 체지방량, 체단백질량은 각각 나가사키산＞여수산＞통영산 넙치의 순서로 많았고, 일본산이 한국산에 비하여 근육량도 많은 특징을 나타내었다. 혈청중의 지질량에서, cholesterol양은 여수산 넙치가 많았고, triglyceride 양은 나가사키산 넙치에서 많았다. 또한, 혈청중의 lipoprotein은 전기영동상에서 나가사키산 넙치가 통영산 넙치에 비하여 LDL이 더 많았다.